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2013 Modularization of Korea's Development Experience:

# ICT Human Resource Development Policy

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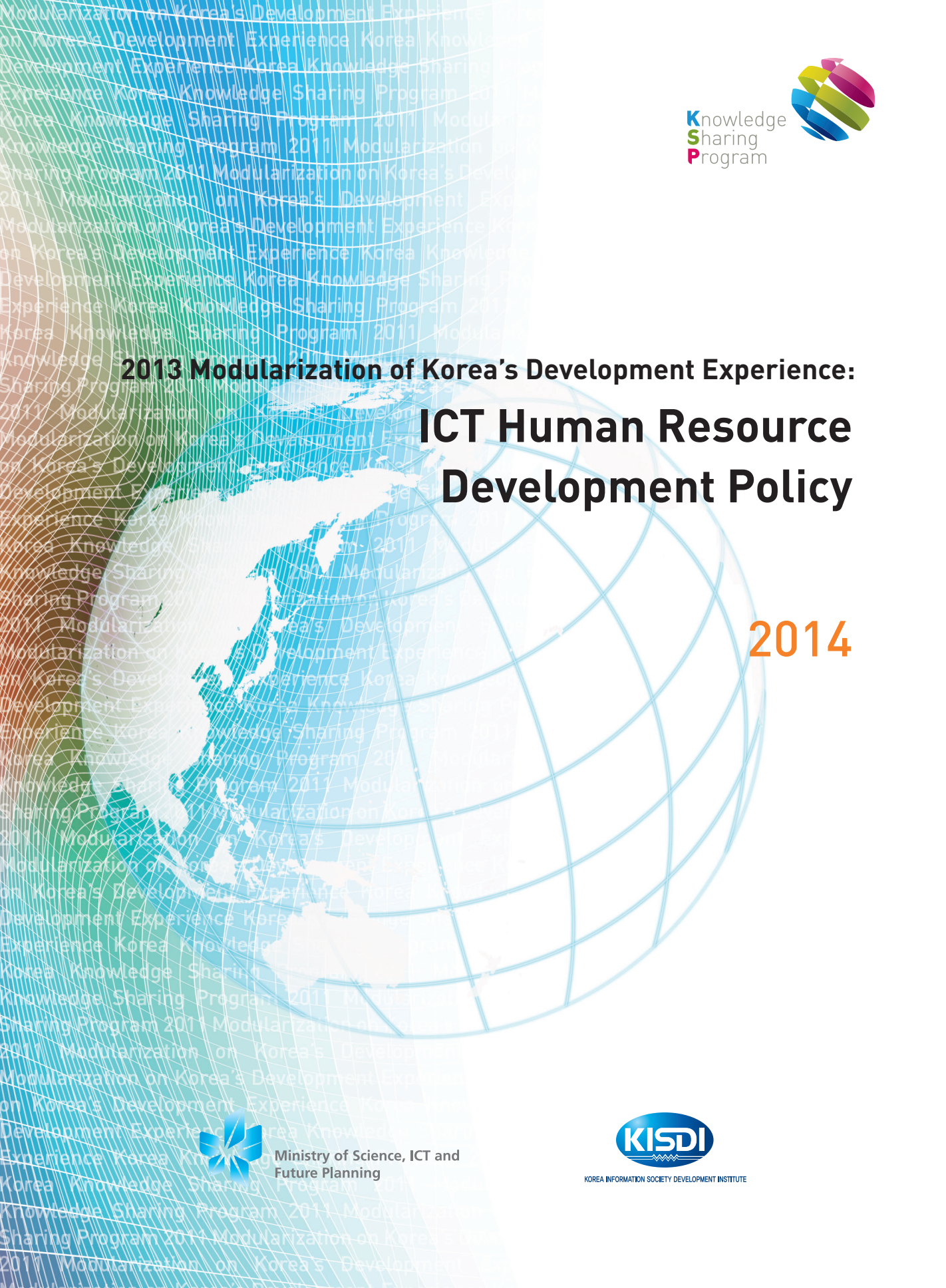

Ministry of Science, ICT and Future Planning

KISDI
KOREA INFORMATION SOCIETY DEVELOPMENT INSTITUTE

2013 Modularization of Korea's Development Experience:

# ICT Human Resource Development Policy

2013 Modularization of Korea's Development Experience

# ICT Human Resource Development Policy


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# ICT Human Resource Development Policy

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# Preface

The study of Korea's economic and social transformation offers a unique window of opportunity to better understand the factors that drive development. Within one generation, Korea had transformed itself from a poor agrarian society to a modern industrial nation, a feat never seen before. What makes Korea's experience unique is that its rapid economic development was relatively broad-based, meaning that the fruits of Korea's rapid growth were shared by many. The challenge of course is unlocking the secrets behind Korea's rapid and broad-based development, which can offer invaluable insights, lessons and knowledge that can be shared with the rest of the international community.

Recognizing this, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) in 2004 to share Korea's development experience and to assist its developing country partners. The body of work presented in this volume is part of a greater initiative launched in 2007 to systematically research and document Korea's development experience and to deliver standardized content as case studies. The goal of this undertaking is to offer a deeper and wider understanding of Korea's development experience in hopes that Korea's past can offer lessons for developing countries in search of sustainable and broad-based development. In furtherance of the plan to modularize 100 cases by 2012, this year's effort builds on the 20 case studies completed in 2010, 40 cases in 2011, and 41 cases in 2012. Building on the past three year's endeavor that saw publication of 101 reports, here we present 18 new studies that explore various development-oriented themes such as industrialization, energy, human capital development, government administration, Information and Communication Technology (ICT), agricultural development, and land development and environment.

In presenting these new studies, I would like to express my gratitude to all those involved in this great undertaking. It was their hard work and commitment that made this possible. Foremost, I would like to thank the Ministry of Strategy and Finance for their encouragement and full support of this project. I especially would like to thank KSP Executive Committee, composed of related ministries/departments, and the various Korean research institutes, for their involvement and the invaluable role they played in bringing this project together. I would also like to thank all the former public officials and senior practitioners for lending their time and keen insights and expertise in preparation of the case studies.

Indeed, the successful completion of the case studies was made possible by the dedicated efforts of the researchers from the public sector and academia involved in conducting the studies, which I believe will go a long way in advancing knowledge on not only Korea's own development but also development in general. Lastly, I would like to express my gratitude to Professors Kye Woo Lee, Jinsoo Lee, Taejong Kim and Changyong Choi for their stewardship of this enterprise, and to the Development Research Team for their hard work and dedication in successfully managing and completing this project.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessary represent those of the KDI School of Public Policy and Management.

**April 2014**

**Joon-Kyung Kim**

**President**

**KDI School of Public Policy and Management**

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## Chapter 5

# Acronyms and Glossary

| | | |
|---|---|---|
| AIIT | : | Advanced Institute of Information Technology |
| APT | : | Asia-Pacific Telecommunity |
| ASIC | : | Application Specific Integrated Circuit |
| BCN | : | Broadband Communication Network |
| CDMA | : | Code Division Multiple Access |
| ETRI | : | Electronics and Telecommunications Research Institute |
| FKII | : | The Federation of Korea Information Industries |
| GIS | : | Geographical Information System |
| HCI | : | Human-Computer Interaction |
| HRD | : | Human Resource Development |
| ICT | : | Information and Communication Technology |
| ICPC | : | (Korea) Information&Communication Polytechnic College |
| ICU | : | Information and Communications University |
| IF | : | Impact Factor |
| IITA | : | Institute for Information Technology Advancement |
| IMD | : | International Institute for Management Development |
| IMT-2000 | : | International Mobile Telecommunication 2000 |
| ISCO | : | International Standard Classification of Occupations |
| IT SoC | : | IT System on Chip |
| ITRC | : | Information Technology Research Center |
| JCR | : | Journal Citation Reports |
| KADO | : | Korea Agency for Digital Opportunities and Promotion |
| KAIT | : | Korea Association of ICT Promotion |
| KBA | : | Korean Broadcasting Association |
| KCA | : | Korea Communications Agency |
| KCC | : | Korea Communications Commission |
| KICA | : | Korea Information and Communication Contractors Association |
| KISDI | : | Korea Information Society Development Institute |
| KRIVET | : | Korea Research Institute for Vocational Education&Training |

| | | |
|---|---|---|
| KVBA | : | Korea Venture Business Association |
| LCD | : | Liquid Crystal Display |
| MCST | : | Ministry of Culture, Sports, and Tourism |
| MIC | : | Ministry of Information and Communication |
| MKE | : | Ministry of Knowledge Economy |
| MOCIE | : | Ministry of Commerce, Industry and Energy |
| MOSPA | : | Ministry of Security and Public Administration |
| MPW | : | Multi-Project Wafer service |
| MSIP | : | Ministry of Science, ICT and Future Planning |
| NABO | : | National Assembly Budget Office |
| NBIT | : | Nano Bio Information Technology |
| NEXT | : | Nurturing EXcellent Engineers in Information Technology |
| NHRD | : | National Human Resources Development |
| NIA | : | National Information Society Agency |
| NIS | : | National Innovation System |
| OECD | : | Organization of Economic Development and Cooperation |
| OS | : | Operating System |
| RF | : | Radio Frequency |
| RFID/USN | : | Radio Frequency Identification/Ubiquitous Sensor Network |
| SCI | : | Science Citation Index |
| SCM | : | Supply Chain Management |
| SME | : | Small and Medium-sized Enterprises |

# Summary

This report studies a series of ICT human resource development (HRD) policies in Korea since 1997. According to the OECD (2002), ICT HRD is now a main determinant of economic growth and social cohesion in countries and regions. By presenting Korea's experience in ICT HRD policy making and its implementation process, we would like to shed light on the future policy making of developing countries. We have presented the following analyses of the ICT HRD policy in Korea: i) Objectives and Achievements; ii) Domestic and Foreign Circumstances at the Time of Introduction; iii) Strategy and System; iv) Specifics of Policies in Chronological Order; v) Evaluation of Success Factors With a Case Study of Software Skills Nurturing Policy; and vi) Implications for Developing Countries.

## I) Objectives and Achievements

The establishment of the "Informatization Promotion Fund" in 1996 jump-started the investment into ICT HRD. The objectives and goals of the Korean ICT HRD policies were frequently renewed, reflecting the changes in the market environment and ICT industry: the objectives and goals of ICT HRD policies followed a sequence of building ICT infrastructure (1997~2000), quantitative expansion (2001~2003), horizontal linkage strengthening (2004~2007), and ICT professional skills deepening (2008~present).

Until the quantitative expansion period, the policy objective was to create a virtuous cycle that could accelerate the growth of the ICT industry by nurturing ICT skills, which in turn would lead to an increase in ICT jobs and more demand for ICT skills. As qualitative mismatch, not a shortage of ICT skills is identified as a real problem, and the Korea government shifted the direction of its ICT HRD to a qualitative enhancement, by strengthening the linkage between educational institutions (supply) and industries (demand).

Policies for the quantitative expansion of ICT human resources made significant achievements. ICT graduates accounted for 53% of the number of annual engineering school graduates at the undergraduate level in 2000. After the policy objective changed from quantitative expansion to qualitative improvement, the criteria of achievement indexes were also changed to employment rates, in-field employment rates, the number of industry-university projects, and employers' degree of satisfaction. The employment rate increased from 73.6% in 2008 to 79.6% in 2012, while the in-field employment also rose from 78% to 89%. The number of industry-university collaboration projects dramatically rose from 1,082 in 2008 to 2,073 in 2012, and employer satisfaction from 84 points to 88.8 points out of 100.

The ICT HRD policy was also used as a tool for boosting the economy during deep recession periods, such as the Asian financial crisis from 1997 to 2001, and the global economic crisis from 2008 to 2010. During these periods, the Korean government increased budgets for the retraining of existing ICT workers and conversion training for the unemployed.

## II) Domestic and Foreign Circumstances as of Time of Introduction

In December 1997, Korea asked for the IMF's financial aid to address its financial crisis. It was suggested that Korea's economic growth strategy should be changed from factor driven to a set of total factor productivity improvement policies. ICT's industry promotion was considered a strategic means to resolve impending issues under the financial crisis, and as leading tools to enhance total factor productivity. The U.S.A, whose economy was restructured for global competitiveness during the late '80s to the early '90s via government's expanded investment on ICT, was considered the benchmark model for Korea.

In 1998, the World Bank reported that investment into human resources is more essential and efficient than investment for physical resources in a knowledge based economy. The U.S Department of Commerce reported that a 10% increase in education investment leads to an 8.6% increase in productivity, which is about a three times higher return than returns from capital investments. Many nations and research institutes forecasted that the ICT industry would grow at unprecedented speed, together with the increased utilization of ICT in other industries. The consequent shortages of people with ICT skills were also predicted. According to OECD (1999) and IDC (1998), the shortage of ICT workers in 1997 was estimated to be between 600,000 and 700,000. To tackle these severe shortages of ICT skills, each nation promoted various policies to train ICT human resources (Kwon&Oh, 1999).

Since 2004, the ICT HRD policy switched its direction from quantitative expansion to qualitative enhancement. This change of direction in policy was spurred partly by the stagnant employment growth of the ICT industry. Employment of ICT industry sharply increased up to the year 2000, following the 1997 Asian financial crisis. After 2000, however, a series of bankruptcies from ICT start-ups led to a sudden collapse of the so-called ICT bubble. The level of employment in the ICT industry dramatically decreased in 2001. More than 40,000 jobs in the ICT industry vanished in a single year. In the subsequent years, ICT jobs did not pick up. Studies suggesting an oversupply of ICT human resources began to be published. According to the study conducted by KRIVET in 2004, it was estimated that there would be an oversupply (15,226) of ICT professionals with a bachelor's degree or lower, and a shortage (5,000) of ICT professionals with a master's degree or higher, until 2010.

## III) Strategy and System

Korea's ICT HRD policy was implemented to facilitate the nurturing of basic, applied and professional ICT skills from a variety of different channels, such as domestic formal educational institutions, private training centers, universities abroad, firms and workplaces. The ICT HRD policy has been pursued based on a synergistic circle of 1) the establishment of ICT infrastructure for HRD; 2) increased supply of ICT human resources from more regular educational institutions; 3) retraining of the ICT workforce; 4) ICT education to the entire population; and 5) a regular forecast of future supply and demand trends, improvement of ICT certificate systems, and the expansion of institutional frameworks, etc. (Ko, 2011b).

The ICT HRD program has evolved from a supply and domestic oriented quantitative expansion policy to a demand and global oriented qualitative enhancement policy, while going through stages of building ICT infrastructure, expanding enrollment, strengthening horizontal linkage, and deepening professional ICT skills.

While most countries include resources secured by frequency auction, etc. into the general budget, the Korean government created the "Informatization Promotion Fund" under the premise that "government funds collected from ICT industry through new common carrier selection may as well be reinvested into the ICT industry". The fund was used for technology development, ICT HRD, standardization, the ICT infrastructure rollout, etc. The long-term and continuous investment of the Korean government in ICT HRD was possible largely through the Informatization Promotion Fund. Thanks to the fund, the Korean government was financially stable and flexible enough to carry out high-cost ICT HRD projects with nationwide impact. It also enabled the government to swiftly respond to changing skill requirements of the market, and to reflect shifts in the technological environment when implementing ICT HRD policies.

## IV) Specifics of Policies

Korea's ICT HRD program was initiated in 1997. The program can be classified into four stages by types and characteristics of government support; the ICT infrastructure building stage from 1997 to 2000, the quantitative expansion stage from 2000 to 2003, the horizontal linkage strengthening stage from 2004 to 2007, and the ICT skills deepening stage from 2008 up to the present.

During the ICT infrastructure building stage from 1997 to 2000, there was a software venture boom, which fueled interest in software as well as demand for software skills. Moreover, along with the spread of the high-speed Internet throughout the nation, the general public began to have an interest in informatization. There was a growing need to retrain the unemployed with a focus on ICT retraining in the wake of the Asian economic crisis in 1997. Thus, ICT training programs were implemented with an emphasis on establishing infrastructure to develop and expand the supply of ICT human resources. Major HRD projects implemented during this period include the establishment of the ICU, the support of ICT model schools, the support of software departments in universities, the establishment of software-specialized high schools, the deployment of domestic mainframe computers in schools, the support of ICT business promotion centers in universities, and the provision of ICT retraining programs for the unemployed.

From the period of 2001 to 2004, major companies in Korea, including Samsung Electronics, raised their global market share and strengthened global competitiveness in the ICT industry. In order to reinforce this trend, the government implemented a quantitative expansion policy in the enrolment of ICT-related departments in universities. A study found out that there would be a shortage of approximately 99,000 ICT professionals from 2002 to 2006, which acted as a ground for designing these policies (Kwon et al., 2001a). One of major policies in this period was the expansion of enrolment for ICT major fields in universities. The MIC supported the purchasing cost of ICT equipment and facilities at formal educational institutions including universities, if they increased the enrolment quota for ICT major fields.

In 2004, studies suggesting an oversupply of ICT human resources started to come out. In addition, although colleges focused on theoretical basic courses, companies were in demand of job applicants with practical business capabilities corresponding to the rapidly evolving technology. From a business perspective, it was a period when there was an increase in demand for highly-skilled human resources with problem solving capabilities so that they could create high value-added products. Reflecting such changes, the government had shifted the focus of ICT HRD policies from training of undergraduates to graduate or advanced-level students. In order to meet the demand from industry and resolve the qualitative

mismatch problem, the ICT HRD program was conducted with three major policy areas of demand-oriented ICT HRD, high-quality ICT professionals with global competitiveness, and ICT-specialized education and systematic infrastructure since 2004. Previous policies were focused in the area of comprehensive, highly-skilled ICT professionals, industrial production, and the potential for ICT human resource development. With such changes, the paradigm of ICT HRD policies changed from supply-oriented to demand-oriented, quantitative to qualitative, domestic-oriented to global-oriented, and metropolitan area-focused to balanced regional development-focused (Ko et al., 2012b).

Two major demand-focused policy initiatives were the introduction of the supply chain management (SCM) model to universities and the Nurturing EXcellent engineers in information Technology (NEXT) program. "The essence of the SCM model is the creation of a systematic mechanism in which, industries provide the skill requirements on human resources to regular educational institutions, and in turn, such skill requirements are properly reflected to educational curricula. Subsequently, industries hire, on a priority basis, human resources trained in conformity with those requirements. The SCM model was reinforced to the NEXT in 2006. NEXT was designed to help universities analyze its competitiveness on its own initiative, formulate improvement plans, reform curriculums and expand internships and the number of professors, thus, improving the quality of education (Ko, 2011b: pp 155)."

ICT HRD policy from 2004 to 2007 focused on nurturing high-quality ICT human resource for the successful promotion of its IT 839 strategy. Previous ITRCs were revised to be closely linked to the technology development roadmap of the IT 839 strategy. And the relations with the IT 839 strategy were reflected in the selection of new ITRCs. In order to secure the efficiency of ITRCs, an industry-academy mutual researcher exchange program was mandated in addition to regulations that granted incentives to the center with outstanding co-research performance by industry, academia, and the research center. Its objective was to accelerate the commercialization of developed technologies. The number of ITRCs increased from 32 in 2002 to 50 in 2007, and most of these centers were associated with 3 infrastructures or 9 new growth engines of the IT 839 strategy (See [Figure 4-1]).

Korea took the lead in the international standard of the engineering education in the ICT field and initiated the Seoul Accord in 2008. The Seoul Accord enabled four-year university graduates in computer and ICT related majors to freely obtain jobs within the member countries gaining equal recognition. The Seoul Accord substantially will promote international mobility of computer and ICT-related human resources in the long run. By reflecting the industry demands in the Korean universities' ICT major curriculum, the accord is expected to help reduce qualitative mismatch between the demand and the supply of ICT skills.

With the launch of the Lee Myung-bak government in 2008, the MIC was dismantled and the Ministry of Knowledge Economy (MKE) was established. The MKE was responsible for the promotion of the ICT industry. The MKE announced "New IT Strategy" in 2008. The strategy had a goal of creating 10 ICT convergence industries worth 1 trillion won domestically, as well as fostering 1,000 ICT companies with sales of 50 billion won and 10 global SW firms. Naturally, ICT HRD policy evolved with the introduction of the "New IT Strategy". More emphasis has been given to the nurturing of human resources for ICT convergence and SW industry development. "The mid-term ICT HRD plan developed by the MKE in 2010 contained the following key initiatives under the two key strategies for developing and supplying resources customized for demand, and making the program simpler and more efficient by i) developing highly-educated/skilled resources to meet the market demand, ii) providing companies with more opportunities to participate in human resources development, iii) strengthening the link between human resources development and employment, iv) building a human network to assist with entry to overseas markets, and v) improving the reliability and usability of human resources demand and supply statistics (Ko, 2011; pp 171)."

## V) Evaluation of Success Factors

This study identified three success factors of Korean ICT HRD policy. They are: i) Changes in Government Organizational Structure in Response to the ICT Market and Technology Shifts; ii) Balanced Development of Basic, Applied and Professional ICT Skills; and iii) Establishment of a Goal (Mission, Vision) - Strategic Goal - Performance Goal - Performance Evaluation System.

In addition to the analysis on the success factors of ICT HRD policy, we presented the case study of the software skills nurturing policy, which has been considered a disappointment. The basic analogy of our evaluation and recommendation on software skills nurturing policy of Korea is as follows.

We first find three stylized facts about the labor market for SW skills in Korea. First, the in-field employment rate of software majors is shown to be lower than that of hardware majors. Second, the shortage rate of SW workers is higher than that of HW workers. Third, the level of income and job stability of software worker is low compared to that of hardware worker. The policy directions that could be extracted from such stylized facts are as follows. First, in order to resolve the qualitative mismatch between the supply and demand of software skills, there needs to be a stronger horizontal linkage between educational institutions and companies. The fact that software majors have lower success in finding related jobs while companies cannot find qualified software skills demonstrate the proverbial saying 'there are

many applicants but not many capable ones' to be right. Or, it may mean that there are not enough quality jobs for highly skilled software majors in the workplace. The fact that the level of income is much lower for software workers compared to hardware workers gives weight to the possibility that there may not be many desirable jobs in the software industry. The reason for the shortage was not in the lack of supply of workers but in the lack of value-added creation in this industry. Yet if the government decides to intervene to solve the shortage phenomenon by increasing the number of graduates with the relevant skills, this would lead to even lower income levels. When making policy, it is necessary to consider all indices of the ICT labor market, including the shortage rate, income, and other factors. If low income and high shortage rates in certain occupations are observed, the policy direction should lean toward the promotion of high value added for related industry and occupation.

## VI) Implications for Developing Countries

Korea's experience in ICT HRD policy making and its implementation process could serve as a good example for developing countries in many ways. In this study, we presented the following five lessons learned in Korea's journey for ICT HRD that can be emulated in developing countries: i) Align ICT HRD Policy with Industrial Policy; ii) Develop Statistical Indicators and Provide Forecast for the ICT Labor Market and Qualifications; iii) Design and Implement Short-term and Long-term Policies to Respond to Skills Mismatch; iv) Promote Balanced Development of Basic, Applied and Professional ICT Skills; v) Be Flexible and Build a Virtuous Circle for ICT Human Resources Development.

2013 Modularization of Korea's Development Experience
ICT Human Resource Development Policy

# Chapter 1

## Objectives and Achievements

1. Definition of ICT Human Resources
2. Objective and Achievements of ICT HRD Policy

# Objectives and Achievements

## 1. Definition of ICT Human Resources[1]

Before discussing ICT HRD policy, we need to define ICT human resource first. There is no agreed specific definition of ICT human resources, however. ICT human resources, in concept, refer to those who utilize ICT or ICT in performance of main business duties. Based on this conceptual definition, ICT human resources can be measured, in actual terms, by three criteria such as industry, occupation, and education (major, qualification, skill, etc.).

Table 1-1 | Definitions of ICT Human Resources and Their Use

| | Definitions and Use |
|---|---|
| ICT Industry Human Resources | • Defined by classification of ICT industries<br>• Used, in large part, for international comparison, and as material (e.g., OECD) to define national economic standing of ICT industry<br>• Mismatches due to application to some industries having ambiguous definition of ICT industry&limitation of measuring ICT human resources at private companies only |
| ICT Occupation (type of job) Resources | • Defined by classification of ICT occupations. Based on the definition of ICT human resources, it seems as a more proper criterion than ICT industry resources<br>• A problem comes up on which occupation is classified as ICT occupation resources by promptly reflecting the changes of occupations. Existing classification of occupations fails to timely reflect such changes |

1. This Section is taken from Ko (2011b).

| | Definitions and Use |
|---|---|
| Human Resources with ICT Education (major, qualification, skill, etc.) | • Used to estimate the size of supplied ICT human resources<br>• Need to define ICT-relevant majors, qualifications, and skills<br>• For now, it is estimated through the size of ICT majors at regular educational institutions. Need to verify the supply of ICT human resources by irregular educational institutions and the relationships with ICT certificates |

Source: Kwon et al. (2001a).

As a start, 'persons in ICT industry' generally refers to those who engage in industries classified as ICT industries out of persons engaged in computer-relevant industries. By contrast, human resources falling under the category of 'persons engaged in ICT occupations' or 'ICT specialist resources' are classified by occupation rather than by industry, and a crucial determining factor is the possession and utilization of ICT-relevant skills and expertise.

In Korea, ICT industry resources and ICT occupation resources are defined and extracted based on formal classification systems such as the Korean Standard Industry Classification, the Korean Standard Classification of Occupation and the Korean Employment Classification of Occupation, etc. On one hand, the classification of ICT human resources based on such formal classification criteria provides a benefit of reliable measurement in terms of representation and comparability, which on the other hand, poses a problem of low appropriateness to realities.

Taking into account the effects from recent rapid progress in ICT technology, emergence of new technology and convergence in technologies, the time has come to upgrade the classification systems in order to better understand the statistics of human resources that are hard to grasp through the existing standard classification systems. In consideration thereof, currently, efforts are under way to improve the classification systems. For example, the OECD expanded the classification of ICT industries into retail and repair industries involving ICT-relevant equipment in the revised ISIC version 4.0 as of May 2006, recommending the coverage of entire value chains from the 'production' of ICT equipment and services to 'distribution.' However, until now, statistical surveys on ICT industry human resources are restricted to ICT manufacturing industry, communication services industry, S/W and ICT service industries.

Kwon et al.(2003a) classifies ICT occupations as shown in <Table 1-2>. The four-digit classification categorizes ICT occupations into computer specialist occupation, middle- and low-level computer-relevant occupation, electronics&communication technology occupation, production, operation and maintenance occupation, other ICT-relevant occupations and managerial occupations. Kwon et al. (2001a) uses the 1993 occupation

classification system to maintain data continuity, however, the conversion into the revised occupation classification system of 2000 will bring about changes to the detailed classification of occupations. Only some managers defined in the detailed classification of human resources in Kwon et al.(2001a) have to be refined as ICT human resources. Specifically, with regard to no. 1226 managers in transportation, warehouse&production department of communication industry under the detailed classification system of occupations, only managers in production department of communication industry have to be included. Changes also have to be made to include only some managers with regard to no. 1227 production department of business services industry and to include only persons engaged in communication industry with regard to no. 1316 general managers in transportation, warehouse and communication industry. Likewise, only some general managers have to be included with regard to no. 1317 business services industry. However, since it is impossible to separate managers to be categorized into ICT human resources under the current classification system of occupations, the size of ICT human resources is inevitably over-estimated in the absence of division of the arbitrary proportions. With regard to these human resources, the over-estimation is being adjusted by employing proportions in consideration of the size of industrial sales volume.

Table 1-2 | Classification of ICT Human Resources

| Type of Occupation | The 2000 Fifth Revision of Standard | The 1993 Fourth Revision of Standard Classification of Occupation |
|---|---|---|
| Computer Expert Occupation | 1201 Computer system expert<br>1202 Network-relevant expert<br>1203 Computer program expert<br>1204 Multimedia material production expert<br>1209 Other computer-relevant expert | 2131 Computer system designer &analyst<br>2132 Computer programmer<br>2139 Other unclassified computer expert (2432 Librarian&relevant information expert) |
| Middle-and Low-level Computer-relevant Occupation | 2201 Computer-relevant operations staff<br>2202 Computer control staff<br>3171 General administration supporting staff<br>3172 Data entry staff | 3121 Computer assistant staff<br>3122 Computer control staff<br>4112 Word-processor&relevant control staff<br>4113 Data entry staff<br>4114 Calculator control staff |
| Electronics& Communications Technology Occupation | 1322 Electronics&communications engineering specialist<br>2322 Electronics&communications technology worker | 2144 Electronics&communications engineer<br>3114 Electronics&communications engineering technician |

| Type of Occupation | The 2000 Fifth Revision of Standard | The 1993 Fourth Revision of Standard Classification of Occupation |
|---|---|---|
| Production, Operation& Maintenance Occupation | 7332 Electronics equipment installation worker<br>7333 Electronics maintenance&repair worker<br>7334 Telegraph, telephone installation&repair worker<br>7335 Electric wiring, repair&cable erection worker<br>2352 Broadcasting&communications equipment technology worker<br>8321 Electric&electronics equipment assembly worker except for house-hold purpose | 7242 Electronics maintenance staff<br>7243 Electronics maintenance and repair staff<br>7244 Telegraph, telephone installation and service staff<br>7245 Electric wiring worker, repair man, cable connection staff<br>3132 Broadcasting&electrical communications equipment control staff<br>8283 Electronics equipment assembly staff |
| Other ICT-relevant Occupation and Managerial Occupation | 0236 Manager in operation department in transportation and communications industry<br>0237 Manager at operational department in business service industry<br>0246 Manager at computerization department<br>0306 General manager in transportation and communications industry<br>0307 General manager in business service industry (1812 Librarian) | 1226 Manager at transportation, warehouse and at production department in communications industry<br>1227 Manager at production department in business service industry<br>1236 Manager at computerization department<br>1316 General manager in transportation, warehouse and communications industries<br>1317 General manager in business service industry |

Source: Kwon et al. (2001a).

The Standard Occupation Classification, which was used in occupational classification described above, categorizes occupations by skill specialization and skill level based on the International Standard Classification of Occupations (ISCO). The Employment Classification of Occupation categorizes occupations, in large part, based on skill type considering such factors as job capability level, industrial and occupational mobility, labor market structure, etc. Labor Demand Trend Survey, an official statistical survey, conducted by the Korean Labor Ministry, acknowledges the limitation of surveys using the existing Standard Classification of Occupation, and replaces it with the Korean Employment Classification of Occupation. Recently, ICT occupations, occasionally, are also surveyed through the employment structure surveys conducted by the Labor Ministry on the basis of the Korean Employment Classification of Occupation in order to reflect the particular

characteristics of ICT occupations largely dependent on characteristics of technological areas.

Table 1-3 | ICT Occupations Pursuant to the Korean Employment Classification of Occupation

| ICT Occupational Groups | Korean Employment Classification of Occupation | |
|---|---|---|
| SW/SI Development&Design Occupational Group | 2029 | ICT Consultant |
| | 2021 | Computer system design analyst |
| | 2022 | System software developer (system software engineer) |
| | 2024 | Database administrator |
| | 2025 | Network system analyst&developer |
| | 2023 | Application software developer (application software engineer) |
| | 2027 | Web developer (Web engineer) |
| | 2026 | Computer security expert |
| Digital Content Occupational Group | 0855 | Multimedia designer |
| | 0856 | Drawer (CAD worker) |
| | 0864 | Multimedia planner (including web planner) |
| System Operation& Administration Occupational Group | 0143 | ICT-relevant administrator |
| | 2028 | Computer system operation administrator |
| | 1931 | Computer&Office machine installation&repair worker |
| HW Development&Design Occupational Group | 1911 | Electronic engineering expert (engineer) |
| | 1912 | Electrical engineering expert (engineer) |
| | 2012 | Communication engineering expert (engineer) |
| | 2011 | Computer engineering expert (engineer) |
| ICT Education Occupational Group | 0411 | University professor |
| | 0412 | University instructor |
| | 0455 | Vocational capability development&training instructor |
| | 0463 | Instructor at a private computer education institute |
| ICT Technology Sales Occupational Group | 1011 | Technology sales staff |
| HW Maintenance Occupational Group + Communications Broadcasting Service Occupational Group | 2033 | Communications equipment engineer |
| | 2032 | Communications equipment installation&repair man |
| | 2034 | Communications cable installation and repair man |
| | 2031 | Broadcasting equipment (H/W) installation and repair man |
| | 1962 | Electronics product manufacturing device operation staff |
| | 1970 | Electrical/Electronic part&product assembly and inspection man |
| | 1939 | Other electrical/electronic installation and repair man |

ICT human resources can be classified in various methods other than ICT occupation resources and ICT industry resources, etc. The OECD (2006) divides ICT human resources into three categories and defines ICT human resources, both narrowly and broadly:

i) ICT specialists: refer to persons who can develop, operate and manage ICT systems and ICT constitutes the main part of their job.

ii) Advanced users: refer to persons who can skillfully handle an advanced software or tool or a unique software to a certain field and ICT is not the main duty but merely a tool.

iii) Basic users: refer to persons with general skills for utilizing information required in information society, e-government, and working life.

## 2. Objective and Achievements of ICT HRD Policy

ICT human resource development (HRD) policies can be defined as the provision of proper incentives and support to ICT educational institutions, as well as individuals and companies for the efficient development, distribution and utilization of ICT human resources. The objectives and goals of the Korean ICT HRD policies have been frequently renewed, reflecting the changes in the market environment and ICT industry.

The initial policy objective was to provide adequate supply of ICT human resources in harmony with the rapidly growing ICT industry. The ICT manufacturing industry, which includes semiconductor, cell phone, LCD, etc, has led the growth of the Korean economy since the second half of the 1990s. In the 90s, the ICT manufacturing industry ranked second among other manufacturing industries in terms of contribution to the nation's GDP, only outnumbered by the petrochemical industry. In the 2000s, its contribution rate to GDP posted a record high of 18.5% (The Bank of Korea, 2010). And ICT HRD policy has been essential in sustaining the high growth rates of the ICT industry.

Table 1-4 | Top 3 Industries* in Terms of Their Contribution to Real GDP Growth and Economic Standing as a Percentage of GDP **

(Unit: %)

| | Contribution to Real GDP Growth | | | | Percentage to Real GDP | | | |
|---|---|---|---|---|---|---|---|---|
| | 71~79 | 80~89 | 90~99 | 00~09 | 71~79 | 80~89 | 90~99 | 00~09 |
| Top 1 | 7.0 | 3.3 | 4.6 | 18.5 | 3.9 | 3.7 | 2.9 | 5.1 |
| Top 3 | 12.4 | 8.0 | 13.1 | 26.6 | 6.9 | 7.9 | 7.5 | 11.2 |

Source: Lee, Wonki et al. (2010).

Note: * Top 3 industries by period are listed in the descending order from rank 1 to 3 based on their contribution rate to real economic growth, the lists in the bracket are based on the proportion of real value-added.

1971~79: Clothing, Food& Beverage, Petrochemical Industry;

1980~89: Primary metal (Clothing), Petrochemical Industry (F&B), F&B (primary metal).

1990~99: Petrochemical Industry, ICT manufacturing (Primary metal), Primary metal (automobile).

2000~09: ICT manufacturing industry, automobile (petrochemical industry), machinery (primary metal).

** ICT manufacturing industry is defined as the industry for manufacturing of semiconductors, electronic components, video, sound and communications devices, computers and office machines based on National Accounts Industry classification.

The primary objective of the ICT human resource policy was to create a virtuous cycle that could accelerate the growth of the ICT industry by nurturing ICT skills, which in turn would lead to an increase in ICT jobs and more demand for ICT skills. Policies for the quantitative expansion of ICT human resources made significant achievements. ICT graduates accounted for 53% of the number of annual engineering school graduates at undergraduate level in 2000, which was the result of the government's dedicated policy to promote the ICT industry as an engine of economic growth so that the country could overcome the Asian financial crisis started in 1997 (MKE, 2010).

The quantitative expansion alone was not sufficient to adequately cope with rapidly changing demand for ICT skills. The mismatch between supply and demand, not a shortage of ICT skills, was the real problem. The government, hence, shifted the direction of ICT HRD to qualitative enhancement by strengthening the linkage between educational institutions and industries. It is difficult to point out the exact time for such a change, but it would be reasonable to assume that the period between 2000 and 2002, a transitional period when the ICT research center program was initiated, as well as the year 2003 when the SCM model was introduced, was the turning point.

ICT HRD policy was used as a tool for boosting the economy during deep recession periods such as the Asian financial crisis from 1997 to 2001 and the global economic crisis from 2008 to 2010. During these periods, the Korean government increased budgets for retraining and conversion training for the unemployed. It was assumed that fostering ICT

skills can increase the probability of those out of employment finding jobs, since the ICT sector was the most rapidly growing industry. The direct creation of ICT jobs was the main objective of the ICT HRD policy at that time.

The size of net job creation can be computed by subtracting the size of job destruction in existing firms from the size of new jobs created by existing firms and new entrants. It means that jobs can be created through ICT HRD only when those with ICT skills that are required for new jobs are trained and enter the job market as a result of human resource development. It is, however, almost impossible to empirically measure such cases. Thus, it is presumed that ICT HRD responsive to changing demands in the labor market has a positive effect on job creation without numerical evidences.

<Table 1-5> shows the trend in the size of beneficiaries of the government's ICT HRD program. The numbers in the table represent the size of students or trainees, who have received benefits of the ICT HRD program, not the number of students majoring in ICT-related fields. In 2009, the number of university graduates majoring in ICT fields was 30,631, 47% of the total number of university graduates with an undergraduate engineering degree. The 12,820 students, who received benefits of the ICT HRD program took up more than one thirds of university graduates majoring in ICT at undergraduate level. In other words, one out of every three undergraduate students in ICT fields has chosen his or her major partly due to the government support.

**Table 1-5 |** Trend in the Number of Beneficiaries of ICT HRD Program

(Unit: Persons)

| Year | 1997~2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | total |
|---|---|---|---|---|---|---|---|---|---|
| Undergraduate School | 47,575 | 12,285 | 21,673 | 15,648 | 11,610 | 10,947 | 14,291 | 12,820 | 146,849 |
| Graduate School | 29,044 | 2,853 | 2,165 | 3,213 | 3,409 | 3,317 | 1,230 | 2,552 | 47,783 |
| Retraining | 185,809 | 7,625 | 5,163 | 1,978 | 3,753 | 5,253 | 5,267 | 3,856 | 218,704 |
| Total | 262,428 | 22,763 | 29,001 | 20,839 | 18,772 | 19,517 | 20,788 | 19,228 | 413,336 |

Source: MKE (2010).

As mentioned earlier, the government has emphasized the qualitative enhancement of ICT human resources rather than quantitative expansion since 2003. In order to respond to the rapid changes in ICT skill requirements, retraining programs for existing ICT workers were also expanded. This expansion of retraining programs resulted in extending the career spans of existing ICT workers from 6.9 years in 2003 to 11.1 years in 2011 (MKE, 2008).

After the objective of policy was changed from quantitative expansion to qualitative improvement, the criteria of achievement indexes was also changed from the number of the beneficiaries of the program to general employment rates, in-field employment rates, the number of industry-university projects and employers' degree of satisfaction. These achievement indices were suitable for the primary objective of the program, which was to nurture ICT human resources meeting the demands of the industry. <Table 1-6> shows the major achievement indices of the ICT HRD program since 2008.

From 2008 to 2012, the employment rate and in-field employment rate consistently increased. The employment rate increased from 73.6% in 2008 to 79.6% in 2012, while the in-field employment also rose by 11%p from 78% to 89%. Considering the decrease in the general employment and in-field employment rate due to the global financial crisis since 2008, such achievements of the ICT HRD program are outstanding. Moreover, the number of industry-university collaboration projects dramatically rose from 1,082 in 2008 to 2,073 in 2012 and it might be attributable to the ICT HRD program, which created an ICT education environment focused on practical training and field experiences than theory. The effectiveness of the ICT HRD program can be also confirmed by the gradual increase in employer satisfaction from 84 points in 2008 to 88.8 in 2013 out of 100 (Sookmyung Women's University Industry-Academic Cooperation Foundation, 2013).

**Table 1-6 |** Major Achievements of ICT HRD Program since 2008

(Unit: %, The No. of Project, Score)

| Major Index | 2008 | 2009 | 2010 | 2011 | 2012 | Total (Average) |
|---|---|---|---|---|---|---|
| Employment Rate (%) | 73.6 | 73.6 | 75.8 | 77.2 | 79.2 | 75.88 |
| In-field Employment Rate (%) | 78.0 | 83.3 | 85.9 | 87.0 | 89.0 | 83.6 |
| Industry-University Collaboration Project (no.) | 1,082 | 1,367 | 1,605 | 1,826 | 2,073 | 7,953 |
| Employer Satisfaction (Score) | 84.0 | 85.0 | 86.6 | 87.5 | 88.8 | 86.4 |

Source: Sookmyung Women's University Industry-Academic Cooperation Foundation (2013).

Note: * No. of industry-university collaboration projects: No. of industry-university collaboration projects (mentoring) + No. of industry-university collaboration projects (capstone design) + No. of industry-university collaboration projects.

Table 1-7 | Comparison of Employer Satisfaction on Job Performance of Beneficiaries and Non-beneficiaries of ICT HRD Program

(Unit: Score)

| Classification | Satisfaction of Job Performance | | |
|---|---|---|---|
| | Non-beneficiaries | Beneficiaries | Differences |
| Total | 71.4 | 88.8 | 17.4 |
| Future Talents (Seoul Accord) | 70.7 | 86.7 | 16.0 |
| R&D (ICT/SW, ITRC, ICT Convergence, System) | 71.1 | 88.9 | 17.8 |
| Company Supply (ICT Mentoring) | 80.0 | 90.0 | 10.0 |

Source: Sookmyung Women's University Industry-Academic Cooperation Foundation (2013).

To evaluate the effectiveness of the ICT HRD program, the employer's satisfaction rates for ICT HRD program beneficiaries turned out to be much higher compared to the rates for non-beneficiaries of the program. In 2012, ICT HRD program beneficiaries scored 88.8 out of 100 in employer satisfaction, 17.4 points higher than that of non-beneficiaries at 71.4. By area, the difference in employer satisfaction rates was the greatest in R&D human resources, followed by future talents (undergraduates) and ICT mentoring beneficiaries (Sookmyung Women's University Industry-Academic Cooperation Foundation, 2013).

<Table 1-8> shows the trends in the achievements of the ICT HRD program in terms of research papers. Since the budget for the program decreased from 94.7 billion won in 2008 to 82.6 billion won in 2012, the number of papers also fell from 4,204 in 2008 to 3,703 in 2012. The quality of the research papers, however, seemingly improved, as shown in a number of relevant indicators. First of all, the number of SCI papers was on a constant rise except for the period of 2011~2012. As a result, the percentage of SCI papers increased from 16.5% in 2008 to 20.7% in 2012. The quality of SCI papers can be evaluated by the Impact Factor (IF). The IF is a measure reflecting the average number of citations of articles published in an academic journal and a paper with a higher IF is assumed to be more influential. The average IF of the SCI papers published as a result of the ICT HRD program has gradually increased. And the increase in IFs can be attributed to the constant rise in the proportion of SCI papers in the top 10% articles with high IFs. The proportion rose from 2.9% in 2008 to 6.9% in 2012. Since IFs of SCI papers are a mere reflection of the number of citations, the number varies considerably depending on the publication date of a journal. To address this shortcoming of the IF, the quality of papers is also evaluated by the Eigen-factor Score and Article Influence Score. The Eigen-factor Score is a rating of the relative importance of all journals listed in Thomson's Journal Citation Reports (JCR) and

the sum of the Eigen-factor scores is 100, while the Article Influence Score measures the relative importance of the journal on a per-article basis and a score greater than 1 indicates each article in the journal has above-average influence. Between 2008 and 2012, the Eigen factor score slightly decreased, whereas the article influence score increased. Overall, it can be evaluated that the ICT HRD program has positive influence on the quality of Korea's SCI papers (Sookmyung Women's University Industry-Academic Cooperation Foundation, 2013).

Table 1-8 | Accomplishments of the ICT HRD Program regarding Research Papers

| | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| Project Budget (100 million won) | 947 | 886 | 789 | 824 | 826 |
| Total No. of Papers | 4,204 | 3,696 | 3,345 | 3,773 | 3,730 |
| No. of SCI Papers | 693 | 656 | 699 | 820 | 772 |
| Percent of SCI Papers (%) | 16.5 | 17.8 | 20.9 | 21.7 | 20.7 |
| Average Impact Factor | 1.486 | 1.246 | 1.387 | 1.563 | 1.624 |
| Percent of Papers with Top 10% Impact Factor | 2.9 | 2.9 | 3.3 | 6.7 | 6.9 |
| Eigen-factor Score | 0.032 | 0.019 | 0.023 | 0.027 | 0.030 |
| Article Influence Score | 0.53 | 0.488 | 0.52 | 0.602 | 0.636 |

Source: Sookmyung Women's University Industry-Academic Cooperation Foundation (2013).

Under the ICT HRD program, the mentoring system, practical job training, and industry-academic cooperation projects have been promoted and expanded to enhance work performance of ICT workers. Since 2008, the number of mentors and mentees participated in the program has gradually increased and the ratio of mentors per mentee also rose from 40.4% in 2008 to 58.8% in 2012. Moreover, the number of industry-university collaboration projects nearly doubled from 1,082 in 2008 to 2,080 in 2012, and the number of project participants also increased from 5,113 in 2008 to 10,972 in 2012. The increased number of participants in the mentoring system and industry-academy collaboration projects can be interpreted as more opportunities for students to learn how to identify and solve problems. The total hours of field practice increased from 36.7 in 2008 to 44.2 in 2010, but nosedived to 30.5 hours in 2012, negatively affecting practical business skills of students (Sookmyung Women's University Industry-Academic Cooperation Foundation, 2013).

Table 1-9 | Accomplishments of the ICT HRD Program regarding Job Performance

(Unit: No. of People, %, H)

| | Mentor/Mentee | | | Education Hours | | Industry-Academia Cooperation Projects | |
|---|---|---|---|---|---|---|---|
| | Mentor | Mentee | Ratio | Field Practice Hours | Percent of Field Practice Hours | No. of Projects | No. of Participants |
| Total | 12,784 | 23,563 | 54.3 | 61,569 | 38.6 | 7,953 | 40,265 |
| 2008 | 1,412 | 3,496 | 40.4 | 14,866 | 36.7 | 1,082 | 5,113 |
| 2009 | 2,008 | 4,018 | 50.0 | 19,054 | 40.4 | 1,367 | 6,613 |
| 2010 | 2,582 | 4,517 | 57.2 | 14,333 | 44.2 | 1,605 | 8,512 |
| 2011 | 3,178 | 5,402 | 58.8 | 7,084 | 37.4 | 1,826 | 9,059 |
| 2012 | 3,604 | 6,130 | 58.8 | 6,232 | 30.5 | 2,073 | 10,968 |

Source: Sookmyung Women's University Industry-Academic Cooperation Foundation (2013).

Note: For the number of mentors participated in the ICT mentoring project, the accumulative value was applied.

The aforementioned objective, goal and achievements of ICT human resource policies only deal with ICT specialists required for the advancement of the ICT industry. Along with the development of professional ICT skills, it is very important to develop basic ICT skills to utilize computers and the Internet. From 2000 to 2002, the MIC and other nine ministries jointly worked together to provide ICT education classes for 10 million Koreans, who were either information have-nots or information leaders, to create a society without the digital divide. The exact target number of persons subject to the ICT education was 11.13 million, over one fifths of the total population. About half of them were housewives, local residents and workers, and students were the largest group of all with 3.6 million. The disabled, farmers, senior citizens, inmates, soldiers, public officials, teachers and employees of public corporations were also included as targets. As of June 2002, more than 1.38 million people, around one fourths of the total population, received the ICT education, already surpassing the target number. This remarkable achievement is evaluated to have contributed to boosting ICT demand by improving citizens' ICT capabilities. The number of Internet users in Korea dramatically increased to 24.38 million or 56% of the population at the end of 2001 from a mere 3.1 million or 22.4% at the end of 1999.

Table 1-10 | Accomplishments of the 10 million Basic ICT Education Project

(Unit: 1,000 Persons)

| Education Target | Goal | Actual Beneficiaries | Education Target | Goal | Actual Beneficiaries |
|---|---|---|---|---|---|
| Disabled person | 207 | 101 | Worker | 1,500 | 1,435 |
| Farmer | 171 | 129 | Soldier | 740 | 623 |
| Fisherman | 20 | 16 | Public Officer | 510 | 510 |
| Senior citizen | 171 | 443 | Teacher | 615 | 1,109 |
| Housewife | 2,000 | 434 | Student | 3,364 | 3,373 |
| Inmate | 32 | 120 | Employee&Executive of Public Corporation | 200 | 153 |
| Local Resident | 1,600 | 5,359 | Total | 11,130 | 13,850 |

Source: Yeom et al. (2002).

In the introductory stages of information and communications devices and infrastructure, a divide between those who have access to these devices and those who do not can be created. Also, in the stage of dissemination, there can be a usage divide between those who can use these devices and infrastructure, and those who cannot. For this reason, the public informatization policy of Korea has been developed and implemented to expand general access and utilization. In fact, narrowing the usage divide through ICT education contributed to a better life quality for education recipients. As shown in <Table 1-11>, the beneficiaries of ICT education scored much higher than non-beneficiaries in terms of computer utilization, hours of use, Internet utilization and website ownership.

Table 1-11 | Comparison of ICT Education Beneficiaries and Non-Beneficiaries

(Unit: %, Minute)

| | Beneficiary (A) | Non-Beneficiary (B) | A-B |
|---|---|---|---|
| Computer Utilization Rate | 99.8 | 69.1 | 30.7 |
| Hours of Use | 89.1 | 63.8 | 26 |
| Internet Usage Rate | 92.7 | 63 | 29.7 |
| Personal Website Ownership | 24 | 7.8 | 16.2 |

Source: KADO (2003), Quoted from Ko (2011b).

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# Chapter 2

## Background and Importance

1. The Importance of ICT Human Resource
2. Domestic and Foreign Circumstances at the Time of Introduction

# Background and Importance

## 1. The Importance of ICT Human Resource

As the information and communications technologies continue to develop and diffuse throughout the economy, individuals are facing the challenges of adjusting their skills and learning to use these new technologies. ICT has facilitated productivity enhancing changes within firms, industries and nations. To maximize the benefits of ICT, skill upgrading and organizational changes are required (OECD, 2002).

In a knowledge-based economy, where a nation's competitiveness depends on its ability to create, utilize and distribute knowledge, more emphasis is put on the accumulation of knowledge or information rather than traditional factors of production. The law of increasing returns is applicable to knowledge; knowledge begets knowledge. With a skill based technological change, a new set of knowledge is required for existing jobs and new jobs. For this reason, the Organization of Economic Development and Cooperation (OECD) recognizes human resources development as one of the four main pillars for a knowledge-based economy together with an economic&institutional system, information and communications technology (ICT), and national innovation system (NIS). ICT human resources development is related to two main elements of a knowledge based economy.

ICT skills are important for Individuals in terms of compensation, employability, and personal development. The productivity, competitiveness, and adaptability of the firm are increasingly dependent on the ICT skills of its employees. It is now a main determinant of economic growth and social cohesion in countries and regions (OECD, 2002).

As the nurturing and acquiring of qualitative human resources emerge in a list of priorities to gain competitiveness, major countries reinforce human resources development plans. In this context, the EU set up an increase in human resources investment through more

rigorous education and technology training as one of the ten action plans in the Renewed Lisbon Strategy 2005. Similarly, the US suggested investment in human resources as one of the three main policy tasks in Innovative America, 2004 (Ko, et al., 2007a).

## 2. Domestic and Foreign Circumstances at the Time of Introduction

Since the 1990s, the world economy and society was rapidly restructured toward the new order as well as going through a fast-paced informatization. It has become an impending issue to strengthen national competitiveness through informatization and globalization at unprecedented speeds. Globalization is enhancing each sector of the nation to meet the global level by reforming system, awareness and custom, thus strengthening the national and citizens' competitiveness. As joining the globalization trend, Korea carried out government reform in 1994, and the establishment of the Ministry of Information and Communication (MIC) is one of the most important parts of the reformation. In an effort to make the national ICT development structure as a part of the national industry development strategy, the MIC was established in charge of Information and Communications Technology (ICT) related affairs by having extended and reformed Korea Post Office, and unified previously dispersed government functions related to ICT (KIM, 2001).

In December 1997, Korea asked for the IMF's financial aid to address its financial crisis. On the surface, 1997 financial crisis was triggered by lack of foreign exchange liquidity, but a more fundamental reason for the crisis was the poor management of companies, including excessive borrowing and a high-cost low-efficiency management structure. Later on, it was suggested that the government economic growth strategy should be changed from factor driven to total factor productivity improvement. The ICT development was considered as a strategic means to resolve impending issues under the financial crisis, and as the leading cause of persistent economic growth by enhancing total factor productivity. In case of the U.S.A, the economy was restructured during the late 80s to early 90s as the government expanded investment on ICT, which resulted in continuous economic growth, a low unemployment rate and its restoration as the most competitive nation, a reputation once taken away by Japan.

In 1996, OECD defined a knowledge based economy as an economy where value is mainly created by creating and applying knowledge and information, and foresaw that the knowledge based economy would bring a major force for growth in the future. In 1998, the US Department of Commerce studied several cases of the digital economy increasing efficiency in 'The Emerging Digital Economy.' Based on such trends, the Korean government also anticipated that the ICT industry would play a key role for the economic

recovery and in support of the idea, the Korean government focused on legislative reform to attract the foreign investment, promoting exports of the ICT industry, and creating more jobs through training ICT experts (Kim, 2001).

<Table 2-1> shows the annual budget of the MIC on the ICT HRD Program from 1994 to 2000. The investment made in 1997 was about 10 times bigger than the previous year and especially, the figure in 1998 was sharply increased despite the 1997 Korea Financial Crisis.

Table 2-1 | The MIC's Budget on ICT HRD Program

(Unit: 100 Million Won)

| Year | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|
| Budget | 45 | 40 | 65 | 594 | 1,160 | 1,050 | 795 |

Source: Kwon&Oh (1999), Ko et al. (2007a).

Under the IMF bailout program, economic recession and company restructuring resulted in mass unemployment. The MIC initiated the so-called "Industrial Human Resources Education Project." The core of this project was to support the retraining of existing human resources, and it supported the enhancement of technical skills of industrial workers to cope with rapidly developing ICT technologies, and the vocational education for the unemployed, including highly-educated individuals to be rehired in the ICT field, including SW. Along with the fast growth of the ICT industry, the industrial human resources education project was assumed to be an efficient resolution for lowering the unemployment rate, and in 1998 and 1999, when the unemployment rate was sharply increased to 7.0% and 6.5%, respectively, from 2.6% in 1997, the budget on this project was considerably increased. However, in 2002, when the economy was recovered, the budget was remarkably declined back to the level before the financial crisis.

For a knowledge-based economy, the importance of human capital where the intangible assets such as 'knowledge' and 'technical skill' are embedded, has been highlighted. In 1998, the World Bank announced that the investment on human resources is more essential and efficient, than investments into physical resources in the knowledge-based economy, The U.S. Department of Commerce reported that a 10% increase in education investment leads to an 8.6% increase in productivity, which is about three times higher return than that of capital investments. Many nations and research institutes forecasted that the ICT industry would grow at unprecedented speed, together with increased utilization of ICT in other industries. The consequent shortages of people with ICT skills were also predicted. According to OECD (1999) and IDC (1998), the shortage of ICT workers in 1997 was estimated to be between 600,000 and 700,000. To tackle these severe shortages of ICT

skills, each nation has promoted various policies to train ICT human resources (Kwon&Oh, 1999).

Table 2-2 | Estimated Shortage of ICT Workers in Late 1990s

(Unit: Persons)

| Countries | Estimated Shortage | Institution |
|---|---|---|
| Global | 600,000 | EICTO (1998) |
| USA | 346,000 | ICTAA (1998) |
| | 450,000 | Microsoft |
| Canada | 20,000~30,000 | OTP |
| EU | 320,000 | IDC |
| Germany | 60,000 | EICTQ |
| UK | 20,000 | EICTQ |

Source: OECD (1999), IDC (1998), Quoted from Kwon&Oh (1999).

Along with strengthening the training programs for ICT human resources, each country has implemented various policies to attract ICT talents from overseas. The policy can be categorized to the following four types. The first type is relaxing the regulation on short-term working visas or increasing the number of working visa issuances. For example, the U.S.A consistently increased the number of H-1B, a short-term working visa usually issued for ICT human resources and Germany also increased the number of people qualified for short-term working visa for ICT human resources, called 'green card', introduced in 2000. Moreover, most advanced nations including Australia, Canada, France, Japan, New Zealand and UK relaxed the regulation on issuance of a working visa for ICT human resources. South Korea benchmarked these systems and started the 'gold card' and the 'science card' program preferentially issued for ICT human resources. The second type is the policies usually applied in Germany, Canada and Australia to set up special inward migration programs for occupations with shortages. The third type is the policies to increase the non-wage incentives to attract the highly skilled ICT human resources and it was adopted in Australia among others. The fourth type is the policy to allow foreign students to change status at the end of their studies and this was widely adopted in such countries as Germany, Switzerland, Australia and USA (Kwon et al., 2001; OECD, 2002; Ko et al, 2012). In addition, the establishment of proper infrastructures including immigration policies, citizenship policies and child education support has been emphasized as the long-term strategies to attract outstanding ICT human resources at the national level. For example, China established industrial parks to promote the inflow of outstanding ICT human resources from overseas and built the database for oversea residing Chinese with outstanding ICT skills and talents.

The establishment of the Informatization Promotion Fund in 1996 jump-started the investment on ICT HRD. The policies have been implemented under the long-term plans, which were designed in a sequence of the expansion of ICT skill base, the quantitative expansion, strengthening of professional ICT skills and qualitative enhancement, because it had secured a stable and relatively abundant financial source. Thanks to stability and abundance of the financial source, various policies required for ICT skill developments could be implemented in a timely manner.

Since 2004, the ICT HRD policy switched its direction from quantitative expansion to qualitative enhancement. This change of direction in policy is spurred partly by the stagnant employment growth of the ICT industry. Employment of ICT industry sharply increased up to the year 2000 after the Asia financial crisis of 1997. After year 2000, however, a series of bankruptcy of ICT start-ups lead to a sudden collapse of the so-called ICT bubble. The employment of ICT industry dramatically decreased in 2001 comparing to 2000. More than 40,000 jobs in ICT industry were gone in a single year. In the subsequent years, employment in the ICT industry did not pick up. Employment in the communication service industry, which had been stagnant around 100,000 since 1997, dropped in the year 2003 due to the restructuring of major telecommunication service providers. Moreover, the SW and computer service industries, which created the employment for 67,000 people from 1998 to 2001, did not add many jobs from 2001 to 2003 (See <Table 2-3>).

Table 2-3 | Trends of Employment in ICT Industries

(Unit: Persons)

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|
| Information& Communication Device | 240,621 | 266,816 | 332,812 | 265,976 | 283,625 | 284,048 |
| Communication Service | 99,270 | 90,753 | 98,286 | 100,614 | 102,999 | 97,171 |
| SW&Computer Service | 46,171 | 55,289 | 89,716 | 112,309 | 114,064 | 114,251 |
| Information& Communication Industry | 386,062 | 412,858 | 520,814 | 478,899 | 500,688 | 495,470 |

Source: Korea Association for ICT Promotion (2004).

The USA also experienced the sudden drop in the employment of ICT industries. During 1993 to 2000, the annual average employment growth rate for the entire industry of the USA was 3.2%, but the annual average employment growth rate of the ICT industry was 6.2%, accounting for the creation of 1.8 million jobs. However, during the period of 2000 to 2002, the employment of the ICT industry was reduced by 60,000, which was dropped 6 times faster than the employment reduction rate for the entire industry, 1.6%. It accounted

for 25% of the total employment reduction (US DOC, 2003). All in all, the deceleration of job creation in ICT industry both domestic and global dimension, motivated to change the direction of the ICT HRD from quantitative expansion to qualitative enhancement in Korea.

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# Chapter 3

## Strategy and System

1. Strategy for policy making and Implementation
2. Funding for Policy Implementation

# Strategy and System

## 1. Strategy for Policy Making and Implementation

ICT HRD policies of Korea emphasized the quantitative expansion of ICT human resources at the initial stage. This policy achieved great success of sustained increases in ICT graduates. In 2009, 47% of engineering school graduates with bachelor's degrees was from ICT related major fields (NIA, 2010). The ICT HRD program has evolved from a supply and domestic oriented quantitative expansion policy to a demand and global oriented qualitative enhancement policy, while going through stages of the building ICT infrastructure, expanding enrollment, strengthening horizontal linkage, and deepening professional ICT skills.

During the period of building ICT infrastructure, Korea's ICT HRD policy focused on laying the foundation for the expansion of ICT human resources by carrying out a range of projects to build ICT facilities and infrastructure, keeping up with the growth of the ICT industry. The development of ICT curriculum and distribution of main computers were backed by government support during this period, and the Information and Communications University (ICU) was newly founded in 1998. From 2001 to 2003, with the rapid growth of the ICT industry, the government budget was mainly spent on laying the ground for producing highly-skilled human resources and expanding a number of ICT professionals based on an improved ICT education environment. More specifically, the expansion of enrollment in ICT-related college departments, establishment of the ICU undergraduate college, support of university IT research centers and advanced ICT education, promotion of short-term training courses of new technologies such as information protection were pursued during this period. From 2004, by adopting the supply chain management (SCM) model, ICT HRD policy that was more responsive to industry demand was implemented,

in addition to continuous support to promote university IT research institutes, attract more international students and expand continuing education for ICT industry workers (Ko, 2011b). The policy direction of ICT HRD began to shift from quantitative expansion to qualitative improvement in 2008 with more government resources invested in nurturing experts with master's or doctoral degrees, SW specialists and convergence leaders. In a nutshell, Korea's ICT HRD program has been evolving in response to changes in internal and external policy and economic environments, including fluctuating labor demand in industries and advancements in technology.

ICT HRD policy was implemented to facilitate the nurturing of basic, applied and professional ICT skills from various channels, such as domestic formal educational institutions, private training centers, universities abroad, firms and workplaces. ICT HRD policy has been pursued in a virtuous circle of 1) establishment of ICT infrastructure for human resources development; 2) increased supply of ICT human resources with more regular educational institutions; 3) retraining of the ICT workforce; 4) ICT education to the entire population; and 5) regular forecast of future supply and demand trends, improvement of ICT certificate systems, expansion of institutional frameworks, etc. (Ko, 2011b).

## 1.1. Building Infrastructure for ICT Human Resource Development

One of priorities of Korea's ICT HRD policy was the universal access and use of computers and the Internet for all schools. In 1997, the first Comprehensive Plan for Education Informatization, which aimed at building basic ICT infrastructure for all elementary and secondary schools so that students would have no difficulties using computers and the Internet, was announced. The goal was accomplished at the end of 2000, two years earlier than the target year, and Korea became the first country in the world where every 10,000 elementary and secondary schools are connected to the Internet with in-school computer networks and some 13,000 school computer labs were successfully constructed. In addition, multimedia devices including PCs were distributed to 214,000 classes across the country, while every 340,000 school teachers were supplied with individual PCs, signaling the completion of the plan to build basic infrastructure for informatization of the educational sector. As a result, the Internet began to be actively utilized in teaching and learning at school, while students were given opportunities to develop self-directed learning skills and an inquisitive attitude (MEST, 2003; Ko, 2011a).

Between 2001 and 2005, the second Comprehensive Plan for Education Informatization was formulated and implemented. The three major objectives of the second Plan included: i) creating an ICT-friendly educational environment by supplying one PC per five students; ii) conducting diverse ICT classes such as a "computer practice room", "classroom dedicated to specific subjects", and "small-group learning classes"; iii) assisting to provide 2 Mbps

or faster Internet bandwidth; and iv) maximizing ICT education under the 7th Education Curriculum. Afterwards, the focus of ICT education policy was shifted to software utilization capabilities from hardware skills, especially in elementary and secondary schools by helping teachers and students improve software capabilities, providing support for the development of ICT-based education content, assisting teachers in enhancing information skills, and promoting ICT-based education (MEST, 2003, Ko, 2011a).

Starting from the 1980s, the Korean government took the initiative to improve information literacy of public servants with ICT training. To be specific, the 5-year Plan for Rigorous ICT Training was developed in 2000, and a total of 2.11 million public officials received ICT education and improved their basic ICT skills by 2005. In the same year, the government also launched the Informatization Human Resources Development Plan for Government Innovation, with the objective of establishing a more advanced e-Government and boosting the utilization rate. Under the plan, a comprehensive ICT education package covering eight areas of ICT planning, Enterprise Architecture, quality&standardization, security technology&management, network, database, project management, and application&system was introduced to enhance key capabilities required in fulfilling ICT-related missions and duties. In order to provide tailored education programs for trainees with different skill sets and abilities, the education courses were divided into three levels of general, core, and advanced, and systematically developed in consideration of preceding and ensuing courses (MOPAS, 2005; MOPAS, 2008).

## 1.2. Expansion of ICT Human Resources through Formal Educational Institutions

The Korean government made sustained efforts to keep up with changing ICT skill requirements arising from technology and industry development. The rapid growth of the ICT industry and the rise of new ICT segments such as the internet, e-commerce, ICT-service, and state-of-the art ICT hardware created ICT jobs that would require the expansion of ICT skills from formal educational institutions such as universities and graduate schools.

To expand ICT skills, a number of policy measures were developed and pursued, including a program to provide support to universities and junior college to secure the latest ICT equipments with a condition of an increase in the enrollment quota for ICT departments, a program to encourage the recruitment of professors with field experience, and a project to expand ICT education in non-ICT departments through curriculum reorganization, in order to meet the changing labor demand in industries. The 'select and focus' strategy was employed for the ICT skills base expansion. A few selected schools received intensive support, and beneficiaries of program were regularly evaluated and replaced if the evaluation results

were not satisfactory. Although the government support was extensively provided across colleges, universities and vocational high schools in the initial stage of informatization, the focus was placed on advanced educational institutions to meet the increasing industry demand for highly-skilled ICT human resources (Ko, 2011b).

Support for master's and PhD students was provided through university IT research centers. IT research center selected as the target of the government ICT HRD program was offered as much as 800 million won for eight years and was able to conduct research and nurture ICT graduates with higher qualifications with a long-term vision. The government also established the ICU to expand the supply of highly-skilled ICT professionals with master's or doctoral degree and provided scholarships to domestic university graduates to pursue a master's or doctoral degree in ICT-related studies at prestigious educational institutions abroad. This government program was expanded to include recruitment of foreign talents. By helping local graduate schools host and nurture international students in their post-graduate courses, the government tried to improve the global competitiveness of Korea's higher educational environment and build a network of international ICT leaders that have a deep understanding of, and friendliness towards, Korea.

The main source of ICT workers is and continues to be tertiary-level education. The conventional educational institutions such as universities and junior colleges, however, usually fail to respond to changing demands for ICT skill requirement of firms. To reflect changing demand of firms for ICT skills spurred by technological change and ICT market conditions to curriculums of educational institutions, horizontal linkage between two parties needs to be strengthened. The two parties, however, do not have sufficient incentives to invest on building a system that reinforces horizontal linkage, because the system, once built, has a ripple effect over entire educational institutions and firms that benefits are not limited to those who invested in the system. In other words, the system has a typical characteristic of a public good such as non-excludability and non-rivalry. Thus, the horizontal linkage system between firms and regular educational institutions, which is required for nurturing of ICT human resources meeting the demands, can be established only when the government provides support. The Korean government initiated various policies for strengthening the horizontal linkage between firms and universities. The introduction of a SCM model, the co-evolution of support for ITRC and IT 839 strategy, the NEXT project for supporting universities to strengthen the competitiveness of ICT courses on their own, and the Seoul ACCORD for international standardization of engineering education in ICT fields were a few examples of the government's efforts.[2] One of key strategies in implementing those policies was to adopt an interim evaluation system, in which the performances of the target educational institutions of those government support programs were assessed during the

2. NEXT is an acronym for Nurturing EXcellent engineers in information Technology.

process to disqualify non-performing endeavors, thereby encouraging competition between the beneficiaries.

## 1.3. Retraining of ICT Human Resources

Information and communications technologies advance very rapidly, which means that skill requirement of ICT jobs are changing constantly. Since the skill requirement of ICT jobs is specific and time-variant, it is quite difficult to replace one ICT worker to another. As the amount of knowledge and information, even within same technologies, continue to get updated due to the short innovation cycle of information technologies, designing effective retraining and lifelong learning program has become an important agenda for policy makers. The Korean government has been assisting retraining programs targeting employees of ICT firms and the unemployed, while striving to put in place a mechanism that induces self development throughout life cycle of jobs (MEST, 2003; Ko, 2011a).

The retraining can be offered either at the workplace or private training institutions. The retraining generates benefits for both employees and firms in the form of increased wages and increased labor productivity, respectively. A high worker turnover rate might give disincentives for firms to invest in retraining, but the firm's offer of retraining can be an additional incentive for workers to accept a job. The costs for retraining are generally shared by employees and firms. The firms tend to bear the cost of firm-specific skills, whereas the employees are willing to bear the cost of general skills. Neither firms nor employees are willing to pay for the whole costs of retraining (OECD, 2002). Thus, government support for retraining is necessary, especially when the demarcation between firm-specific ICT skills and general ICT skills has become blurry with the rapid advancement of technology.

Korea has the experience of providing subsidies to private training centers for their short-term ICT programs for several years following the Asian financial crisis at the end of 1997. To promote retraining, the government designated well-performing private training centers, such as the MIC ICT Academies, and provided subsidies for facility and equipment purchases. The government also provided expenses to these academies to train the highly-educated unemployed, and turn them into ICT workers. Training vouchers for ICT skills were also introduced. Vouchers were directly issued to jobless people wishing to study ICT at a private training center. Using the vouchers, people could select courses they wanted to take, and this supposedly fostered the competition between training centers, henceforth leading to a more efficient allocation of resources and a higher quality of training. The voucher program, however, had some problems. Some trainees got a cash rebate from private training centers by just signing up for the course using vouchers, and didn't really receive training. A typical example of a moral hazard occurred during the course of implementing the voucher program. It is a hidden action problem and the implementing

body needed to monitor the trainees and private training centers more carefully. Higher level online ICT education was provided by a project called the cyber university program. The program includes education on data security, ecommerce and other subjects whose educational demand has been growing rapidly. The curriculum development costs have been supported by the government.

When it comes to the budget, retraining was the area that used a substantial amount, especially during the period 1998~2002, following the Asian currency crisis. After the 2008 financial crisis, the Korean government started a new type of retraining program. It involved ICT education and training for SME new hires through the 'utilization of private education centers' initiative starting in 2011. This project set the government subsidy up to 80% of the educational expenses, to encourage SMEs to invest in their own customized ICT human resources development programs (Ko, 2011b).

A special training program for the highly demanded hot ICT skills was implemented continuously and flexibly, responding to changing demand of the market. The subject of hot ICT skills education changed from ASIC, JAVA, RF design to IT SoC, to meet demands. This program partly subsidized the training costs of participants and operated in conjunction with the unemployment insurance program, to minimize the cost burdened by the participants (Ko, 2011b). As the contents of hot ICT skills became more complicated and theoretical, a retraining program operated by the government-designated domestic, as well as foreign universities, were initiated and the ICT industrial workforce was allowed to obtain master's degrees in highly demanded ICT areas.

## 1.4. Provision of "Internet Education all Program" to the Public

Table 3-1 | 1999 Survey on Informatization Levels

(Unit: %)

| Classification | Computer Utilization Rate | | Internet Utilization Rate | | Computer Education Completion Rate | | Education Willingness in 2000 |
|---|---|---|---|---|---|---|---|
| | '99. 5 | '99.12 | '99. 5 | '99.12 | '99. 5 | '99.12 | |
| Farmers/Fishermen | 2.9 | 4.7 | 1.0 | 2.2 | 4.8 | 4.7 | 18.6 |
| Housewives | 10.9 | 28.0 | 1.8 | 9.2 | 19.1 | 31.8 | 62.8 |
| Small Businessman | 23.6 | 36.8 | 5.9 | 18.4 | 20.0 | 25.3 | 51.3 |
| The Disabled | - | 46.5 | - | 28.6 | - | 36.5 | 58.5 |
| Middle/ High School Students | 66.6 | 88.3 | 21.7 | 65.7 | 70.3 | 79.5 | 77.5 |

| Classification | Computer Utilization Rate | | Internet Utilization Rate | | Computer Education Completion Rate | | Education Willingness in 2000 |
|---|---|---|---|---|---|---|---|
| | '99. 5 | '99.12 | '99. 5 | '99.12 | '99. 5 | '99.12 | |
| Public Officers | - | 91.0 | - | 69.3 | - | 77.7 | 74.7 |
| Teachers | - | 96.0 | - | 74.9 | - | 87.7 | 72.4 |

Source: Yeom et al. (2002).

In 1999, the Korean government started to subsidize the mass distribution of low cost PC and successfully induced Internet users to grow to 10 million in the same year. Since then, as the number of broadband Internet subscribers increased significantly, concerns on a digital divide rose and the Korean government started to address the problems through various policies. According to the 1999 survey on informatization levels by social stratum, those in farming and fisheries, housewives and the disabled showed comparatively low informatization levels in all aspects, such as in the utilization rates of computer&the internet, completion rates of informatization education, etc. In addition, the gap between these people and those in other social strata such as students and public officials was aggravated, because people in the lower levels of informatization showed less willingness to take informatization education. In response to widening digital divide among different social groups, the Korean government formulated the 'Informatization Education for 10 million People Program" at a cabinet meeting in June 2000, and intensively conducted the basic ICT education for the entire population, including those who have traditionally been neglected for technology–related policies (Ko, 2011b).

## 1.5. Institutional Framework for ICT Human Resources Development

The government should provide sufficient information about ICT education and the ICT labor market. The size of ICT human resources entering the labor market is determined by an individual's investment decisions on specific ICT qualifications, skills and education. It is necessary to provide the future prospects of demand for ICT skills, promising ICT occupations, expected wage levels and job stability for various ICT occupations to secure adequate and optimal supply of appropriate ICT skills in the future. The individuals need information on the future, as well as present ICT labor market conditions, because it takes quite a while to acquire certain ICT skills. The forecasts on future labor market help individuals to reduce the possibility of making wrong investment decisions on ICT skills caused by incompleteness and asymmetry of information (Ko&Lee, 2004).

The labor market forecast has the characteristics of a public good. There are little incentives for individuals, firms, educational institutions and private training centers to pay for the cost of conducting a labor market forecast or that of developing the model, even though they all are happy to use the results of such forecasts. Due to the problems of the free ride or non-excludability, the cost of labor market forecasts can by shared by the beneficiaries in the market. In fact, a significant cost is required to conduct an accurate labor market forecast. Various data related to labor demand and supply at both the micro and macro levels are required, and building a model to estimate the demand and supply of human resources would entail significant costs. In general, the labor market forecast is conducted with government support. The labor market forecast can decrease the gap between demand and supply, by providing relevant information to various decision makers (Ko&Lee, 2004).

The Korean government consistently supported basic fact-finding studies on current ICT labor market conditions, as well as demand and supply forecasts for ICT skills. The ICT HRD program itself is evaluated annually by experts on ICT labor market and ICT education, and evaluation results are reflected for constructive changes in the program.

Although national ICT certification systems can be found in many countries across the world, most of them have been managed inefficiently and unsuccessful in the face of swift technological advancements. To ensure the consistency and reliability of the certificates issued through the system, a national-level ICT certification system is necessary. However, some have argued that a government-led certification system is not a right fit for ICTs on the ground that the ICT market is rapidly changing and the changes are mostly driven by product or service providers, and that the role the government is to promote certification programs run by the private sector for maximizing the immediate impact of ICT certificates (Ko, 2011b). The Korean government increased the adoption of the private certification system. Even though private certifications, compared to the national certification, lacked transparency and continuity, it helped reflect the changes in the ICT market demand in a swift manner.

## 2. Funding for Policy Implementation

Under the slogan of “We were late in industrialization. But we will lead the information age,” the Korean government had sought to raise public awareness of the need to advance the nation’s information capabilities since the 1990s. It had legislated the Basic Law of Informatization Promotion with the objective of promoting and pursuing nation-wide informatization. In addition, the government built up the Information and Communication Promotion Fund (1993~1995), which was financed by contributions of telecommunications

operators and later called the Informatization Promotion Fund, to provide finances to its diverse ICT projects and initiatives. The ICT HRD program is financed by this Informatization Promotion Fund (Ko, 2010).

While most countries include resources secured by frequency auctions, etc., in the general budget, the Korean government created the Informatization Promotion Fund under the premise that "government funds collected by MIC through new common carrier selection, may as well be reinvested into MIC" and used it for technology development, ICT HRD, standardization, research infrastructure, etc. The long-term and continuous investment in ICT R&D by the Korean government was possible largely because of the Informatization Promotion Fund. The government used the fund to commercialize the CDMA, IMT-2000 service and building world-class ICT infrastructure, based on which the quality and convenience of the people's lives have improved (Ko, 2010).

The Informatization Promotion Fund, which was mainly used to make investments in or finance the nation's informatization and other ICT-related projects, had two accounts: the General Account and the Research Development Account (See <Table 3-2>). After large-scale informatization projects, such as high-speed network and step1 e-government project, were completed and the purpose of the general account of Informatization Promotion Fund was achieved, the general account was abolished in 2005 and the title of the fund was changed back to the ICT Promotion Fund, which has been focused on investing in ICT R&D. The following <Table 3-3> shows the major history of the fund. Thanks to the fund, the Korean government was financially stable and flexible enough to carry out high-cost ICT HRD projects that had nationwide impact. It also enabled the government to pursue the nation's informatization without budget, time and human resource constraints, and to swiftly respond to and reflect shifts in the technological environment into its projects, since the main purpose of the Fund was to financially back up the government in implementing related projects. The success of the projects financed by the Fund also had spillover effects to other related fields and industries, and opened up new business opportunities, thereby accelerating the nation's informatization process (Ko, 2010: Sookmyung Women's Univ. Industry-Academic Cooperation Foundation, 2013).

Table 3-2 | Purposes and Sources of Informatization Promotion Fund

| | Purpose | Source |
|---|---|---|
| General Account | • Build broadband network and promote its utilization<br>• Facilitate informatization in different areas: public, regional and industrial areas<br>• Build a foundation for the growth of the ICT industry | • The government's contribution<br>• Profit from the operation of the Fund<br>• Borrowings and other revenue |
| Research and Development Account | • Develop ICT technologies<br>• Nurture skilled ICT resources<br>• Develop and set ICT standards<br>• Build a foundation for ICT research | • The government's contribution or loans<br>• Mandatory contribution collected from telecommunication operators<br>• Profit from the operation of the Fund<br>• Borrowings and other revenue |

Source: Ko (2010).

Table 3-3 | Major History of ICT Promotion Fund

| Fund | History |
|---|---|
| ICT Promotion Fund (1993~1995) | • Jan, 1993: Creation and operation of ICT Promotion Fund<br>- Article 5, Law on ICT research and development (enacted Dec.14, 1991)<br>- Foundation to systematically promote national informatization and ICT industry (Establishment of Ministry of Information and Communication in 1994) |
| Informatization Promotion Fund (1996~2004) | • Jan, 1996: Reorganized into Informatization Promotion Fund (Article 33, Informatization Promotion Act)<br>- Enactment and declaration of Informatization Promotion Act (Aug. 4, 1995)<br>- It was divided into general account for informatization promotion and R&D account for ICT industry, the R&D account succeeded ICT Promotion Fund |
| ICT Promotion Fund (2005~present) | • Jan, 2005: Reorganized into ICT Promotion Fund (Informatization Promotion Act amended)<br>- In Informatization Promotion Fund, the general account was abolished and R&D account succeeded<br>- Feb, 2008: following the government reorganization, managing agency of ICT Promotion Fund changes from MIC to MKE (Informatization Promotion Act amended)<br>- Aug, 2009: The legal basis for ICT Promotion Fund changed (ICT Industry Promotion Act enacted)<br>- Mar, 2013: following the government reorganization, managing agency of ICT Promotion Fund changed from MKE to MSIP (ICT Industry Promotion Act amended) |

Source: NIPA website (http://www.nipa.kr).

2013 Modularization of Korea's Development Experience
ICT Human Resource Development Policy

# Chapter 4

## Specifics of Policies

1. Policies of ICT Infrastructure Building Period (1997~2000)
2. ICT HRD Policy of Quantitative Expansion Period (2001~2003)
3. ICT HRD Policy in Horizontal Linkage Strengthening Period (2004~2007)
4. ICT HRD Policy in ICT Professional Skills Deepening Period (2008~Present)

# Specifics of Policies

ICT HRD program of Korea was initiated in 1997. The program can be classified into four stages by types and characteristics of government supports; the ICT infrastructure building stage from 1997 to 2000, the quantitative expansion stage from 2000 to 2003, the horizontal linkage strengthening stage from 2004 to 2007, and the ICT skills deepening stage from 2008 up to the present.

## 1. Policies of ICT Infrastructure Building Period (1997 ~2000)

During the ICT infrastructure building stage from 1997 to 2000, there was a software venture boom and it fueled interest in software as well as demand for software skills. Moreover, along with the spread of the high-speed Internet throughout the nation, the general public began to have an interest in informatization. There was a growing need for ICT retraining directed at the unemployed in the wake of the Asian Financial Crisis in late 1997. Thus, ICT training programs were implemented with an emphasis on the establishment of infrastructures for the development and expanded supply of ICT human resources. Major HRD projects implemented during this period included the establishment of the ICU, the support of ICT model schools, the support of software departments in universities, the establishment of software specialized high schools, the deployment of domestic mainframe computers in school, the support of ICT business promotion centers in universities, the provision of ICT retraining programs for the unemployed, etc.

Table 4-1 | ICT HRD Policies of the ICT Infrastructure Building Period (1997~2000)

| Policy Objective | Building Infrastructure and Expanding Supply of ICT HRD |
|---|---|
| Policy Measure | • ICU Establishment (1998)<br>• Support of ICT model schools and software departments of universities<br>• Support of expansion of ICT equipment and faculty members<br>• Connecting all the schools through broadband<br>• Support retraining programs for hot ICT skills<br>• ICT conversion education for non-ICT sector human resources and the unemployed<br>• Foster employment of female ICT human resources |
| Success Factor | Securing stable financial sources for ICT HRD by establishing the ICT Promotion Fund |
| Implemented by | Ministry of Information and Communication |
| Limitation Factor | Expansion of budgets for the retraining and conversion training for the unemployed amid the Asian economic crisis |
| Achievement | • Establishment of the ICT-centric economic growth strategy<br>• Support of vulnerable social groups and the unemployed<br>• Establishment of infrastructure and institutional framework for the development of ICT human resources |

Source: Reconstructed from Ko et al.(2012a) and Ko et al., (2012b).

During this period, the provision of computers and the internet to every school across the nation was the top priority. The first stage of the educational informatization plan, started in 1997, aimed to establish basic ICT infrastructure so that every elementary and middle school students can use computers and the Internet and the goal was achieved by the late 2000, which was two years faster than the original plan. Therefore, for the first time in the world, about 10,000 elementary schools and middle schools throughout the nation were equipped with LAN and connected to the internet. Moreover, multimedia devices including personal computers were supplied to all the classrooms and a personal computer was supplied to all teachers (Ko, 2011b).

The ICT training program for this period was classified into the "Comprehensive ICT Human Resource Development Program", the "Highly-Skilled ICT Professionals Development Program, the "Industrial ICT human Resource Retraining Program" and the "Potential ICT Human Resource Training Program." The comprehensive ICT HRD program was aimed at training human resources with a bachelor's degree or lower, while the highly-skilled ICT professionals development program was for human resources with a master's degree or above. The industrial ICT human resource retraining program was

to provide specialized education to existing ICT human resources to meet the changing demand of industrial sectors, and the ICT conversion training program was for the training of the unemployed and non-ICT human resource for ICT occupations. The Potential ICT Human Resource Development Program was established to provide ICT education to new generations, females, soldiers, the underprivileged and juveniles.

"The Comprehensive ICT human Resource Development Program" was divided into the ICT faculty member expansion, which supported ICT specialists to be employed as faculty members, and the education facility/equipment expansion, which included the restructuring of ICT curriculum and supporting of ICT-related programs in non-ICT major courses. The select and focus strategy was employed for the expansion of ICT human resources through formal education institutions. "ICT model schools" were selected to be subject to benefits of this program. At the initial stage of informatization, undergraduate schools, community colleges and vocational high schools were all eligible for the benefits of the program, but as demands for ICT human resources got advanced, only higher educational institutions became qualified for the program (Ko, 2011b). Universities, which were revealed to have proper educational curricula, research facilities, sufficient potential to be developed as world-class universities, and attracted the investment through industry-academic cooperative education and research, became candidates for the ICT model school program. Through the examination of submitted ICT specialization plans and on-site surveys, IT model schools were selected. For the final selection, the balanced development of regions was considered. A total of 30 universities, 20 in 1997 and 10 in 1998, were selected and 1.5~3 billion won was provided to each of the universities in consideration of the university size, and the total sum was 58.1 billion won. The selected universities received the fund for 4 years, but universities whose performance was found to be unsatisfactory by the annual evaluation were dropped off from the project and the spots were taken by other previously lower-ranked universities (MIC, 1997).

To ensure that ICT vocational education met the demands of the ICT industry, 13 billion won was allocated to the selected 20 vocational colleges specializing in ICT education and 7 billion won was offered to 20 selected vocational high schools to support the expansion of their ICT facilities. The vocational colleges specializing in ICT education were selected in consideration of the excellence of the academic program, regionally balanced development and promotion of female ICT human resources. Three women's colleges were selected first and then more colleges for the remaining slots were picked in consideration of the excellence and regional balance. Education courses related new ICT technology were provide to teachers of outstanding vocational high schools at five education centers established by the Korea Agency for Digital Opportunities and Promotion (KADO). In addition, they received a chance to have long/short-term training at educational institutions, research centers and overseas companies (MIC, 1997).

Moreover, policy to promote the employment of a female labor force in the ICT industry was also implemented. The conversion ICT education course for women was established at the Advanced Institute of Information Technology (AIIT), an ICT training body of Korea Agency for Digital Opportunities and Promotion (KADO), to provide women opportunities to work in the ICT sector. This course was offered in two tracks: one for simple training courses and the other for transforming non-specialized labor forces into specialized ones. As of 1996, among 286,000 female students of vocational high schools, about 100,000 female students were majoring in ICT, but the ICT curriculum for female students were limited to simple assistant tasks such as word processing and making spreadsheets. Therefore, the enrollment of female students in technical high schools, which had a curriculum of nurturing specialized ICT skills, was promoted, and technical high schools with a high percentage of female students and vocational high schools with curricula of specialized ICT skills were preferentially selected as the ICT vocational education model school. Along with these policies, the integrated database for women in ICT was established to help the entry of women into the ICT labor market (MIC, 1997).

The Information and Communication University (ICU) was founded in March 1998 upon the "Framework Act on Telecommunications" and it only had a graduate school based on the "Higher Education Act." Before December 1995, a graduate school could not be founded without its undergraduate school, but "Higher Education Act" was revised as "It is allowed to establish a graduate school without an undergraduate school to train specialized workforce for specific areas if necessary." The ICU was established as a subsidiary of ETRI with a view to closely linking research activities with education. The initial admission quota was 210; 130 for master's degree and 50 for doctoral degree in the departments of information engineering, communication engineering and basic electronic engineering and 30 for master's degree in the department of industrial engineering. For the establishment of ICT, the "Framework Act on Telecommunications" was revised as follows: ① The ETRI established under the approval of the Minister of MIC pursuant to Article 32 of the "Civil Act" shall be considered the ETRI under the amendment to Article 15-2 of the "Framework Act on Telecommunications"; ② The research institute is a foundational juristic person; ③ The research institute can establish a graduate school to nurture human resources specialized in electronics and telecommunications in compliance with the Higher Education Act; ④ When especially necessary, the Minister of Information and Communication may advise the key telecommunication service operators to contribute to the institutes carrying out the business; ⑤ Only the research institute can use a name of an Electronics and Telecommunication Research Institute; and ⑥ Unless provided for in this act, the research institute should comply with the Civil Law for juridical foundation (Electronic Newspaper, 2012).

The budget required for the establishment and operation of the ICU was 101 billion won, and the government covered the construction cost of 45 billion won and reserve fund of 4 billion won using the Informatization Promotion Fund, and the operational fund of 40 billion won and the laboratory facility cost of 12 billion won was raised by major telecommunications service providers and private ICT companies participating in the establishment of the ICU in compliance with the revised "Framework Act on Telecommunications." The ICU operated three semesters for each academic year and integrated the master's and the doctoral course to train the best ICT talent (Electronic Newspaper, 2012).

"The Highly-Skilled ICT Professional Development Program" emphasized the support for ICT R&D personnel in graduate school. It purported to systematically organize ICT research capabilities in universities. The Information Technology Research Center (ITRC) program, the most representative one, aimed to develop core ICT technologies and highly-skilled ICT human resources by supporting R&D in universities. This program supported universities to cultivate ICT research talents to implement strategic R&D and to provide opportunities for graduate students to participate in the R&D process, and be trained as highly-qualified ICT research personnel. This program was initiated by appointing a total of 25 research centers in 2000, including eight research centers converted from the "Fund for Hiring Professors Fully in Charge of ICT Research" started in 1998, eight research centers converted from the "University S/W Research Center Support Program" started in 1999, as well as nine newly selected research centers.

All 16 research centers from the previous two programs were converted into ITRC. Initially, they were supposed to pass strict evaluations to be re-selected as ITRC. However, all 16 centers passed evaluations with a score higher than 80 (See <Table 4-2>). On the other hand, only nine research centers were newly selected for the ITRC out of a competitive pool of 33 applicants (NABO, 2006). The performances of ITRCs re-selected from previous two programs suggest that it was not wise to give the status of ITRCs to all the centers. Among the 16 re-selected centers, six centers were dropped by 2005, whereas 13 out of 61 ITRCs had been dissolved by 2005.

Table 4-2 | Status of the ITRCs as of 2006 , which were Converted from Pre-Existing Program without Competition in 2000

| | University | Core Area of Research | Evaluation Result | Remarks |
|---|---|---|---|---|
| Fund for Hiring Professors fully in charge of ICT Research | Korea Univ. | Next Generation Internet | 86.0 | |
| | Gwangju Institute of Science and Technology | Optical Communication | 93.4 | |
| | Chung-Ang Univ. | Digital Broadcasting | 82.6 | Dropped in 2001 |
| | Seoul National Univ. | Wireless Communication | 81.8 | |
| | KwangWoon Univ. | Wireless Communication | 87.8 | |
| | Kyungpook National Univ. | Wireless Communication | 87.2 | Dropped in 2003 |
| | Pusan National Univ. | Computer and Component | 82.8 | Dropped in 2002 |
| | KAIST | Computer and Component | 89.0 | |
| University S/W Research Center Support Program | Yeungnam Univ. | Next Generation Internet | 91.0 | Dropped in 2003 |
| | Soon Chun Hyang Univ. | Next Generation Internet | 80.6 | |
| | Pusan National Univ. | Wireless Communication | 83.6 | |
| | Ewha Women's Univ | SW technology | 91.4 | |
| | Inha Univ. | SW technology | 85.4 | |
| | Dongshin Univ. | SW technology | 83.4 | Dropped off in 2005 |
| | Chonbuk National Univ. | Computer and Component | 86.2 | Dropped off in 2002 |
| | Konkuk Univ. | Computer and Component | 83.4 | |

Source: MIC (2006), NABO (2006).

90% of research expenses, such as the direct research cost, wages, and cost for research facilities and equipment, for graduate students in the ITRCs were supported by government grants, while the remaining 10% was paid for by universities. 70% of fixed contributions for initial investment was covered by the government, and the remaining 30% was bored by matching funds from universities and industries. The ICT field of research can either be designated by the government or be freely chosen by the applicants. For the former, the top-down case, 0.8 billion won was provided annually for each selected center up to eight years, and for the latter, the bottom-up case, 0.5 billion won was offered annually for up to

six years for each selected center. All the ITRCs were subject to interim evaluations every two years, and the bottom 10~20% of the research centers were dropped from the program upon the interim evaluation results. Moreover, the size of annual research funds given to ITRCs are adjusted in line with the evaluation results. For balanced regional development, the universities in the Seoul Metropolitan area were not allowed to apply for the contest for ICT fields freely chosen by applicants (National Assembly Budget Office, 2006). <Table 4-3> compares the support areas, qualifications, selection methods, and the size of support for two contests.

Table 4-3 | Qualification, Selection Method and the Size of Budget of ITRC

| Classification | Contest for ICT Fields Designated by the Government | Contest for ICT Fields Freely Chosen by Applicants |
|---|---|---|
| Area | ICT and ICT convergence | ICT, ICT convergence, specialized local industry related with ICT |
| Qualification for Application | University with a graduate school and ICT department<br>- Participation of over 8 professors and over 40 graduate students in MA/Doctor's course | University with a graduate school and ICT department<br>- Participation of over 5 professors and over 20 graduate students in MA/Doctor's course |
| Selection Method | Research plan Evaluation | First: Preliminary plan evaluation (The size of applicants should exceed 2.5 times of the quota)<br>Second: Research plan evaluation |
| The Size of Budget | About 800 million won/year<br>Up to 8 years<br>(4 years is the maximum since '08) | About 500 million won/year<br>Up to 6 years<br>(4 years is the maximum since '08) |

Source: Information Technology Research Center Website http://itrc.or.kr.

The Korean government allocated a relatively large budget for ICT retraining from 1998 to 2002 amid the Asian Financial Crisis. Through a vigorous evaluation process, the government designated outstanding private training centers as the MIC ICT Academy and supported the purchase of ICT equipment and facilities. The government subsidized the costs of conversion training of highly-educated unemployed youth, to facilitate their inflow into ICT-related jobs with the objective of reducing the shortage of ICT workers as well as lowering the unemployment rate. Although direct training subsidies were given to the trainees, the program lowered the relative costs of ICT training, which increased the demand for ICT training. Hence, support was directed to private ICT training centers. Moreover, a voucher system was introduced. To the employed and the unemployed,

who were willing to enroll in ICT training courses provided by the MIC ICT Academy, vouchers were distributed. It led to competition among the MIC ICT Academies, which resulted in the consequent enhancement of quality of training. Still, a voucher system could cause the moral hazard problem, if students and MIC ICT Academies acted in collusion and decided to receive the government subsidies without actual training and split them for personal interests. Such cases have been actually reported. Thus, ICT training voucher program should be implemented with consideration of the possibility of extra costs for supervision. The training programs for hot ICT skills, of which demand had sharply increased, were consistently operated. As for the promotion of highly advanced hot ICT skills, the government provided subsidies to formal educational institutions to establish a specialized education program for in-demand ICT skills. And for relatively basic hot skills, government provided subsidies to private ICT training institutes. These training programs were implemented in line with unemployment insurance to minimize the burden of training costs for workers (Ko, 2011). Since the retraining program was considered to be an effective solution for unemployment during the Asian Financial Crisis, the project budget increased sharply in 1998 and 1999. However, since 2000, following economic recovery, the budget had declined back to pre-crisis levels.[3]

<Table 4-4> shows major details of the ICT retraining projects implemented in 1999. The largest portion of the budget was allocated for the "ICT Professional Skills Nurturing Program," which consisted of ICT conversion education, ICT education for international vendor certificate acquisition, multi-media contents education and SOHO business start-up education. The next largest part of the budget was invested in the "Specialized ICT Educational Institution Support Project" and, through this project, state-of-the-art ICT education facilities were supported as specialized ICT training institutes, including the Advanced Institute of Information Technology (AIIT) established in the Korea Agency for Digital Opportunities and Promotion (KADO), and the Institute of Information and Communication (IIC) established in the Korea Information and Communication Contractors Association (KICA).[4] The former provided high level retraining programs on SW, multi-media and GIS, while the latter offered practical training programs to broadband and LAN installers. In addition, International Joint SW Education Programs, the Overseas ICT Training Program for the workers in local ICT SMEs, the Foreign ICT specialists Utilization Support Program for ICT SMEs, the invitation of ICT workers from APT member countries for ICT training in Korea, and the invitation of Chinese Telecommunications Leaders were classified as retraining programs for implementation (MIC, 1999).

3. The budget for ICT retraining was 11 Billion Won in 1997, 51.4 Billion Won in 1998, 36.6 Billion Won in 1999 and 12.3 Billion Won in 2000 (Ko, et al., 2007a).

4. IIC was reestablished as the Korea Information&Communication Polytechnic College (ICPC) in 2002.

Table 4-4 | Contents of ICT Retraining Project in 1999

| Classification | Project in Detail | Budget (won) |
|---|---|---|
| ICT Professional Skills Nurturing Program | - ICT conversion education, ICT Education for International Vendor Certificate Acquisition, multi-media content education and SOHO business start-up education for the highly educated unemployed | 15 billion |
| Specialized ICT Training Support Program | - Support of state-of-the-art ICT education facilities specialized in ICT educational institutions such as AIIT and IIC | 7.1 billion |
| International Joint SW Education Program | - Support of the introduction of SW education curriculum from prominent overseas university to nurture globally competitive SW skills | 3 billion |
| ICT Overseas Training | - Support of workers at ICT SMEs, professors at vocational colleges, and teachers at vocational high schools to experience overseas training to nurture up-to-date knowledge | 1 billion |
| Foreign ICT Specialist Utilization Support Program | - Support of the employment of foreign ICT specialists by domestic SMEs<br>- Inviting ICT specialists from advanced ICT nations to support the propagation of up-to-date ICT technologies in Korea | 1 billion |
| Invitation of ICT Workers in APT Member Countries for ICT Training in Korea | - Provide all-expense-paid ICT training courses in Korea for ICT workers in APT member countries | 700 million |
| Invitation of Chinese Communication Next-generation Leaders | - Provide Chinese leaders in telecommunication opportunities to enroll in master's and doctorate program in Korean ICT graduate schools | 400 million |

Source: MIC (1999).

The potential ICT HRD project was to provide ICT education to new generations, females, soldiers, the underprivileged and juveniles. Through this project, ICT education facilities were expanded and education costs were subsidized to allow access to computers and the internet. The support for young talent with ICT skills was included in the potential HRD project for the convenience of classification. <Table 4-5> shows major contents of the potential HRD project in 1999.

Table 4-5 | Content of Potential HRD Project in 1999

| Classification | Project in Details | Budget |
|---|---|---|
| Support for the ICT Skill-gifted Young Talents | - Host a computer creativity contest to discover gifted young ICT talent, provide ICT education for ICT skill-gifted ICT young talents | 700 million won |
| Informatization Education Support for the Disabled | - Informatization education is provided for the disabled to promote the social participation via internet and to enhance their ability to adopt to the informatization age | 2 billion won |
| Informatization Education Support for the Females | - Provide informatization education for females to promote the social participation of female labor force<br>- Support the special educational institutions for women operated by "Girl Scout of Korea" and "Central Women's Association" | 2 billion won |
| Information and Communication Education for Soldiers | - Provide information and communication education to young soldiers to equip them with digital knowledge required for the modern war | 2 billion won |

Source: MIC (1999).

The budget for the ICT infrastructure building stage was allocated to five items – equipment and facilities expenses, research expenses (including scholarships for master's and doctoral programs), education/training support expenses, faculty expenses and miscellaneous costs. It showed that more than 50% of the expense for the HRD program was invested in supporting equipment and facilities (See <Table 4-6>). In most of cases, the facilities and equipment expenses and the research expenses arose from supporting formal educational institutions, and the rest of expenses arose from supporting remaining institutes and individuals. It seemed appropriate that the ICT HRD program emphasized support for formal educational institutions during the ICT infrastructure building stage. Nevertheless, overlaps between projects of different government organizations could not be ruled out and the specialization of specific ICT sectors could not be implemented at this stage, and would be delayed until the next stage (Ko, 2002).

Table 4-6 | ICT HRD Program Budget by Item (1997~2000)

| Item | Size of Budget | Percent |
|---|---|---|
| Equipment and Facilities Expense | 19.61 billion won | 54.5% |
| Research Expense | 48.3 billion won | 13.4% |
| Training Expense | 88.9 billion won | 24.7% |
| Faculty Expense | 9.8 billion won | 2.7% |
| Others | 16.8 billion won | 4.7% |
| Total | 35.99 billion won | 100% |

Source: Ko (2002).

## 2. ICT HRD Policy of Quantitative Expansion Period (2001 ~2003)

From the period of 2001 to 2004, major companies in Korea including Samsung Electronics raised their global market share and strengthened global competitiveness in the ICT industry. In order to reinforce the trend, the government implemented a quantitative expansion policy in the enrollment of ICT-related departments at universities. A study found out that there would be a shortage of approximately 99,000 ICT professionals from 2002 to 2006, which acted as the impetus for designing these policies (Kwon et al., 2001a). One of major policies in this period was the expansion of enrollment for ICT major fields in universities. The MIC supported the purchasing cost of ICT equipment and facilities at formal educational institutions including universities, if they increased the enrollment quota for ICT major fields.

Since the MIC did not have the authority to adjust the enrollment quota for universities, it provided a financial incentive. By establishing an ICT bachelor program at ICU, the MIC was able to expand the enrollment quota for ICT-related major fields directly. ICU established a graduate school of software in 2001 and two undergraduate schools, the school of engineering and the school of ICT business in 2002. <Table 4-8> demonstrates the expansion of the enrollment quota in ICT-related major fields between 2001 and 2003. For three years, the enrollment quota was expanded by approximately 15,000, including 2,000 in graduate schools.

Table 4-7 | ICT HRD Policies of Quantitative Expansion Period (2001~2003)

| Policy Objective | Quantitative Expansion of ICT Human Resources |
|---|---|
| Policy Measure | • Expansion of the enrollment quota for the ICT major fields<br>• Establishment undergraduate schools at ICU(2002)<br>• The support for ITRC was increased<br>• Connecting all the schools with broadband<br>• Retraining program for Hot ICT skills<br>• ICT conversion training for non-ICT workers and the unemployed<br>• Internet Education for All Initiative |
| Success Factor | Harmonization of informatization promotion strategies, ICT industry development strategies and ICT HRD policies |
| Implemented by | MIC |
| Limitation | Expansion of uncertainties and polarization of the ICT industry amid the collapse of global ICT bubble |
| Achievement | • Alleviation of the ICT human resource supply insufficiency<br>• Smooth implementation of ICT new growth engine development policy<br>• Strengthening of the interrelation between ICT R&D policies and HRD policies |

Source: Reconstructed from Ko et al.(2012a) and Ko et al., (2012b).

Table 4-8 | Enrolment Expansion of ICT Majors during Quantitative Expansion Period

(Unit: Person)

| The Increase in Enrolment Quota | 2001 | 2002 | 2003 | Total |
|---|---|---|---|---|
| Graduate School | 1,044 | 991 | 24 | 2,059 |
| Undergraduate School | 3,211 | 4,242 | 263 | 7,716 |
| Vocational College | 4,163 | 855 | - | 5,018 |
| Sub-Total | 8,418 | 6,088 | 287 | 14,793 |

Source: Internal data of NIPA.

<Table 4-9> shows budgets of the ICT HRD program from 1997 to 2001. The budget of the ICT HRD program increased abruptly to 43.11 billion won in 2001 and decreased to 25.56 billion won in 2002. This was because the IMT-2000 licensee was selected in 2000 and the payment of the spectrum allocation was contributed to the Informatization Promotion Fund. According to the paragraph 1, Article 11 of the Radio Waves Acts, it states that "When any noticed frequency falls under one of the following pursuant to the provisions

of Section 1, Article 10, the Minister of Information and Communication may receive the price of frequency assignment as contribution for such an assignment; i) If it is recognized that economic value and technical impact of such frequency is great; ii) If it is recognized that such frequency is in competitive demand; iii) Otherwise, if it is recognized that such frequency is required for radio promotion". Moreover, in the paragraph 2, Article 11, it states that "Any contribution paid by any person who obtained frequency assignment pursuant to the provisions of Section 1 shall revert to the revenue of Informatization Promotion Fund under the provisions of Article 33, the Basic Informatization Promotion Act."

Since payment for the spectrum allocation was a major financial source for the Informatization Promotion Fund, the fund was more likely to increase during a year when there was a spectrum allocation. It might be reasonable to assume that the establishment of the ICU was an efficient way of spending the drastically increased budget.

Table 4-9 | ICT HRD Program Budget (1997~2002)

(Unit: 100 Million Won)

| Classification | 97 | 98 | 99 | 00 | 01 | 02 | 03 |
|---|---|---|---|---|---|---|---|
| Undergraduate | 464 | 547 | 400 | 379 | 2,026 | 805 | 856 |
| Graduate school | - | 65 | 198 | 130 | 437 | 410 | 772 |
| Retraining | 88 | 294 | 115 | 52 | 630 | 617 | 131 |
| Underprivileged | - | 105 | 117 | 129 | 1,218 | 724 | 50 |
| Total | 552 | 1,010 | 830 | 690 | 4,311 | 2,556 | 1,809 |

Source: Internal Data of NIPA.

<Table 4-10> shows budgets of the ICT HRD program between 2001 and 2002. A project for the employment of ICT specialists as faculty members was to promote the utilization of ICT specialists such as visiting professors, adjunct professors and teaching assistants (MIC, 2002). Moreover, the development of curriculum for ICT cyber universities was also supported. The ICT Cyber University was operated with participation of 25 universities and it offered accredited college credit courses. From 2000 to 2002, more than 8,000 students took 48 courses.

Table 4-10 | ICT HRD Program Budget (2001, 2002)

(Unit: 1 Million Won)

| Classification | Project Name | Project in Details | 2001 budget | 2002 budget |
|---|---|---|---|---|
| Basic Technical Human Resource Development | Expansion of faculty members | Employment of domestic/foreign ICT specialists as faculty members | 9,000 | 9,000 |
| | Expansion of educational ICT facilities and equipment | Support of facilities and equipment to ICT-related departments | 45,000 | 60,000 |
| | | Establishment of undergraduate School at ICU and its operating cost | 110,000 | 5,000 |
| | | Support of the ICT model schools | 26,800 | - |
| Specialized Technical Human Resource Development | Development of high skilled/research human resources | Promotion of the establishment of university ICT research center | 13,000 | 14,200 |
| | | Support for the ICU (BK21 project) | 11,300 | 1,400 |
| | | Nurturing of top quality human resources in wireless communication | - | 3,000 |
| | | Establishment of a digital media research center | 15,000 | 3,000 |
| | | Activation of cyber education information and communication | 1,500 | 1,500 |
| | | Expansion of graduate school programs in S/W process and S/W engineering | - | 2,000 |
| | | JAVA Professional | 4,000 | - |
| | Development of global ICT specialists | ICT training in Overseas for undergraduate students | 800 | 7,000 |
| | | ICT overseas scholarship program | 1,000 | 6,600 |
| | | Korea Stanford venture business education | 1,000 | 800 |
| | | Korea ¸Carnegie Mellon S/W human resource education | 1,200 | 1,400 |
| | | ICT training in overseas for public officers | 50 | 1,000 |
| | | Global ICT human resource exchange | 1,850 | 2,500 |

| Classification | Project Name | Project in Details | 2001 budget | 2002 budget |
|---|---|---|---|---|
| Industrial Human Resource Re-education | General ICT education | ICT education and MIC ICT Academy support | 45,000 | 11,000 |
| | Development of specialists for specific ICT sectors | Broadband Infrastructure Rollout | 2,100 | 2,300 |
| | | IT SoC | 800 | 800 |
| | | RF design | 1,200 | 1,200 |
| | | Wireless internet | 300 | 1,600 |
| | | Geographical Information System | 800 | 2,500 |
| | | Information Security Professionals | 2,247 | 2,200 |
| | | Venture CEO | 1,500 | 1,400 |
| | | Digital content technology | 1,291 | 1,000 |
| | | Online games | 2,000 | 1,000 |
| | Support of informatization of traditional industries | Informatization of 30,000 small businesses (MOCIE) | 21,000 | 43,000 |
| | | Networking of small businesses | 25,800 | 5,000 |
| Potential Human Resource Training | Nurturing of ICT talents | Computer creativity contest, etc | 1,300 | 700 |
| | | Training of elementary/middle/high school teachers for informatization | 200 | 300 |
| | | Development of human resources for the future electronics industry | - | 400 |
| | Resolving an Digital divide | Underprivileged youth informatization education | 6,700 | 6,200 |
| | | Public informatization education for the disabled, seniors and females | 22,313 | 15,013 |
| | | Informatization education for the middle aged | 3,350 | - |
| | | Support of informatization education provided by other government organizations | 44,414 | 36,757 |
| | Establishment of the institutional foundation | Supply and demand investigation and achievement analysis, etc | 4,603 | 900 |
| Working Expense | | | 2,700 | 3,902 |
| Total | | | 431,118 | 255,572 |

Source: MIC (2002).

The Digital Media Lab Project supported the operation of master's and doctoral degree programs in digital media, in which students can directly participate in creative research projects, research on the field of digital media regarding ubiquitous computing, multimedia processing, HCI, and Digital Expression, and conduct joint research with prominent research centers overseas, including Massachusetts Institute of Technology. This project was initiated in early 2001 for the establishment of Media Lab Asia, introducing the research model of MIN Media Lab, with a budget of 15 billion won allocated. However, in January 2002, during the negotiation with MIT about conditions of 10 million-worth cooperation in human resources exchanges, joint research, etc. for 3 years, some argued that the conditions offered by MIT was much unfavorable than those offered to the Media Lab Europe and the negotiation broke down. In the end, the Digital Media Lab was established at the ICU as an independent body with no collaboration with MIT (NABO, 2006).

A re-education program for incumbent ICT human resources through collaboration with prominent educational institutes abroad was designed as well. With joint projects with Stanford University, USA, education courses for venture businesses, including lectures on foundations and the management of start-ups, were offered to train specialists on ICT businesses. Entrepreneurs, venture capitalists and ICT practitioners were the targets of this project. Education courses that were necessary to establish and operate venture companies such as venture capital, business establishment, the internet business was provided. In addition, enhanced software professional education courses were offered for professors, project leaders, engineers and software consultants through the software specialist education collaboration project with Carnegie Mellon University, USA.

Also, programs in line with international activities, mainly in the form of dispatching ICT human resources to overseas countries for work or study, were pursued in order to acquire advanced technologies and to train research human resources. For example, there were projects supporting the dispatch of undergraduate and graduate students to prominent ICT educational institutes abroad, in order to train local ICT specialists to acquire business skills and an international mindset, and the international studies support project to encourage outstanding domestic ICT talents to acquire a master's degree and/or a doctoral degree at prominent educational institutes overseas.

The ICT HRD retraining program designated outstanding private ICT training institutions as the MIC ICT Academy to train ICT human resources equipped with hot skills such as IT SoC (System on Chip), RF (Radio Frequency), wireless Internet, GIS (Geographical Information System), information protection, digital content and game. In addition, the project to promote the building of a network for small businesses and the informatization of SMEs was implemented. The facilities and equipment, and ICT education costs for the highly-educated unemployed youth was subsidized to designated MIC ICT

academies. The small business network project was designed to promote informatization of small businesses and the self-employed. It aimed to provide essential ICT services and specialized ICT services by industry and business to small business owners and the self-employed at affordable prices. The success of this project lies on the development and implementation of BM to reflect the characteristics of various small industries and business conditions of the self-employed. Small businesses and the self-employed, including beauty salons, restaurants and pharmacies, could gain benefits from this project, but the actual number of small businesses and the self-employed receiving the benefits was far less than its target. The Ministry of Information and Communication had aimed to provide benefits of this project to 156,000 of small businesses and the self-employed in 2002, and 300,000 in 2003, but the number had barely reached 200,000 by April 2004. Also, in the case of the educational project, moral hazard problems of the MIC ICT Academies, which had received educational subsidies from the government without providing education courses due to insufficient supervision of the project, were observed (Electronic Newspaper, 2003.4.17.).

During this period, "10 million informatization education plan," which was developed at the Cabinet meeting in June 2000, was implemented. 10 government organizations including the Ministry of Information and Communication had worked together from 2000 to 2002 to provide informatization education to more than 10 million people, of the informatization absent class and the informatization leading class, to bridge the digital divide. The targeted number of people subject to the education was 11.13 million, or more than 20% of the total population of Korea at that time. More than 50% consisted of housewives, local residents and workers. Also, 3.6 million students were subject to the education, which made students the largest target group. In addition, the targeted number of people subject to informatization education was set for various social groups including the disabled, farmers, senior citizens, prisoners, soldiers, teachers and employees and executives of public corporations.

By June 2002, more than 1.38 million people, or more than 25% of the total population, received the informatization education, which consequently enhanced the information capabilities of the public.

## 3. ICT HRD Policy in Horizontal Linkage Strengthening Period (2004~2007)

Many colleges and universities increased the quota of ICT-related majors during the ICT infrastructure building period and quantitative expansion period, with studies suggesting an oversupply of ICT human resources. According to the study conducted by KRIVET in 2004, it was estimated that there would be an oversupply (15,226) of ICT professionals with a bachelor's degree or lower, and a shortage (5,000) of ICT professionals with a master's degree or higher until 2010.

In addition, although university level ICT education focused on theoretical basic courses, companies were in demand of demanding job applicants with practical business capabilities corresponding to rapidly evolving ICT technology. From a business perspective, it was a period when there was an increase in demand for highly-skilled human resources with problem solving capabilities, so that they could create high value-added products. Reflecting such changes, the government had shifted the focus of ICT HRD policies from training undergraduates to graduate or advanced-level students. With an oversupply of middle- or low-level workers, steps such as the abolition of academic departments or reduction in the number of students needed to be taken. In order to meet the demand from industry and resolve the qualitative mismatch problem, the ICT HRD program was conducted with three major policy areas: demand-oriented ICT HRD, high-quality ICT professionals with global competitiveness, and ICT-specialized education and systematic infrastructure building since 2004. Previous policies were focused in the area of comprehensive, highly-skilled ICT professionals, industrial development, and the potential ICT HRD. With such changes, the paradigm of ICT HRD policies changed from supply-oriented to demand-oriented, quantitative to qualitative, domestic-oriented to global-oriented, and metropolitan area-focused to balanced regional development-focused (Ko et al., 2012b).

Table 4-11 | ICT HRD Policy of Horizontal Linkage Strengthening Period (2004~2007)

| Policy Goals | Improvement in Quality of ICT Human Resource |
|---|---|
| Policy Tools | • SCM model operation and engineering education certification<br>• ICT specialized education<br>• IT SoC HRD project<br>• Blue Ocean type HRD project<br>• Nurturing EXcellent engineers in information Technology (NEXT) |
| Success Factor | Harmony in IT 839 strategy and ICT HRD policy |
| Implemented by | Ministry of Information and Communication,<br>Ministry of Knowledge Economy |
| Limitation | Saturation of wireless and cable communication market and slowdown in growth rate of information and communication industry |
| Achievements, Impact | • Paradigm Shift of ICT HRD policy from quantitative expansion, supply-centered, and domestic-oriented from improvement in quality, demand-centered, and global-oriented<br>• Balanced Regional Growth is reflected in ICT HRD Policy |

Source: Reconstructed from Ko et al.(2012a) and Ko et al., (2012b).

Table 4-12 | Unit and Sub Unit Project of ICT HRD Policy Revised in 2004

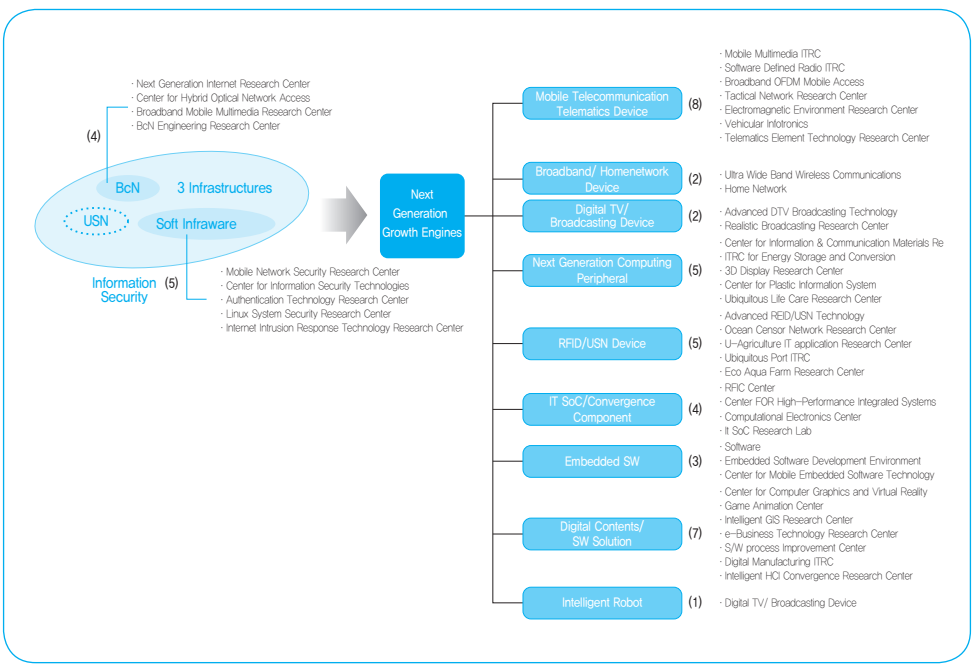
| | Unit Project | Sub Unit Project |
|---|---|---|
| ICT HRD Program | Support for Better Educational Conditions in ICT related University Program | Strengthening Competitiveness of ICT Education in University |
| | | Invitation of Foreign Faculty |
| | | Support for Better Educational Conditions of ICU |
| | | Strengthening of Education in the field of Radio Wave at University Level |
| | Building an Institutional Framework for ICT HRD | Construction of Statistical System for ICT Labor Market and ICT Education |
| | Highly-Skilled ICT Research Personnel Nurturing | Support of ITRC |
| | | Support for Digital Media Lab |
| | | IT SoC Core Design Professional Nurturing Program |
| | Global ICT Talents Nurturing | Support for Global ICT Talents Utilization |
| | Support for Specialized Technology Education in ICT | Support for ICT R&D Personnel engaged in Commercialization |
| | | Nurturing ICT Human Resource for Broadband Infrastructure |
| | | Blue Ocean Type ICT Professional Skills Nurturing |
| | | Construction of ICT Manpower Support System |
| | | Digital Broadcasting Technology Professional Manpower Nurturing |
| | Small&Medium ICT Venture Company Manpower Support | Support Small&Medium ICT Business Manpower |

Source: NABO (2006).

In 2004, the IT 839 strategy was established and promoted. The IT 839 strategy was based on the concept of the ICT industry value chain, and its objective was to establish a virtuous circle in the ICT industry and to achieve co-growth of all industries by forming organic relations among eight services, three infrastructures, and nine new growth engines. Namely, it aimed to improve the competitiveness of the entire ICT industry by constructing a virtuous circle where the government opens a new initial service market through policy tools such as business licensing, decision on service method, standardization, promotion of pilot projects, and then has service providers invest in infrastructure, and finally develops various products and solutions based on the infrastructure (Min, 2006).

ICT HRD policy from 2004 to 2007 focused on nurturing high-quality human resources for the successful promotion of the IT 839 strategy. First of all, previous ITRCs were revised to be closely linked to the technology development roadmap of the "IT 839 strategy." And the relations with the IT 839 strategy were reflected in the selection of new ITRCs. In order to secure the efficiency of ITRC business, an industry-academy human resource exchange system was mandated in addition to regulation that granted incentives to the center with outstanding co-research performance from cooperation between industry, academy, and research centers. Its objective was to accelerate the commercialization of developed technologies, and to find out and resolve the problems facing the industry. The number of ITRCs increased from 32 in 2002 to 50 in 2007, and most of these centers were in association with three infrastructures or nine new growth engines in the IT 839 strategy. [Figure 4-1] illustrates the mapping between 50 ITRCs in 2007 and strategic products of the IT 839. It was presented in the order of eight ITRCs associated with mobile communications/telematics devices, seven with digital content/SW solutions, five with computing and peripherals of the next generation, five with RFID/USN devices, five with information protection, four with BCN, four with IT SoC/Convergence parts, and others (Ko et al., 2007a).

**Figure 4-1 |** Mapping between IT 839 and ITRC




Source: Ko et al. (2007a).

IT SoC core design professionals nurturing projects relating to the IT 839 strategy began in 2004. This project was initiated to address the structural problems within the IT SoC sector and accelerate the localization of IT SoC products. This project was a case of prompt response of the government to the demand of IT SoC companies. Most of correspondence to changes in the labor market, such as an increase in demand for semiconductor design professionals with the improved competitiveness of the non-memory semiconductor sector in Korea. It was promoted with the goal of nurturing leading professional skills in SoC design with system technology for each application fields, including mobile communications, DTV, and semiconductor design technology. The achievements of the project included the implementation of an IT SoC major certification program, construction of the IT SoC academic infrastructure, practical business education for IT SoC industries, support for IT SoC development practice projects, the establishment of an industry committee, and the promotion of the project. <Table 4-13> illustrates detailed contents of the IT SoC project (NABO, 2006).

**Table 4-13 |** Detailed Content of IT SoC Core Design Professional Nurturing Project

| Performance | Detailed Contents of Project | | |
|---|---|---|---|
| IT SoC Core Design Manpower Nurturing | Running IT SoC major certification | | |
| | Opening advanced course on IT SoC design | | |
| Practical Business Manpower Nurturing for Industries | Middle&Long-Term Education | | Education period of over 5 days |
| | Short-Term Education | Short-term Design Education | Education period of under 5 days |
| | | Design Tool Education | EDA Tool Education |
| | | Industry-Customized Education | Opening of courses requested by industries |
| | Course on Engineering Knowledge | | Invitation lecture by professionals in related field |
| Construction of IT SoC Education Infrastructure | Support the construction of SoC design practice environment | | |
| | Construction and operation of IT SoC management system | | |
| | Development of lecture contents for IT SoC major certification | | |
| | Running regional campus of IT SoC academy | | |
| | Development and running of platform for education | | |

| Performance | Detailed Contents of Project |
|---|---|
| Support IT SoC Development Practice Project | • Strengthening research and practice activities to attract major certification participating students to participate in major/design practice and industry-academy cooperation project<br>• Strengthening of design tool and MPW support to attract development practice project participating students to acquire IP design and chip manufacturing experience |
| Running Committee and Public Relations on Project | • Hold development consulting committee, education committee, business briefing, and others to establish development direction of promoting project and enhance the project performance<br>• Running company sponsorship system for education in close contact with the industries<br>• Hold IT SoC industry exhibition, conference, and Job-Fair |

Source: MIC (2006).

The colleges participating in the IT SoC major certification program performed SoC research through the development practice project, by developing an IT SoC design technology, which was highly demanded in industries with a RFP. They went through practice processes in order to acquire IP design and chip manufacturing experience. The education and practice of IT SoC core design skills consisted of taking courses for IT SoC major certification and advanced courses on design. And specialists with knowledge and experience in the field were nurtured through this project (NABO, 2006).

Also, the supply chain management model introduced in 2003 was executed at full scale during this period. The Supply chain management (SCM) refers to a system, which figures out the flow of distribution from parts providers to producers, distributors, and customers on a value chain and supports the smooth flow of necessary information. Companies can estimate the demand for the product through the supply chain management and accordingly a procurement plan and production plan for the product can be established. A company determines how many products it can manufacture within a given period, sets up the stock level of raw materials, determines where to store completed products, and determines transportation methods to be used for product delivery by adopting the supply chain system (Wikipedia, 2013).

"The essence of the SCM model is the creation of a systematic mechanism in which, industries provide the skill requirements on human resources to regular educational institutions, and in turn, such skill requirements are properly reflected to educational curricula. Subsequently, industries hire, on a priority basis, human resources trained in conformity with those requirements. The SCM model was reinforced to the NEXT in 2006 (Ko, 2011b: pp 155)."

In 2004, the Hanium site, an E2B (Education to Business) site, which connects companies, opened to the public. Hanium supported a team-up of industry experts, college students, and college professors to conduct projects proposed by companies based on the mentoring system (Ministry of Information&Communication, 2007) as an integrated online network for demand&supply. Hanium is a pure Korean word meaning "connect as one" as it is a compound word of "Han", which means "one" and "Ium", which means "connection". Currently, it is used to represent the nurturing of ICT human resources, which connects colleges with companies. In regards to the Hanium mentoring project still under progress, 3,000 experts affiliated with 1,700 domestic ICT companies are currently participating as ICT mentors, and about 20,000 practical business manpower was estimated to have been nurtured through participation in the knowledge sharing by ICT mentors. Students could enhance their practical business skills that meet the changes of ICT technologies, while businesses can have a chance to hire outstanding manpower and reduce the re-education costs of employees. Also, the project could spread a social trend of knowledge sharing.

The project, introduced when the attempts to adjust engineering education to meet the demand of companies, were made, was carried out with the aim to strengthen the competitiveness of Korea's college ICT education. This project was combined with the Nuturing EXcellent engineers in information Technology (NEXT) project, running on the SCM model, and engineering education certification. NEXT, introduced in 2006, was a project to improve education environment, in which colleges analyze their competitiveness, set up education quality improvement plans, conduct revision of curricula, expand internship programs and professor employment, etc. It was a project in which colleges can decide the field they deem necessary of support and therefore is considered a more advanced government support system (Ko, 2011b). ICT human nurturing SCM model of the MIC was promoted in connection with a policy task of the "enhancement in industrial site suitability of college education" on the National Human Resources Development (NHRD) Basic Plan of the Ministry of Education and Human Resources Development. The background for the promotion of the SCM project was the deficiency in industry-academy cooperation for ICT manpower nurturing, lack of site suitability of college education, and lack of demand-oriented ICT major education that meets the global standard. It was examined that ICT field major credits declined from 84 credits in 2002 to 66 credits in 2003 and companies still spent more than 10 million won per person for re-education of new employees for two years or longer. Also, according to global competitiveness index of the IMD, the global ranking of industry&academy cooperation related index was revealed to be low presenting 19th for company/college cooperation in 2001 and 17$^{th}$ for knowledge transfer between industry and academy in 2002. Therefore, the main focus was set on not only the construction of a demand-oriented education system through expansion in the manpower nurturing SCM model, but also the settlement and expansion of global-level engineering education certification (Ko, 2007a).

The Engineering Education Accreditation System proposes the criteria and guidelines of engineering education programs in order to promote the development of engineering education, as well as to produce international ICT manpower. It also provides consultations on the achievement of educational goals per major, while advising evaluation and accreditation on the study performances of each graduate. In regards to the engineering field, the Washington Accord has been in operation by countries like the U.S., U.K., and Japan since 1989, in order to recognize the importance of global equivalence in accrediting engineering education. Korea became an associate member of the Washington Accord in 2006, and a regular member in 2007. However, due to the ICT field having been classified as natural sciences and with its root of computer science having a short academic history, the existing engineering education accreditation system was inapplicable, thereby raising the need for a new accreditation system. Accordingly, Korea took the lead in an international standard for engineering education in the ICT field, while proposing the necessity of exchanging ICT manpower among countries, hence officially enforcing the Seoul Accord in December 2008.

The Seoul Accord enabled four-year university graduates in computer and ICT related majors to freely obtain jobs within the member countries gaining equal recognition. The Seoul Accord substantially promoted international mobility of computer and ICT-related manpower in the long-term, reflected the industry demands in the Korean universities' ICT major curriculum, and nurtured ICT manpower to satisfy industry demand. Also, with some companies preferentially recruiting ICT professionals from the Seoul Accord member universities, it is evaluated that a virtuous circle has been established by raising both the quality of education and the recruitment opportunities for university graduates. <Table 4-14> lists the Seoul Accord member countries, and <Table 4-15> lists the companies that grant benefits to the graduates of the Seoul Accord member universities.

Table 4-14 | The Seoul Accord Member Countries&the Accreditation Boards

| Members | Accreditation Boards | Year of Admission |
|---|---|---|
| Korea | ABEEK (Accreditation Board for Engineering Education of Korea) | 2008 |
| U.S. | ABET (Accreditation Board for Engineering and Technology) | 2008 |
| Japan | JABEE (Japan Accreditation Board for Engineering Education) | 2008 |
| U.K. | BCS (the British Computer Society) | 2008 |
| Canada | CIPS (Canadian Information Processing Society) | 2008 |
| Australia | ACS (Australian Computer Society) | 2008 |
| Taiwan | IEET (Institute of Engineering Education Taiwan) | 2009 |
| Hong Kong | HKIE (The Hong Kong Institution of Engineers) | 2009 |

Source: Hanium Webpage, http://www.hanium.or.kr/portal/index.do.

Table 4-15 | Companies Granting Benefits to the Graduates of the Seoul Accord Member Universities

| Launch | Company Name | Benefits to Accredited Graduates |
|---|---|---|
| 2005 | AhnLab, Inc. | Preference in document screening |
| 2006 | Samsung Electronics | 10% additional points in interview screening |
| 2007 | LG-Nortel | 10% additional points |
| | 16 Affiliates of Samsung Corporation | 10% additional points |
| 2008 | NHN | Preference in document screening |
| 2009 | KT and SK Communications | Preference in document screening |
| 2010 | KVBA, SK Telecom, Onse Telecom, Seoul Semiconductor, Seoul Opto Device, Kaon Media, Wins Technet | Preference in document screening |
| | Running Seoul Subway Line 9, Incruit | Acquisition of accreditation noted in the resume |
| | Bit Computer | 10% additional points in interview |
| | Dreamwiz, Montista Telecom, Insung Information and 5 Affiliates | 10% additional points in document |
| | Shinsegae E&C | Additional points in document |
| | Seoul Commtech | 5% additional points in document screening |
| 2011 | STX Group | Preference in document screening |

Source: Hanium Webpage, http://www.hanium.or.kr/portal/index.do.

Another project that was promoted in the practical business reinforcement period was the Blue Ocean ICT Professionals Project, introduced in 2006. Designed as a specialized education program targeting experienced workers in the ICT industry, it was launched jointly by industry and academia with the purpose of nurturing manpower for the continuous growth of the ICT field. In the case of Korea University, ICT professionals were supported to acquire a dual master's degree with the Georgia Institute of Technology for the first time in Korea through this project. The significance of this project lies in providing opportunities for experienced workers in R&D to grow further through project experience and new technology education. For an experienced worker-oriented education, this program offers a trimester system, and after completing a one-year curriculum and a six-month project

work, the students are able to graduate in 18 months. However, while the original purpose of the project was to secure the competitiveness of SMEs through the improvement in the competencies of experienced workers in SMEs, some side effects have occurred with some of the students resigning from SMEs and transferring to large companies upon the completion of the program.

Table 4-16 | The Curriculum Situation of the Blue Ocean ICT Professionals Project

| Area | Universities | Curriculum |
|---|---|---|
| Embedded S/W | Korea University | - Embedded software education center<br>- Acquisition of a dual engineering master's degree (MSCS)<br>(Acquisition of master's degree from Korea University and Georgia Institute of Technology, respectively)<br>- A joint curriculum with faculty members of Georgia Institute of Technology<br>- 1 year course work + specialized project (about 1 semester) |
| Mobile Communication | Sungkyunkwan University | - Mobile communication education center<br>- Acquisition of engineering master's degree from Sungkyunkwan University<br>- A curriculum jointly developed by the domestic industry and academia<br>- 1 year course work + specialized project (about 1 semester) |
| Network-Based Intelligent Robot | Hanyang University Consortium | - Network-based intelligent robot education center<br>- A curriculum run by Hanyang University, KAIST, and POSTECH consortium<br>- Acquisition of an engineering master's degree from the university entered(among 3)<br>- 1 year course work + specialized project (about 1 semester) |

Source: Internal data of National ICT Industry Promotion Agency.

The fact that the re-education of ICT manpower was advanced in the practical business reinforcement period could be seen from the promotion of the Blue Ocean ICT Professionals Nurturing Project. Even though the technology life span of research personnel was shortened due to the acceleration of changes in the ICT technologies, most companies lacked the infrastructure for re-education. Hence, re-education was promoted targeting the SMEs' research personnel by utilizing regional ITRC infrastructure. There were 1,200 employees for re-education in 2005, and since 2006, re-education for more than 30 SME

researchers per ICT research center was promoted. The significance of this project lies in having expanded the functions of the ITRC. Together with the function to nurture manpower to lead the national R&D strategy based on interdisciplinary convergence as well as the function to accelerate the commercialization of research performance of universities through the industry-academy-research cooperation, it added the function of assigning research resources of universities for technology innovation in SMEs.

## 4. ICT HRD Policy in ICT Professional Skills Deepening Period (2008~Present)

The Lee Myung-Bak administration dissolved the Ministry of Information & Communication in 2008, newly establishing the Ministry of Knowledge Economy, Ministry of Security&Public Administration, and the Korea Communications Commission to promote the ICT industry policy, information-oriented policy, and competitiveness policy, respectively. The reformation of duties in such government ministries was promoted under the premise that they would respond more flexibly to new changes, including the increase in demand for policies corresponding to the convergence acceleration between ICT and other industries, advancement in the convergence of broadcasting and communications, and information-oriented adverse effects. Based on such reformation, the ICT manpower nurturing policy was to be promoted under the authority of the Ministry of Knowledge Economy. Although the Korea Communications Commission and the Ministry of Culture, Sports, and Tourism both played their parts, the Ministry of Knowledge Economy was the authority in charge of the ICT manpower policy.

The Ministry of Knowledge Economy, which was responsible for devices and software, established the "New ICT Strategy," announced in July 2008. This was to be a new growth engine of the ICT industry, which had slowed down in recent years, expanding ways in which the benefits of ICT skills can benefit all industries. The New ICT Strategy had a goal of creating 10 ICT convergence industries worth 1 trillion won domestically, as well as fostering 1,000 ICT companies with sales of 50 billion won and 10 global SW companies. Furthermore, it had the goal of increasing the number of ICT industries up to 23,000 and ICT industry employees up to 910,000. While the previous ICT policy focused on the nurturing of the ICT industry itself, the New ICT strategy set basic directions to strengthen the competitiveness through the convergence of the advanced ICT industry and traditional industries. For the continuous growth of the ICT industry, the strategy sought growth outside of ICT, including in manufacturing and services, while emphasizing the role of ICT in resolving economic and social issues, including high oil prices and Korea's aging society. It was a strategy to preoccupy new markets for the future by discovering

demands for the ICT industry, which was showing a decrease in its growth rate, thereby launching Korea's future into a new realm ahead of other countries. Accordingly, there was an increase in the convergence ICT manpower nurturing project, especially with the emphasis on convergence of ICT with other industries.

Due to the sub-prime mortgage crisis in 2009, the world economy entered into a recession, and Korea, who was leading the growth in hardware, had to go through a difficult period due to the introduction of the iPhone in 2010, not being sufficiently prepared for a meteoric rise in the popularity of smart phones. Although LG Electronics had increased its world market share in the 3G market with its feature phones, the market share dramatically fell, not being able to promptly respond to the introduction of smart phones. Finland suffered a decrease in its economic growth rate, especially with the decline of Nokia, which had been unrivaled in the mobile phone market up until the introduction of the iPhone. Fortunately, Korea's status as a leading country in up-to-date ICT device manufacturing was not tarnished, thanks to Samsung Electronics performing well in the smart phone market. Experiencing the iPhone-shock, the ICT HRD program naturally changed from being government- to private-oriented, in order to respond swiftly to the changing ICT market environment. The platform, on which universities and industries could freely meet and cooperate, was expanded, and companies became key players in manpower nurturing, instead of simply waiting for the manpower to be supplied from universities.

Table 4-17 | ICT HRD Policy in the ICT Professional Skills Deepening Period (2008~2010)

| Policy Goals | Systemization in the ICT Manpower Nurturing Project |
|---|---|
| Policy Means | • New establishment of the convergence manpower nurturing center<br>• Nurturing of the ICT convergence manpower in connection with previous ITRC<br>• New-ICT internship programs<br>• Establishment of the Seoul Accord<br>• The recruitment promotion project of R&D manpower in ICT SMEs |
| Success Factors | Responding in advance to the change in future ICT demands followed by convergence and globalization, focused support on nurturing manpower with master's degree or above and SW manpower |
| Authorities | Ministry of Knowledge Economy, Korea Communications Commission, Ministry of Culture and Tourism, Ministry of Education and Science |
| Restriction Factors | Lack of cooperation among manpower nurturing policies followed by the decentralization of ICT policy promotion system |

| Policy Goals | Systemization in the ICT Manpower Nurturing Project |
|---|---|
| Effect | • Nurturing of high quality ICT human resource that satisfies the market demand<br>• Expansion of opportunities to participate in manpower nurturing of companies<br>• Strengthening of the linkage between manpower nurturing and recruitment<br>• Establishment of foundation for overseas market entry and overseas employment<br>• Enhancement in the reliability and utilization of manpower supply statistics |

Source: Reconstructed from Ko et al.(2012a) and Ko et al., (2012b).

Table 4-18 | Details and Budget of ICT HRD Program in 2009

(Unit: 100 Million Won)

| Section | Project Name | Budget | | Managing Institute | Notes |
|---|---|---|---|---|---|
| | | 2008 | 2009 | | |
| Convergence Human Resource Capacity Building | Support media convergence major course | 25 | 17 | 9 schools including Seoul National University | • Support in progress (9 universities) |
| | Operate ICT-based convergence education center | 8 | 28 | Public contest | • 4 new centers (automobile, shipbuilding, etc.)<br>• 1 center still in progress (Nano-ICT) |
| | Support for KAIST-ICU Consolidation | - | 75 | KAIST (ICC) | • Support integrated foundation in 09 |
| In Field Human Resource Capacity Building | Capacity Building for University ICT Major | 196 | 168.5 | 69 schools including Catholic University of Korea | • Support in progress (127 tasks) |
| | Operate ICT mentoring system | 26 | 16 | IICTA | • Participation: FKII (1,513 mil won) |
| | Support New-ICT internship | - | 25 | FKII | |
| | Training for ICT human resource with practical skills | 25 | 9 | 10 schools including Juseong University | • Support media related major (10 tasks) |

| Section | Project Name | Budget | | Managing Institute | Notes |
|---|---|---|---|---|---|
| | | 2008 | 2009 | | |
| High Quality Human Resource Capacity Building | Cultivation and support of ITRC | 305.6 | 296.5 | • 28 schools including Kangnung National University and New contest | • In progress (38 centers)<br>• New (8 centers) |
| | Support global IT research center | - | 12 | Public contest | • New (1 center) |
| | IT SoC Key Architect Nurturing | 72 | 64 | ETRI | |
| | Blue ocean type ICT Professional nurturing | 47 | 44 | Korea University, Hanyang University, Sungkyunkwan University, KAIST | • 1 course with foreign institutes<br>• 3 courses with cooperation with industries and academies |
| | Support attraction of overseas students | 110 | 69 | Seoul National University, ICU, etc. | • Professional ICT policy and technology program for foreigners<br>• Support attraction of foreign students |
| Broadcasting Communication Technology Human Resource Training | ICT Human Resource for Broadband Infrastructure | 36 | 36 | KICTC | • 4 majors including broadcasting communication, mobile communication, etc. |
| | Digital broadcasting technology professional nurturing | 12 | 11 | KBA, KCA | • KBA: Terrestrial broadcasting<br>• KCA: Cable broadcasting |
| | Support broadcasting and communication policy research center | - | 15 | ICU, etc. | • 4 in total (in progress and new) |

Source: MKE (2009).

The convergence manpower cultivation program consists of the support for media convergence major courses, ICT convergence training centers, and consolidation of KAIST-ICU. The field-trained manpower support program includes measures for improving the competitiveness of ICT major courses at universities, an ICT mentoring scheme, a New-ICT internship scheme, and training programs for ICT manpower with practical skills. The High Quality Human Resource Program includes support for university ICT R&D centers, promoting the employment of high quality manpower with practical skills, training programs for key architects of IT SoC, cultivating blue ocean type manpower, and support to attract foreign students into Korea.

With the launch of the Lee Myung-Bak administration, ICT convergence became an area of top priority, and the importance of ICT human resources was on the rise. Although ICT convergence technology was expected to become a new growth engine, by facilitating convergence between industries and services, there was a lack of human resources to support it. And convergence education was difficult to execute under the fragmented systems of current university education. Therefore, the government newly established the convergence HRD center and implemented policies to promote the linkage and convergence between college ITRCs. ICT convergence HRD centers were mandated to apply, utilize and further converge ICT to other industries and future technologies in close cooperation with companies, universities and research institutes. One of the most prominent characteristics of this program was the fact that the focus was on undergraduate-level education rather than graduate schools. Although there was an argument that the convergence education shall focus on high quality manpower with graduate schools as the central education organization, this project aims to implement the convergence education through the reorganization of undergraduate education curricula. Through some pilot projects, this project identified the major support targets with most extensive demand for convergence; key industry and ICT (automobile, shipbuilding, fiber, logistics, etc.) and future technology and ICT (Nano-ICT, NBICT, etc.). Also, this project had two separate courses, the degree courses for university/college students and certificate courses for unemployed university/college graduates, and the details of which are shown in the following table.

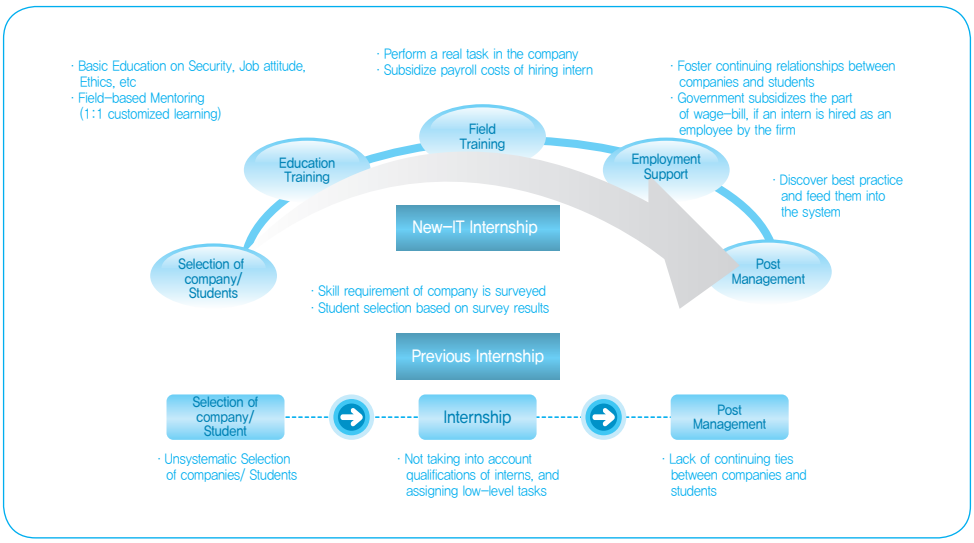
Table 4-19 | ICT Convergence HRD Center Project

| Program | Degree Program | Certification Program |
|---|---|---|
| Education Target | • 4 year college students | • Unemployed college graduates within 1 year of graduation |
| Education Period | • 12 months (regular degree acquiring program) | • 6 months |

| Program | Degree Program | Certification Program |
|---|---|---|
| Supporting Scale | • 0.65 bil won per center, max. 4 years | • 0.2~0.4 bil won per center, max. 2 years |
| Supporting Field | • ICT+Automobile/ ICT + shipbuilding /ICT + Nano ⇒ Expansion in field after 2010 (construction, national defense, medicine, etc.) | • ICT+Automobile/ICT+Shipbuilding<br>• Expansion in field after 2010 (construction, national defense, medicine, etc.) |

Source: Internal data of NIPA, Quoted from Ko (2012b).

**Figure 4-2 |** Comparison between Previous Internship and New-ICT Internship




Source: Internal data of National ICT Industry Promotion Agency.

The internship program, the most typical field training system, had not resolved problems of a quality mismatch, because universities/colleges, ministries, and others implemented various programs competitively without considering the skills demanded by students and companies. In order to overcome the issue, the government introduced the New-ICT internship program, which extended the internship period compared to the previous program, and strengthened the function of employment linkage by introducing plans to strengthen the links between students and companies. The program was supplemented to overcome the weaknesses of the quantitative performance-oriented and insufficiently prepared past programs, and have greater impacts. A company-led pre-education course of internship was strengthened and demand of companies and students was actively reflected on the program. This program was differentiated from previous internship programs with

the provision of subsidies for education and training, field training, and recruitment. The subsidies for education and training was provided for were 400,000 won per person, and, for field training at newly employed level, 500,000 won was granted, and 400,000 won was provided to the personnel of company in charge. Also, in the case of a trainee being recruited by the company as a permanent employee, the half of payroll costs would be covered by government subsidies for the maximum of four months.

The government announced the mid-term reformation plan for ICT HRD in 2010 and it announced improvement plan for university/college ICT major education to resolve the quality mismatch. The mid-term reformation plan of 2010 dramatically changed the direction of ICT HRD in order to cope with environment changes such as ICT convergence and strengthen the basis for the future development of the ICT industry. This plan aimed to convert previous HW-oriented undergraduate level HRD into Master's and PhD centered HRD focusing on high quality manpower in the SW and ICT convergence field. And this plan also introduced parallel curricula of practical skill training with participation of companies. Since 2010, extensive policies on SW has been continuously developed and implemented. For high quality HRD, ICT/SW creative research courses, ICT convergence high-quality manpower courses, ICT Maestro courses have been newly introduced. Also, practical projects through university-business collaboration have been introduced in order to increase field adaptability and the Pro Bono Mentoring system, an evolved mentoring system in the form of talent donation has been proceeded in order to strengthen the link between the education and employment. Meanwhile, the importance of the SW industry has been on the rise, in order to train top notch manpower and field-oriented high-level SW manpower, SW expert training is implemented through various measures including SW maestro and employment courses.

One of the biggest changes in HRD policy announced in 2010 was the strengthening of support for SW. It can be analyzed that the source of ICT industry innovation is being shifted from HW to SW and companies with competitiveness in convergence among HW, SW, and service have emerged as leaders in the world market. And the rapid spread of ICT convergence to all industries also acted as the element to enhance the importance of SW. Namely, considering the lack of high quality manpower in core capacity of ICT convergence including the SW and system semiconductor field, it is necessary to expand high quality manpower development, and nurture innovative manpower with creativity and problem-solving abilities in order to preoccupy the new convergence market and lead convergence innovation. Also, the importance of government-level development of high quality information security experts for smart grid, banking, and other fields has been increased as ICT convergence has been expanded to key industries of the country, which also serves as a key element of changes in ICT HRD. Thirdly, the mismatch of ICT manpower

supply and demand due to the current supply-driven education of university/college results in the oversupply of ICT manpower in general and the lack of SW manpower, expected to continue further. The reason behind this phenomenon is that even though more than enough manpower is supplied via graduates from university/college every year, companies will never hire enough from this pool, since a critical number of students lack necessary practical skills. Namely, there are many applicants but only a small number of capable and appropriate job seekers in the market. <Table 4-20> illustrates the ICT HRD policy direction of the mid-term reform plan.

Table 4-20 | Policy Direction for ICT HRD through Mid-Term Reform Plan

| Strategy | | Before Reform ('09) | After Reform ('13) |
|---|---|---|---|
| ① Demand-Centered Manpower Nurturing | Market Demand | - Training of undergraduates (41%)<br>- High quality of HW manpower (64%) | - Training of masters and doctors (72%)<br>- High quality of SW manpower (70%)<br>• New establishment of SW creativity program, Reduction of ITRC |
| | Request of Companies | - Major-centered education (strengthening of ICT major capacity)<br>- Cooperation and exchange among academies<br>• Participation only by consultative universities | - Parallel education and practical business training (expansion in ICT mentoring)<br>- Cooperation and exchange between industries and academies<br>• Additional participation of consultative companies<br>• Introduction of incentive system for industry-academy cooperation |
| | Future Demand | - Initial execution of manpower for convergence area | - Full-scale nurturing of manpower in convergence area<br>- Introduction of maestro nurturing<br>- Strengthening in overseas manpower network |
| ② Efficiency through Simplified Project | Clarification in Domain | - Overlapping with Project of Ministry of Education, Science&Technology | - Solution for Overlapping with Project of Ministry of Education, Science & Technology<br>• Students, masters and doctors centered |

| Strategy | | Before Reform ('09) | After Reform ('13) |
|---|---|---|---|
| ② Efficiency through Simplified Project | Strict Project Management | - Negligence in process and paternalism<br>• (Selection) Document screening<br>• (Execution) Post-inspection for document<br>- (Evaluation) Absolute evaluation | - Process-centered and performance-centered<br>- On-site evaluation, 10% matching<br>- On-site inspection, irregular inspection<br>- Comparative evaluation, Incentive expansion |
| | Enhancement in Statistics Usage | - Simple reference<br>- General status, shortage rate | - Data on signaling mechanism of labor market<br>- Securing statistics on income, satisfaction, etc.<br>- Advance announcement of recruitment plan of large companies |

Source: Internal data of NIPA, Quoted from Ko (2012b).

The most important part of information and communication manpower nurturing policy of the government since 2010 is the improvement in practical business capacity of job applicants through enhancement in quality of university education. By doing so, the government tried to resolve an employment crisis caused by social problems, reduced re-education costs of SMEs, and enhanced competitiveness. In accordance, the government announced the ICT education improvement plan in April 2011 to promote qualitative improvements in college education. The outline of such projects is as follows.

First of all, in order to improve the quality of college training, the emphasis was put on strengthening faculty capacity and the introduction of a faculty performance evaluation system with a special emphasis on research papers. Also, practical improvements were promoted through the introduction of an ICT capacity evaluation system, to secure colleges and companies' credibility, and expand ICT education participation by companies. However, the structural reformation of ICT majors and the reinforcement of ICT education at elementary and middle schools were not the responsibility of the Ministry of Knowledge Economy. Thus, cooperation with the Ministry of Education and Science in charge of ICT education was pursued.

One of the most important achievements of the ICT manpower nurturing project in 2010 was the establishment of the "ICT education improvement plan for university" to resolve employment discordance between industry and academy. In regards to the improvement plan, three tasks (enhancing the ICT capacity index, strengthening faculty capacity, and expanding ICT education participation by companies) were newly promoted along with two others (introduction and expansion of a new education model, and improvement in the

college evaluation system) included in the previous project (Promotion of the Seoul Accord). The second achievement was the establishment of the Seoul Accord club, a communication channel between universities and companies, for the purpose of enhancing the effect of the Seoul Accord launched in 2008. 37 companies including LG Electronics, Samsung SDS, IBM Korea, Dongbu CNI, Satrec Initiative, Jiran Soft, Fasoo.com, and others participate in Seoul Accord Club, and actively discuss the curriculum.

As the importance of creative human resources such as Steve Jobs is on the rise, the ICT maestro project was promoted to nurture the creativity in ICT human resources through research-centered curriculum, apprenticeships and multidisciplinary approaches. Also, the establishment of IT research centers in universities and high quality of human resource programs for ICT convergence were promoted, in order to train high quality research personnel with problem-solving and project-executing abilities within key ICT convergence fields. Moreover, to satisfy the demand of various companies, the ICT/SW creativity program was created in collaboration with small, medium, and large companies to cultivate practical business capacity, provide on-site experience In case of undergraduate ICT education, the inflow of outstanding human resources into SMEs was accelerated by strengthening the linkage between universities and companies, and the advancement in quality of the mentoring system was promoted to resolve the quality mismatch between the two parties. Also, the industry-academy cooperation project "Pro bono ICT mentoring," based on social contributions, was also introduced. This project provides opportunities for co-growth in that the mentor (company) gets positive publicity over its social contribution activities and the mentee (student) acquires practical ICT technology and knowledge. The recruitment for trainees was strengthened by extending an on-site training period of offline mentoring during winter breaks, and in order to supply outstanding human resources to SMEs. Also, the "Hanium Job EXPO" was held on a regular basis to resolve the employment and recruitment crisis in the ICT field. In 2011, 210 companies and 47 universities participated in this EXPO, consulting and interviewing with undergraduate- and graduate-level students.

ICT HRD program has evolved by properly corresponding to domestic and overseas economy and policy environments, including changes in the demand of industries and technology development. When ICT convergence was promoted, the emphasis was put on nurturing ICT convergence human resources, and the priorities in SW and HW skills nurturing were to respond to the changes in demand for SW and HW. ICT HRD program will continue to form policies reflecting the market environment, as well as future changes in demand. Overall HRD policy in Korea as well as ICT HRD policy was promoted in harmony with the industrial policy and science&technology policy. ICT HRD policy will also be continuously promoted in line with the nation's industry policy, R&D policy, and others (Ko, 2011b).

2013 Modularization of Korea's Development Experience
ICT Human Resource Development Policy

# Chapter 5

## Evaluation of Success Factors

1. Success Factors of ICT HRD Policy
2. Case of Software Skills Nurturing Policy: Half Success

# Evaluation of Success Factors

## 1. Success Factors of ICT HRD Policy

### 1.1. Changes in Government Organizational Structure in Response to ICT Market and Technology Shift

The development of the information and communications sector needs to be achieved through an integrated system of information devices, software, and communications networks. Before the establishment of the Ministry of Information and Communication (MIC), the Ministry of Trade, Industry, and Energy was in charge of devices, while the Ministry of Science and Technology was responsible for software, and the Ministry of Communications was in charge of communications networks. This led to the overlapping and duplication of information and communications-related tasks, leading to cases of exhaustive and repetitive policies among those ministries. With the government reshuffle in December 1994, the function of supporting and promoting the industries of information&communications and broadcasting devices, multimedia, and computer and peripherals was transferred from the Ministry of Trade, Industry, and Energy to the MIC. The development and cultivation of the system industry, development and distribution of electronic data processing technology, and protection and promotion of computer programs became the responsibility of the MIC, shifted from the Ministry of Science and Technology. In addition, the tasks related to cable broadcasting and licensing were also moved from the Ministry of Information to the MIC. In other words, the MIC emerged as a single agency in charge of the entire ICT industry and therefore was capable of making an accurate and comprehensive analysis of the current status of the nation's ICT industry and informatization process. The MIC could also come up with more thorough and consistent strategies for different ICT fields to better respond to changes in the domestic and overseas markets.

The Ministry of Information and Communication played a role of a specialized government body dealing with tasks related to information and communications, namely by taking charge of industrial policy that promote the ICT industry; forming informatization policy that enhances the information and communication infrastructure, such as ultra-speed internet networks and facilitating the utilization of information and communications with various projects such as the E-government project; and establishing competitiveness policy that maximizes the benefits delivered to consumers through appropriate regulations on communications service providers. It also successfully cultivated the ICT industry with the construction of high-speed information and communications networks, commercialization of CDMA, introduction of an effective competition system for the communications market, etc. The legal ground that made it possible for the Ministry to push ahead with strong ICT policies was the "Framework Act on Informatization Promotion." According to the Act, the government had to establish basic plans for informatization promotion for the period of five years and measures to nurture ICT Human Resources were required to be included in the plans.

The needs of businesses in the field were better reflected in government policies, as the MIC became responsible for ICT HRD policy. The MIC, which was in charge of promoting the ICT industry and pursuing informatization policy, was better suited to develop policies that enhance the horizontal linkage between the ICT industry and educational institutions compared to the Ministry of Education, which draws up education policy in relation to regular education institutions. The case in point was the MIC's ICT 839 strategy. While implementing this strategy, the Ministry shifted the direction of its ICT HRD policy to focus on promoting three major infrastructure and nine new growth engines. The Informatization Promotion Fund served as a stable financial source for ICT HRD policy and enabled the Ministry to pursue the policy with a long-term vision.

As the growth rate of the information and communications industry slowed down and productivity improvement through ICT utilization in the non-ICT industries became a hot topic in the late 2000s, some argued that the Ministry of Commerce, Industry, and Energy, which was responsible for the overall development of the industrial sector, should implement ICT promotion policy. In terms of regulatory policy, the necessity for an independent regulatory agency similar to the FCC of the U.S. also surfaced. It was because there was criticism that the MIC was playing the role of both a player and a judge with its two extreme responsibilities of regulating and promoting the telecommunications market. With the establishment of the Lee Myung-Bak administration in 2008, the responsibility to deal with ICT industry policy, informatization policy, and competitiveness policy was given to the Ministry of Knowledge Economy, the Ministry of Security and Public Administration, and the Korea Communications Commission, respectively. This reorganization of government

responsibilities was performed under the premise that it would enable a swift and flexible response to changes in the market, such as the acceleration of convergence between ICT and other industries, advancements in broadcasting convergence, and an increase in demand for policy that addresses adverse effects of informatization. The Ministry of Knowledge Economy reformed the ICT HRD policy with focus on nurturing convergence and software specialists, as well as those with a master's or doctoral degree. The reorganization is evaluated to have contributed to producing ICT talent that meet the demand in the market created with a shift in the focus of the ICT industry policy into ICT convergence.

With the establishment of the Park Geun-Hye administration in 2013, the government body in charge of promoting the ICT industry once again changed to the Ministry of Science, ICT, and Future Planning (MSIP). The MSIP became a large-scale ministry, which covers both science&technology policy and ICT policy. ICT policies that were assigned to the MSIP include broadcasting convergence and promotion as well as spectrum management previously implemented by the Korea Communications Commission, ICT R&D, ICT industry promotion, and SW industry convergence by the Ministry of Knowledge Economy, national informatization plan, information security, and ICT culture by the Ministry of Security and Public Administration, and digital content by the Ministry of Culture, Sports, and Tourism. Five years after the establishment of the ICT policy promotion system involving a number of different government agencies following the close of the Ministry of Information and Communication, a centralized ICT policy implementation system that encompasses regulation, promotion, and informatization was rebuilt. Partially, it signaled a return to supply-oriented policies from the past demand-centered policies as the government acknowledged the need for supply-oriented policies in order to promote ICT start-ups and small and medium-sized enterprises (SME). The fundamentals of the Lee Myung-Bak administration's ICT policy that aimed at enhancing the productivity of the overall economy, while maximizing the ICT industry's growth potential through ICT and broadcasting convergence were maintained with more emphasis placed on the software and services industries.

Table 5-1 | ICT Functions Transferred to the Ministry of Science, ICT, and Future Planning

| Former Ministry | Functions |
|---|---|
| Ministry of Knowledge Economy | - Information and communications industry, mail, postal money, and mail substitutes, R&D |
| Korea Communications Commission | - Convergence and promotion of broadcasting and communications, frequency management |

| Former Ministry | Functions |
|---|---|
| Ministry of Security and Public Administration | - National informatization, information protection, ICT culture |
| Ministry of Culture, Sports, and Tourism | - Digital content promotion, TV advertisement |

Source: The Ministry of Science, ICT, and Future Planning (2013a).

## 1.2. Balanced Development of Basic, Applied and Professional ICT Skills

The OECD (2006) classifies ICT workers into three categories of ICT specialists, applied ICT technology users, and basic ICT technology users. ICT specialists refer to those who are capable of ICT system development, operation, and management, while applied ICT technology users are those who are capable of handling advanced or unique software tools and who utilize ICT as a means in performing tasks. Basic ICT technology users are those who have general knowledge required for the use of ICT in the information society, e-government, workplace and daily lives.

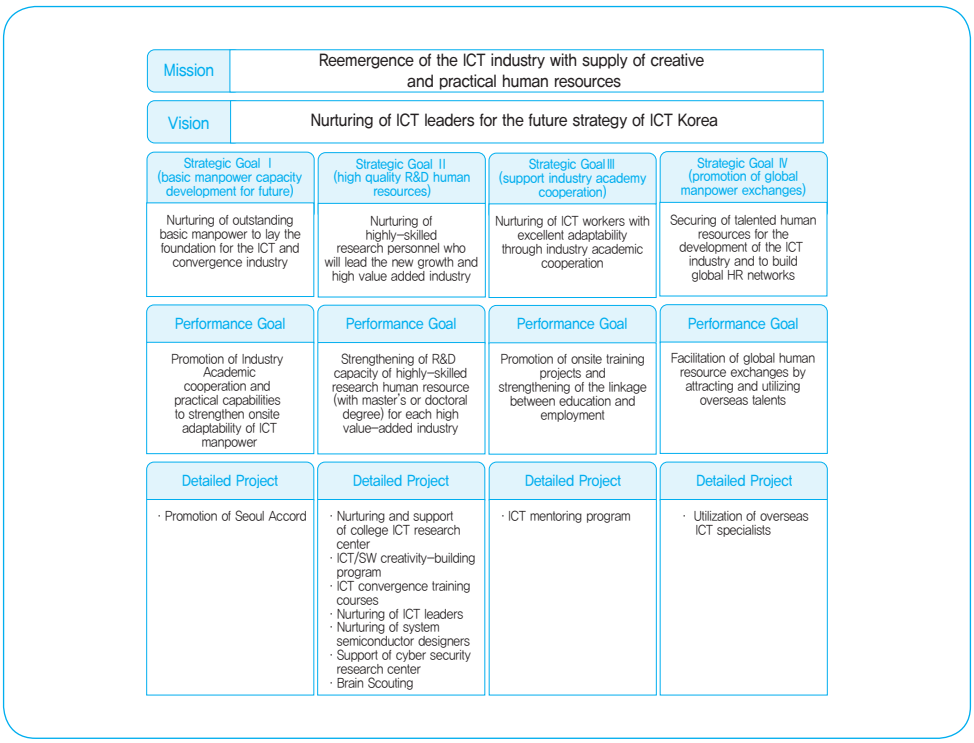
Depending on the objective of ICT human resources policy, different sets of basic, applied and professional ICT skills are demanded. It is therefore important to build an ICT expert training system that could meet diverse needs. Professional ICT skills are essential for the overall advancement of the ICT industry, while experts in applied ICT technologies are needed for the application of ICT to the overall industrial sector. To close the digital divide between generations and regions, government measures that help every citizen learn basic ICT skills should be employed. To this end, a policy mix that takes account of various components of ICT human resources development, such as infrastructure for ICT human resources development, ICT expert training centers, ICT curriculum, information on the supply and demand of ICT professionals, and refresher courses in ICT skills, are needed. Korea has taken a balanced approach in promoting basic, applied and professional ICT skills. When the ICT industry was nurtured as a new growth engine during the Asian financial crisis, the investment was focused on professional ICT skills. At a time when the demand for ICT needed to be boosted following the completion of high-speed internet networks, active investment was made in basic ICT skills through nationwide internet education. With the recent trend of convergence of ICT and other industries, the demand for applied ICT skills is on the rise. Applied ICT skills are generally acquired through regular education in higher education institutions or training in the workplace. For the adequate supply of applied ICT skills, policies designed to identify demand for applied ICT skills in non-ICT sectors and provide such information to educational institutions and potential students have been created.

## 1.3. Establishment of Goal (Mission, Vision) - Strategic Goal - Performance Goal - Performance Evaluation System

ICT HRD policy is designed to have a systematic structure, in which setting missions and visions, categorizing, setting strategic and performance goals for each project, developing detailed project plans, and evaluating the performance of each project through a performance index is undertaken in order. [Figure 5-1] illustrates the schematics of the relations between the mission, vision, strategic goal, performance goal, and detailed projects of the 2012 ICT HRD program. Each project is linked to a performance indicator matched to the characteristics of the project and projects are evaluated after completion based on the indicator established in advance.

The mission of the 2012 program was "Reemergence of the ICT industry with supply of creative and practical human resources" and the vision was "Nurturing of ICT leaders for the future strategy of ICT Korea." In order to achieve this mission and vision, the ICT HRD program set four strategic goals: 1) to produce future talents to lay the foundation for the ICT and convergence industry; 2) to cultivate highly-skilled researchers who will lead the new growth and value-added industry; 3) to nurture ICT workers with excellent on-site adaptability through industry-academy cooperation; and 4) to secure talented human resources for the development of the ICT industry and to build global HR networks.

**Figure 5-1 |** Mission, Vision, Strategic Goal, Performance Goal, and Detailed Project of 2012 ICT Human Resource Development Program




Source: Sookmyung Women's University Industry-Academic Cooperation Foundation (2013).

## 2. Case of Software Skills Nurturing Policy: Half Success

The software industry has been considered as one of the most important part of the ICT industry since the MIC assumed responsibilities for all policies relating to the promotion of the software industry, following the reshuffle of government organization in December 1994. The ministry mapped out policies targeting the software industry independent of the hardware industry, and began to provide necessary support to promote the software industry. During the period 1994~2002, the government focused on laying out the foundation for the development of the software industry. During the period 2003~2007, the government concentrated on improving the industrial structure and developing strategic software (open software, embedded software, for instance). Facing growth limitations due to the industrial structure centered on hardware and intensifying global competition since 2008 and with the emergence of the digital convergence era, the government has been focusing on facilitating convergence of the software industry and non-ICT industries (Ko, 2011b).

With the enactment of the Software Industry Promotion Act in January 2000, policies were mainly aimed at expanding the size of the software industry by supporting software firms and generating markets. As part of the effort to develop software human resources, the government provided assistance for specialized high schools, established related departments, established courses in alliance with overseas universities to develop specialized SW human resources and opened specialized SW HRD courses. However, the lack of essential technologies such as OS and market dominance by global firms made it difficult for Korea to obtain global competitiveness. Under these circumstances, the MIC declared the year 2005 as 'the starting year of the software industry advancement' and announced a strategy to promote the software industry. The government had a vision to turn the nation from an ICT powerhouse into a software powerhouse, and announced a plan to promote software as an essential infrastructure for the nation. As part of the effort to develop software skills, the government focused on enhancing university education through the ITRCs and practical training. In addition, the ministry developed a set of software skill standards and conducted labor supply and demand analysis to create an environment suitable for the development of architect-level high-quality SW human resources (Ko, 2011).

Soon afterwards, the MKE announced the 'Software Industry Development Plan' in Oct. 2008. The plan consisted of ① creating new markets through the convergence of the software and service industries, ② strengthening the competitiveness of national key industries through the convergence of the software and manufacturing industries, and ③ strengthening the software industry's competitiveness. The plan proposed measures to create new markets, jobs, and value-added through convergence of 'software + service' and 'software + manufacturing.' At the same time, the plan laid out a strategy for overseas markets expansion based on the cooperation between SMEs and large business that would eventually strengthen the software industry's capacity (MKE, 2008). In the past, Korea's software workforce consisted of relatively low-educated, low-skill workers (college education of 2-years or under) compared to that of the hardware industry. The government therefore pursued a human resource policy of nurturing high- quality workers in the software industry; eventually the ratio of highly educated workers in the software industry equaled to that of the hardware industry. Thanks to the government's efforts, we have seen since 1998 a rapid increase in the number of highly educated software workers; the number of workers with bachelor's degree or higher have increased from 34.3% in 2002 to 61.4% in 2009. The absolute number of individuals with a bachelor's degree or higher in the software industry has increased to comparable levels with the hardware industry (Ko et al., 2010b).

Table 5-2 | Ratio of Annual HW&SW Graduates with Junior College Degree, Bachelor's Degree, Master's and Doctoral Degree

(Unit: %)

| | 1998 | 2002 | 2006 | 2008 | 2009 |
|---|---|---|---|---|---|
| Masters and Doctors in HW | 7.8 | 8.7 | 9.7 | 8.1 | 8.6 |
| 4-Year College Graduates in HW | 34.3 | 34.0 | 43.9 | 50.3 | 51.7 |
| 2-Year College Graduates in HW | 57.8 | 57.4 | 46.4 | 41.7 | 39.7 |
| Masters and Doctors in SW | 3.4 | 5.9 | 6.8 | 5.4 | 6.2 |
| 4-Year College Graduates in SW | 23.3 | 28.4 | 41.4 | 51.4 | 55.1 |
| 2-Year College Graduates in SW | 73.3 | 65.7 | 51.8 | 43.2 | 38.6 |

Source: Statistical Yearbook of Education, various years, quoted from Ko et al. (2010b).

Table 5-3 | Trend in Supply of HW and SW Graduates with Bachelor's Degree or Higher

| | 98 | 00 | 02 | 04 | 06 | 08 | 09 |
|---|---|---|---|---|---|---|---|
| HW | 13,320 | 15,075 | 17,759 | 20,163 | 19,276 | 18,360 | 17,667 |
| SW | 9,852 | 11,781 | 14,721 | 18,116 | 18,509 | 17,830 | 17,226 |

Source: Statistical Yearbook of Education, Various years, quoted from Ko et al. (2010b).

In retrospect, the government's intervention to shift the structure of the ICT workforce in favor of software skills can be evaluated positively, given the trend of increasing employment opportunities in the software industry. When we look at the employment trend of the ICT industry, the software and information service sectors are remarkable in terms of net job creation. In the last 10 years, the ICT manufacturing sector employed a total of 41,000 workers while the software and information service sectors have employed a total of 123,000 workers, proving to be the main engine behind job creation. In particular, in the past five years there was a loss of 22,000 jobs in the ICT manufacturing sector while the software and information service sectors were the driving force behind job creation, by employing 87,000 workers. In addition, the ICT lease and wholesale and retail sector, as well as the contents sector each created 14,000 and 4000 new jobs. On the other hand, the telecommunication services sector saw a reduction of 28,000 jobs since 2000 due to the effects of restructuring occurring in a mature industry (Lee, 2012).

Table 5-4 | Trends of Employment in ICT Industry

(Unit: Person)

| | 2000 | 2005 | 2010 | 2000-2005 | 2005-2010 |
|---|---|---|---|---|---|
| ICT Manufacturing | 433,705 | 496,576 | 474,948 | 62,871 | -21,628 |
| Telecommunication Service | 79,856 | 66,762 | 52,102 | -13,094 | -14,660 |
| SW and Information Service Industry | 124,984 | 161,083 | 248,104 | 36,099 | 87,021 |
| Contents | 111,532 | 109,407 | 115,335 | -2,125 | 5,928 |
| ICT Rental and Retail&Wholesale Industry | 101,642 | 98,196 | 116,387 | -3,446 | 18,191 |
| ICT Industry | 851,719 | 932,024 | 1,006,876 | 80,305 | 74,852 |
| Ratio to All Industries | 4.0% | 4.1% | 4.2% | 4.7% | 7.7% |

Source: Statistics Korea, 2012, Quoted from Lee (2012).

Despite the dramatic increase in the size of the software industry workers, the employment rate of software related majors show similarity with the employment of hardware related majors. Also, the percentage of full-time jobs held by software majors is lower than that of hardware majors across all educational levels. As can be seen in <Table 5-5>, the employment rate of college graduates with a software major in full-time jobs and in their major-related fields in 2009 are 48.1% and 48.4% respectively, which is lower than the comparable figures of 52.9% and 53.4% of college graduates with a hardware major. Also, in 2009 the employment rate of SW majors with a master's degree was higher by 30% compared to those with a bachelor's degree. It can be inferred that there still is a much higher demand for highly educated master- and doctorate- level SW human skills than bachelor's degree or lower human skills in the market, despite the interventions to increase the pool of high quality software skills by the government. The statistics also show that the mismatch between the human skills produced by education institutions and those required in the market is much greater in the software industry than the hardware industry. Such qualitative mismatch is again confirmed by the statistics showing the shortage of manpower in the software and hardware industries. Both in terms of industry and in terms of jobs, the shortage of human resources is greater in the software industry. When we examine the ratio of workforce shortage in each industry between the periods 2004 to 2008, we can see that the shortage rate in the software industry showed 3.3% in 2004 to 6.1% in 2006. The economic downturn following the Lehman Brothers financial crisis pulled the figure down to 3.4%. But the shortage rate for the hardware industry has shown a continuous downward trend of 3.7% in 2004 to 1.1% in 2008. This trend is shown similarly for the occupations in the software and hardware industries (refer to <Table 5-6>).

Table 5-5 | Trends of Employment for HW Related Majors and SW Related Major Graduates

| | 2009 | | | 2008 | | | 2007 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2-year College | 4-year College | Grad School | 2-year College | 4-year College | Grad School | 2-year College | 4-year College | Grad School |
| ⟨Employment Rate⟩ | | | | | | | | | |
| HW Related Major | 84.8 % | 69.3% | 81.1% | 84.1% | 69.0% | 81.5% | 84.3% | 69.6% | 83.4% |
| SW Related Major | 85.0% | 69.1% | 79.9% | 84.1% | 70.4% | 82.6% | 84.3% | 69.6% | 82.4% |
| Computer Science · Computer Engineering | 85.6% | 68.8% | 81.1% | 83.6% | 70.2% | 83.3% | 82.8% | 70.1% | 84.5% |
| Applied SW Engineering | 80.6% | 71.0% | 86.7% | 80.1% | 73.0% | 77.8% | 80.3% | 72.4% | 75.0% |
| Information · Comm. Engineering | 85.6% | 69.2% | 77.9% | 84.7% | 70.3% | 81.7% | 85.1% | 68.7% | 79.8% |
| ⟨Employment Rate for Full-Time Job⟩ | | | | | | | | | |
| HW Related Major | 62.1% | 52.9% | 72.9% | 72.8% | 59.4% | 75.1% | 71.5% | 60.7% | 83.4% |
| SW Related Major | 54.7% | 48.1% | 67.8% | 63.2% | 57.2% | 74.5% | 65.7% | 55.2% | 82.4% |
| Computer Science · Computer Engineering | 53.6% | 48.5% | 69.3% | 63.0% | 57.4% | 76.5% | 62.4% | 56.3% | 84.5% |
| Applied SW Engineering | 43.3% | 49.5% | 80.0% | 52.3% | 60.8% | 77.8% | 55.6% | 58.2% | 75.0% |
| Information · Comm. Engineering | 56.5% | 47.5% | 65.2% | 64.8% | 56.6% | 71.5% | 67.7% | 53.6% | 79.8% |
| ⟨Employment Rate for Major Related Field⟩ | | | | | | | | | |
| HW Related Major | 63.9% | 53.4% | 78.5% | 64.5% | 55.3% | 79.6% | 65.4% | 56.7% | 82.1% |
| SW Related Major | 52.6% | 48.4% | 76.9% | 52.2% | 51.8% | 79.6% | 54.0% | 51.2% | 80.0% |
| Computer Science · Computer Engineering | 54.5% | 48.6% | 78.4% | 46.3% | 51.2% | 80.3% | 46.9% | 52.2% | 82.1% |
| Applied SW Engineering | 50.9% | 50.9% | 83.3% | 52.1% | 59.9% | 66.7% | 51.5% | 57.2% | 75.0% |
| Information · Comm. Engineering | 52.5% | 48.0% | 74.4% | 53.4% | 51.4% | 78.6% | 56.0% | 49.4% | 77.3% |

Source: KEDI(2008), KEDI( 2009), KEDI( 2010), quoted from Ko et al. (2010b).

## Table 5-6 | Trend of Shortage Rate in HW&SW

| Industry/ occupation | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| HW Industries | 3.7 | 3.7 | 2.4 | 2.2 | 2.1 |
| SW Industries | 3.3 | 5.4 | 6.0 | 6.0 | 3.4 |
| HW Occupations | 3.0 | 7.0 | 2.3 | 2.1 | 2.5 |
| SW Occupations | 2.5 | 4.6 | 5.3 | 5.5 | 4.1 |

Note: 1. HW related industry includes electronic parts, image, sound, and communication equipment manufacturing (32) and SW related industry includes information processing and other computer operation related industry (72).

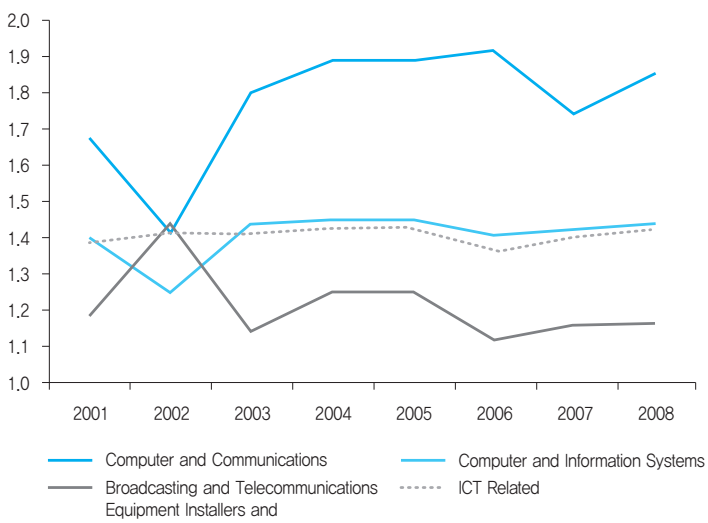
2. HW related occupation includes computer and communication engineering technician (engineer), SW related occupation includes computer and information system related personnel (computer system design specialist, software development specialist, web specialist, and database&information system operation specialist).

3. Shortage Rate=Manpower in shortage/(current manpower + manpower in shortage) *100.

4. Data for 2008 is based on data of second quarter.

Source: MOL (2004), MOL (2005), MOL (2006), MOL (2007), MOL (2008), quoted from Ko et al. (2010b).

## Figure 5-2 | Relative Wage of Software Worker




Note: Relative income of software manpower was compared by converting income of all manpower as 1. Average income change in information and communication related manpower is displayed with dotted line.

Source: Occupational Employment Statistics, various years, quoted from Ko et al. (2010b).

Also, in regards to the occupation, the income levels of the software workforce was markedly low, when compared to the hardware workforce, with average service years coming in shorter as well. [Figure 5-2] illustrates the trend of change in relative income associated with each occupation when income level of all the workforce is set as 1 during the period between 2001 and 2008. During the comparison target period, it was found that the income difference between the software workforce and the hardware workforce has broadened over the years. One reason why the income of software workforce was lower than the hardware workforce lies in the fact that service years of the former is shorter than the latter. In 2008, the average service years of a software worker was 5.1 years while that of a hardware worker 6.8 years, which is a significant difference (Ko, 2011).

The analysis of <Table 5-5>, <Table 5-6>, and [Figure 5-2] can be organized as the following. First, the employment rate of software majors is shown to be lower than that of hardware majors. Second, the shortage rate of SW workers is higher than that of HW workers. Third, the level of income and job stability of a software worker is low compared to that of the hardware worker. The policy directions that could be extracted from such facts are as follows. First, in order to resolve the qualitative mismatch between the supply and demand of software human skills, there needs to be stronger horizontal coherence between education institutions and companies that demand software-related human skills. The fact that software majors have lower success in finding jobs while companies cannot find qualified software human skills demonstrate the proverbial saying 'there are many applicants but not many capable ones' to be right. Or, it may mean that there are not enough quality jobs for highly skilled software majors in the workplace. The fact that the level of income is much lower for software workers compared to hardware workers gives weight to the possibility that there may not be many desirable jobs in the software industry.

In order to procure a sufficient number of high quality ICT professionals, the ICT industry must create high value-added propositions, and the quality and pay conditions of jobs must be sufficient enough to attract potential workers. It is only when ICT employment offers attractive compensation and favorable work conditions that high quality individuals will want to obtain the relevant education and training to become an ICT professional. There are three reasons why the shortage rate of certain ICT manpower is high. First is a case in which the human skills required for a certain ICT field is in great demand but there is a shortage of supply. In this case, there is an excessive demand for human skills and thus both the shortage of workers and income level of this type of occupation increase. In this case, the high demand for workers induces a rise in income level for this type of occupation. The second is a case in which there is difficulty in recruitment due to the low level of income even though there are many individuals equipped with the relevant training or expertise. In this case, despite the shortage of workers, both the rate of employment and income level

are low. The last is a case where recruitment and employment period are lengthened due to the lack of information on education and labor market, regardless of the fact that there is a sufficient supply of highly qualified human skills (Ko&Lee, 2003).

The phenomenon of low-income levels as presented in the second case occurs when jobs in the ICT sector do not generate sufficient value-added propositions. In the case of Korea during the 2000s, there was a severe shortage of workers in the digital contents sector, yet this sector exhibited low levels of income as well. The reason for the shortage was not in the lack of supply of workers but in the lack of value-added creation in this industry. Yet if the government decides to intervene to solve the shortage phenomenon by increasing the number of graduates with the relevant skills, this would lead to even lower income levels. When making policy, it is necessary to consider all indices of ICT labor market, including the shortage rate, income, and other factors. If low income and a high shortage rate in certain occupations are observed, the policy direction should lean toward the promotion of high value added propositions for the related industry and occupation. Also, one can consult the in-fields employment rate as an index when making policy. Even if sufficient numbers of ICT-related graduates are produced, the shortage of ICT human skills and mismatch between employment and specialization cannot be resolved if the number of workers that have jobs related to their major continues to be low. Thus, in-fields employment rate- ratio between the number of ICT-related graduates and workers having occupations related to their educational training is an important indicator. Graduates with training in software tend to have a lower major-related employment rate compared to graduates with training in hardware. Thus there is an outflow of human skills from the software industry to other industries, since other sectors offer a higher level of income. The policy conclusion from this observation is that there needs to be a simultaneous effort to improve both the quality of the software workforce and the value-added benefits of the software industry. Improved working conditions and financial compensation should be also considered in order to increase the attractiveness of the occupation, as well as to induce high quality human skills to enter into this sector.

According to the survey by Na et al. (2013), employees of software companies chose the following government policy as necessary to nurture the software workforce: ▶ Support career path design for long service years as developer (29.0%), ▶ Accurate appraisal of the current status of software engineer recruitment (14.8%) ▶ Support the nurturing of SW specialized companies (14.6%), ▶ Expansion and diversification in education program (employment/re-education) (9.6%), etc. As the survey asked employees with average service years of 10 or longer, the considerable amount of request to support career path design or expansion in education program is understandable. However, we should note that the respondents to the survey demanded accurate appraisal of the current status of SW

manpower recruitment, which reflects the negative attitude by current developers towards the treatment of developers in the industry, as well as the prospects for manpower demand. The fact that 'support the nurturing of SW specialized company' ranked third underscores the importance of promoting high value- added propositions in the software industry, which is as important as nurturing high skilled workers.

Table 5-7 | Government Policies Necessary for SW Manpower Nurturing

| Section | Ratio |
|---|---|
| Improvement in college education | 6.7% |
| Support the activation of venture company | 4.4% |
| Support the cultivation of SW specialized company | 14.6% |
| Support career path design for long service years as developer | 29.0% |
| Grasping of accurate and current status of SW manpower recruitment | 14.8% |
| Expansion of R&D investment in new technology field | 8.8% |
| Expansion and diversification in education program (employment/re-education) | 9.6% |
| Industry-ICT convergence manpower nurturing | 6.4% |
| Expansion of manpower nurturing institution within industries | 1.6% |
| Introduction and reinforcement of remuneration system for in-service invention | 2.1% |
| Others | 2.1% |

Source: Na et al. (2013).

High-quality software skills are a necessary but not sufficient condition for the promotion of high value- added in the software industry. Policies including the cultivation of SW specialized companies, creation of circumstances where the value of software is recognized, construction of a human network suitable for the global software market, etc. should be promoted together with human resources policy. Of course, the promotion of high-quality human skills to meet demand continues to be important in improving the skill levels of the software workforce.

2013 Modularization of Korea's Development Experience
ICT Human Resource Development Policy

# Chapter 6

## Implications for Developing Countries

1. Align ICT HRD Policy with Industrial Policy
2. Develop Statistical Indicators and Provide Forecast for ICT Labor Market and Qualifications
3. Design and Implement Short-term and Long-term Policies to Respond to Skills Mismatch
4. Promote Balanced Development of Basic, Applied and Professional ICT Skills
5. Be Flexible and Build a Virtuous Cycle for ICT Human Resources Development

# Implications for Developing Countries

Korea's ICT human resources development policy has been implemented to resolve a mismatch between quality and quantity in the supply and demand of ICT professionals. It started with building the ICT infrastructure and expanding enrollment in ICT-related schools and programs. Later it developed into the qualitative improvement of ICT education by strengthening the horizontal linkage between ICT firms and educational institutions. Korea's experience in ICT HRD policy making and implementation could serve as a good example for developing countries in many ways. However, there are also policies that would better not be emulated by others. The followings are some of the lessons learned in Korea's journey for ICT human resources development.

## 1. Align ICT HRD Policy with Industrial Policy

Korea's HRD policies have been designed and implemented in harmony with industrial policies. Korea began to invest heavily in ICT HRD after it decided to promote the ICT industry as a future growth engine of the economy. HRD policy in Korea has indeed always gone hand in hand with its industrial policy. <Table 6-1> shows how the nation's HRD policy has been evolving in line with its industrial policy. In the 1970s, heavy and chemical industries were promoted together with the expansion of specialized technical high schools. In the 1980s, policy attention was given to the expansion of technology intensive industries and higher education was actively promoted accordingly. In consequence, the number of university graduates per year more than tripled during the 1980s. In the 1990s, innovation was a key word and thereby S&T graduate schools were heavily funded. During this period, Korea also started to build world-class information infrastructure while making large investment in ICT HRD. In the 2000s, investment in ICT HRD was significantly accelerated with more overt targeting of the ICT industry as a future engine of growth.

Table 6-1 | Harmonization of Industrial Policy and HRD Policy

| | Industrial Policy Development | HRD Policy Development |
|---|---|---|
| 1960s | • Develop import-substitution industries<br>• Expand export-oriented light industries<br>• Support producer goods industries | • Strengthen S&T education |
| 1970s | • Expand heavy and chemical industries<br>• Shift emphasis from capital import to technology import<br>• Strengthen export-oriented industrial competitiveness | • Specialized technical high school was expanded (I.e., machinery) |
| 1980s | • Transform industrial structure to one of comparative advantage<br>• Expand technology-intensive industries<br>• Encourage manpower development and improve productivity of industries | • Emphasis is given to producing highly educated workers<br>• The number of university degrees awarded annually more than tripled during the 1980s |
| 1990s | • Promote industrial restructuring and technical innovation<br>• Promote efficient use of human and other resources<br>• Improve information networks | • Research funding to S&T graduate school had been substantially increased<br>• Evaluation of Universities was strengthened<br>• The number of technical high School doubled<br>• Investment on ICT HRD increased |
| 2000s | • Move towards High tech and high value-added industries<br>• Develop ICT industry<br>• Search the next generation engine of growth | • Emphasis was given on horizontal linkage between schools and industry<br>• Nurturing World-Class graduate schools<br>• Connecting 10,400 schools to the internet and expanded basic internet education for all |

Source: Reconstructed from Hong (2005).

Developing countries could learn from Korea's approach of harmonizing ICT HRD with industrial policy. When promoting certain industries and skills, developing countries need to be more specific and selective since resources can be limited. For example, in order to promote certain areas within the software industry, professional skills directly related to the fields also need to be acquired by workers.

## 2. Develop Statistical Indicators and Provide Forecast for ICT Labor Market and Qualifications

Information about the current and future ICT labor market and ICT education is essential for both individuals and businesses in making decisions whether to invest in ICT training or to hire ICT graduates. In addition, without such information, policy makers will have difficulty designing and evaluating ICT HRD programs. It is therefore recommended that developing countries secure statistics on ICT graduates, desirably with their overall employment rates and in-field employment rates. To build this database on ICT graduates, definitions and classification systems for the ICT industry, ICT jobs and ICT qualifications are essential.

Statistical indicators for ICT labor supply and demand were also developed and utilized in Korea's ICT human resources development programs. These indicators acted as a useful reference for projections of the future labor supply and demand in the ICT sector. The size of workforce with certain qualifications, technical skills or educational levels has been mainly determined by investment decisions made by individuals regarding qualifications, technical skills or education. In making such decisions, information on the future labor market, rather than the current market information, is needed. For this reason, labor supply and demand forecast is performed to help individuals have informed expectations about the future labor market. The market outlook also plays an important role in reducing the possibility of a market failure that may occur from incomplete or asymmetrical information available for individuals when they make decisions on qualifications, technical skills or education.

## 3. Design and Implement Short-term and Long-term Policies to Respond to Skills Mismatch

The primary purpose of ICT human resources policy is to resolve the mismatch between supply and demand. It is true that the nurturing of talented ICT human resources sometimes creates demand for ICT. The demand for labor, however, is basically derived from the demand for product and service. That is, only when there is demand for a certain product or service, there is a corresponding demand for labor required for the production of that specific product or service. Therefore, in formulating ICT human resources development policy, policy makers need to design a supply mechanism that corresponds with the changing demand for ICT skills. In most cases, a mismatch in the ICT labor market is created because of qualitative issues. For example, certain ICT skills are in excess supply whereas other skills are in excess demand.

In order to resolve such a mismatch between the supply and demand of ICT human resources, both short-term and long-term policies should be developed simultaneously. Short-term policies need to focus on enhancing job matching by providing information about the current supply and demand of ICT skills and maximizing the utilization of human resources in the existing ICT labor market. Typical short-term policies include: 1) improving ICT certificate programs; 2) enhancing the linkage between educational institutions, ICT skills training centers and businesses; 3) providing subsidies to ICT training centers and short-term ICT training programs; and 4) harnessing overseas ICT talent and promoting overseas employment of domestic ICT experts. In the long-term, the supply of ICT professionals can be adjusted to meet the demand. Long-term policies designed to resolve the mismatch include: 1) expanding ICT departments in colleges and universities; 2) improving ICT education programs and courses; and 3) enhancing the linkage between ICT R&D and ICT human resources development with better R&D support for ICT graduate schools (Ko, 2011).

## 4. Promote Balanced Development of Basic, Applied and Professional ICT Skills

Korea's ICT human resources policy has been planned and implemented to nurture both ICT specialists, advanced users and basic users. The Korean government's "Informatization Education Plan for 10 Million People" was about basic ICT education, and successfully narrowed the digital divide and spurred the demand for internet-related services. At the same time, the Korean government made huge investments in higher educational institutions in the ICT fields to produce more ICT graduates and to improve the quality of ICT education. Investments were also made to improve ICT skills of the existing workforce.

Depending on the objectives of ICT human resources policy, different sets of basic, applied and professional ICT skills are demanded. It is therefore important to build an ICT expert training system that could meet diverse needs. Professional ICT skills are essential for the overall advancement of the ICT industry, while experts in applied ICT technologies are needed for the application of ICT to the overall industrial sector. To close the digital divide between generations and regions, government measures that could help every citizen learn basic ICT skills should be employed. To this end, a policy mix that takes account of various components of ICT human resources development, such as infrastructure for ICT human resources development, ICT expert training centers, ICT curriculum, information on the supply and demand of ICT professionals, and refresher courses in ICT skills, needs to be in place. This balanced approach and promotion strategy of basic, applied and professional ICT skills is what developing countries can learn from Korea (Ko, 2011).

To nurture ICT professionals, Korea, first of all, took on the task to build regular education institutions, establish ICT-related departments, develop ICT curriculum and train faculties. When building academic organizations for ICT education, Korea made sure that they are equipped with computers and high-speed Internet connection because the ICT education infrastructure in educational facilities is a prerequisite for ICT human resources development.

To help its citizens acquire basic ICT skills, the government should promote lifelong education, in which basic ICT education makes a crucial part. For this reason, developing countries need to take Korea's case as a reference and set strategic and systematic targets and plans for government-led basic ICT education. For those whose ICT environment is shifting from wired to wireless communications, teaching the basics of mobile phones and applications is necessary. In the meantime, bridging the gap in ICT access and use is a high priority in improving basic ICT skills of citizens. However, some countries might find it impossible to build wired and wireless Internet infrastructure for every household in their countries. In this case, creating a favorable environment for ICT access and use in regional educational facilities and utilizing those facilities as an ICT education center for local residents might be a good alternative. This approach, however, requires training of teachers who will conduct ICT basics classes.

## 5. Be Flexible and Build a Virtuous Cycle for ICT Human Resources Development

Korea's policy for ICT human resources development is designed to create a virtuous cycle of educational institutions, businesses and infrastructure, the three major elements of the policy. For developing countries, what is especially noteworthy about Korea's policy is that it enabled the establishment of an efficient supply and demand structure for ICT workers by adopting the supply chain management model, and that it helped those with demand for ICT education or ICT workers make informed decisions by providing more interlinked information on the ICT labor market and ICT education. Since Korea's ICT manpower development policy has evolved in line with the nation's ICT development and labor supply and demand, a virtuous cycle between the ICT industry and ICT human resources has been created. The path of Korea's ICT policies, in which a quantitative expansion including the establishment of infrastructure for ICT human resources development and increase in student quotas for ICT-related majors, was followed by the qualitative improvement of ICT professionals reflecting the changing demands of the market. Investing more resources in cultivating ICT convergence specialists and globally-competitive ICT workforce to respond to the trend of ICT convergence and globalization can also be generally applied.

The nurturing of Korean ICT human resources has been pursued in a virtuous circle of 1) the establishment of ICT infrastructure for human resources development; 2) the increased supply of ICT human resources with more regular educational institutions; 3) the retraining of the ICT workforce; 4) bringing ICT education to the entire population; and 5) regular forecast of future supply and demand trends, improvement of ICT certificate systems, and expansion of institutional frameworks, etc. This policy approach of building a virtuous cycle for ICT human resources development can be also applied to developing countries (Ko, 2011).

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