Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society

Managing the Fourth Industrial Revolution

IoT

Big Data

Mobile

Cloud

AI

Government of the Republic of Korea
Interdepartmental Exercise

Preface

Technological innovation is a pivotal force that has led to groundbreaking shifts in economic and social paradigms as well as social transformations throughout the processes of mechanization, industrialization, informatization, and the rest of human history since the invention of the steam engine. Today, the world stands before another massive wave of change, often referred to as the "Fourth Industrial Revolution." Futurologists unanimously agree that the new world that will be ushered in by this revolution will be an intelligent information society in which cutting-edge technologies, such as artificial intelligence, the Internet of Things (IoT), cloud computing, big data analysis, and mobile platforms, will be integrated into every aspect of society—from welfare and employment to education and national defense, among many others—thereby adding intelligence to all industrial activities.

The society brought about by the Fourth Industrial Revolution will be radically different from any society that has ever existed before. According to a recent McKinsey study, the economic value of this intelligent information society will amount to KRW 460 trillion by 2030. By then, the vast majority of simple and repetitive tasks will have been automated, eliminating a large number of jobs as a result. At the same time, however, new jobs, such as those in software engineering and data analysis, will be created in other growing industries.

The Fourth Industrial Revolution is an inevitable, irreversible movement that is currently underway. However, even the most advanced economies are still in only the very first stage of transformation, making it impossible for us to determine which countries will emerge as leaders of this remarkable change. The South Korean government has been taking crucial steps to thoroughly prepare for the coming Fourth Industrial Revolution, such as fostering entrepreneurial spirit and boldness in Korean society, identifying and proactively supporting promising technologies, and developing creative workforces. In an attempt to secure a leadership position in the unfolding revolution and expedite the realization of an intelligent information society in Korea, the government announced the "Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society" in December 2016.

For the successful implementation of this Master Plan, I hope that the current public-private partnership will continue to flourish, as it will make it possible to achieve the massive transformation and innovation required in all economic, social, and other related systems of the Korean nation. Only through such concerted efforts will we be able to pave the way for the next generation to fully realize an intelligent information society.

Choi Yanghee
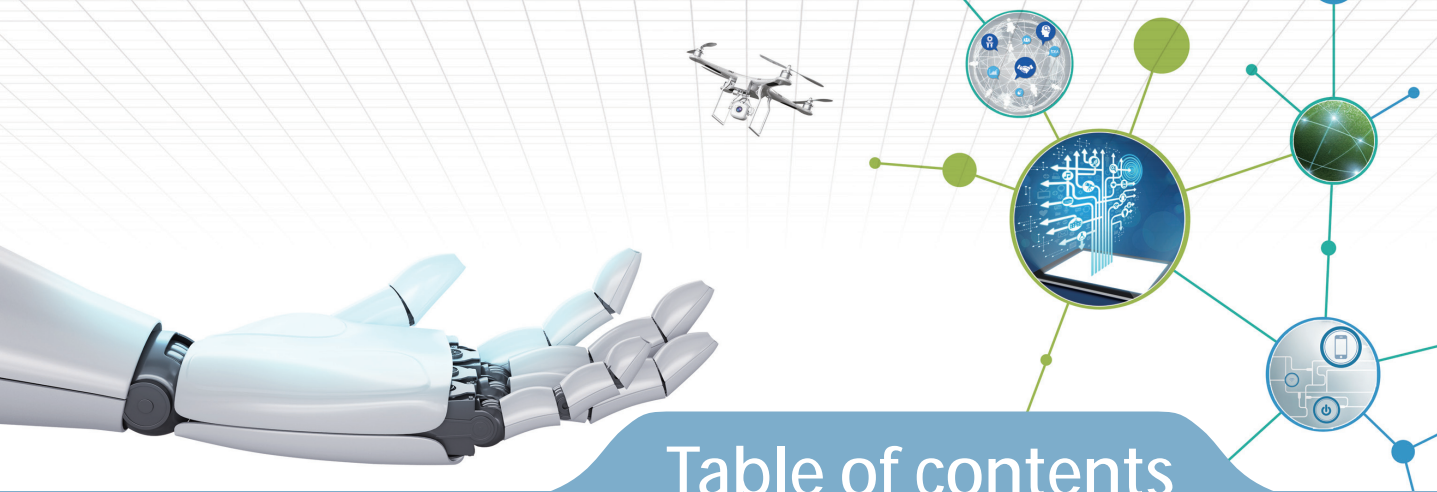Minister of Science, ICT and Future Planning (MSIP)

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An intelligent information society is a society in which new value is generated and progress is achieved through the application of intelligent information technology (Intelligent IT)—backed by the generation, collection, and analysis of massive volumes of data by cutting-edge information and communications technologies—to every aspect of the economy, society and human life.

As data and knowledge come to take precedence over the conventional production factors (labor and capital), industrial barriers are broken down with the increasing convergence of products and services, and intelligent machines and automated systems make their way into even the areas of work that require complex human cognitive capabilities, the entire economy and society will undergo sweeping, innovative transformations.

Progress made so far

◉ The MSIP launched the Public-Private Advisory Board on Intelligent IT (which met three times from October to December of 2015) to organize and hold in-depth discussions on the potential, prospects, and innovation of Intelligent IT and its application to industries.

　✔ The board submitted its National Intelligent IT Strategy report at the interdepartmental meeting in January 2016.

◉ The Plan for the Advancement of the Intelligent IT Industries, which details urgent Intelligent IT and industrial issues that require concerted efforts to address and resolve, was released in March 2016.

◉ The steering plan for the Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society, encompassing the technological, industrial, and social implications of Intelligent IT, was reported at the Cabinet meeting in April 2016.

◉ The Joint Steering Committee for the Intelligent Information Society, comprised of ten government ministries and private-sector experts, was launched in May 2016.

　※ The committee has held three meetings to date, in May, June, and November of 2016.

◉ The Open Public Seminars were held six times, from June to September of 2016, to prompt and disseminate public discourses.

　※ The seminars were held under the theme "Future, Humanity, and Machinery Concerts."

◉ A government-wide steering group was launched on September 1, 2016, to draft a master plan for the intelligent information society.

　✔ Based on the Prime Minister's Decree (of August 31, 2016), the Intelligent Information Society Bureau* was launched.

　　* Made up of civil servants from related government ministries (Ministry of Strategy and Finance [MOSF], Ministry of Education [MOE], Ministry of Science, ICT and Future Planning [MSIP], Ministry of the Interior [MOI], Ministry of Trade, Industry and Energy [MOTIE], and Ministry of Employment and Labor [MOEL]) and private-sector experts.

◉ Interdepartmental and expert review meetings were held in September and October of 2016 by the Planning and Supervision, Technology, Society, and Employment subcommittees of the Bureau.

◉ The Intelligent Information Society Steering Conference was held on December 15, 2016, based on public-private partnership, as a venue for citizens to share their opinions and build social consensus.

◉ Following in-depth deliberation, the Strategic Committee for ICT established the Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society on December 27, 2016.

I

Background

I Background

▶ **The Fourth Industrial Revolution, which is driving significant change in intelligent information technology (Intelligent IT), is expected to transform the basic structure of industries by increasing productivity and efficiency to unprecedented levels based on the enhanced intelligence of machines.**

- Intelligent IT will enhance productivity to the extent that returns to scale increase and trigger fundamental reforms of the conventional production factors, such as labor and capital,* as well as the industrial structure.

  * Here, technological innovation is more important than massive capital investments or minimization of labor cost.

    • Google (60,000 employees, earning USD 23.4 billion) vs. GM (210,000 employees, earning USD 9.7 billion), in 2015

- Information and communications technology (ICT) platform developers are breaking down barriers and expanding their presence into all industries, threatening the existing manufacturing and service sectors.

  * The market value of Uber, a car sharing company, is estimated to be KRW 80 trillion, surpassing GM and Ford (2015). Uber intends to launch a trial run of its new self-driving taxis in Pittsburg in September 2016 and subsequently expand its business portfolio to include logistics and delivery.

▶ **Leading governments and corporations are seizing upon the disruptive impact* of Intelligent IT, and have long researched and invested in it accordingly.**

  * McKinsey has already predicted that the economic ripple effects of the automation of intelligent labor, made possible by artificial intelligence, will amount to between USD 5.2 and 6.7 trillion a year by 2025 (Disruptive Technologies, 2013).

- Leading players in this regard have been increasing the competitiveness* of their Intelligent IT projects by accelerating development and commercialization.

  * E.g., The United States' SmartAmerica Challenge and BRAIN Initiative, Germany's Industry 4.0 Strategy, Japan's Japanese Reconstruction Strategy and New Robot Strategy, and China's Made in China 2025 and Internet Plus Strategy.

- Having realized just how much is at stake in pioneering Intelligent IT, major corporations worldwide have begun making massive investments in Intelligent IT development and related merger and acquisition (M&A) deals.*

  * E.g., IBM's investment in the development of Watson (USD 1 billion), Toyota's Center for AI Research (USD 1 billion), Google's investment in M&A deals (USD 28 billion over 14 years), and Baidu Research's Institute of Deep Learning (USD 300 million).

Increasing investment (CB Insight, 2015)

$15 million — 2010
CAGR 110%
$300 million — 2014

Google's deep-learning projects (Google, 2016)

10 — 2012
150 — 2013
500 — 2014
1200 — 2015
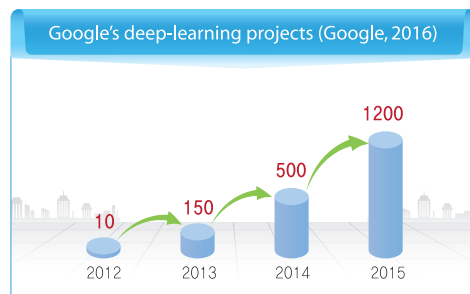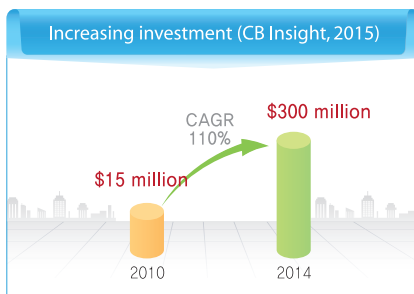
▷ **The transformation of the industrial structure caused by technological advancement will inevitably change the nature of work and profoundly reshape people's lifestyles accordingly.**

- As machines increasingly replace human workers in all sectors of society, productivity will rise, working hours will decrease, and health spans will increase, among other society-wide social and economic benefits.

- Such automation, on the other hand, will also replace simple and repetitive human labor and increase the demand for highly specialized and skilled personnel.

▷ **Under its national informatization plan and programs, South Korea has established world-class ICT infrastructure* and successfully enhanced the competitiveness of its national economy through the convergence of industries and ICT.**

  * South Korea has topped the ICT Development Index for two years in a row (2015-2016).

- Intelligent IT, however, is expected to transform the economic and social structures of the country profoundly. It is therefore critical for the Korean government to prepare policy measures in response to such changes, encompassing not only technology and industry but also education, employment, and welfare.

  * South Korea is ranked 25th, below the Czech Republic and Malaysia, in terms of its adaptability to the Fourth Industrial Revolution, measured in terms of labor flexibility, technological innovation, quality of its education system, social overhead capital (SOC), and legal protection.

< Recent Economic Growth Rates (Bank of Korea, 2016) >
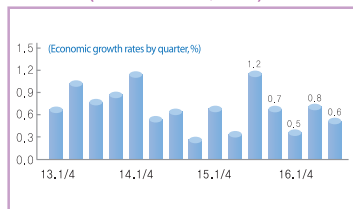
< Adaptability to the Fourth Industrial Revolution (UBS, 2016) >
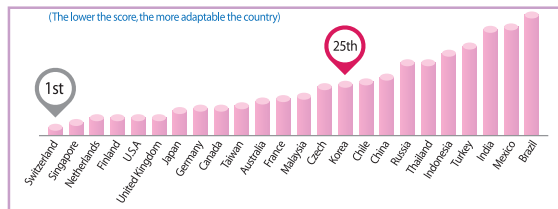
- In order to generate new value and ensure the competitiveness of its intelligent information society, Korea needs to secure innovative technologies in advance, foster related industries, and upgrade services.

- It is critical to observe social changes carefully and build a social consensus on new policy measures. The roles of humans and ethics need to be redefined and the downsides of the new industrial revolution minimized while adjusting the social structure so as to support the peaceful coexistence of humankind and robots.

> It is important for Korean policymakers to make **forecasts regarding the innovations** that will be made **in the next generation**, and tailor **the country's mid- to long-term strategic responses** accordingly, before it is too late.

II

Engine of the Fourth Industrial Revolution: Intelligent IT

Ⅱ Engine of the Fourth Industrial Revolution: Intelligent IT

1. Concept of Intelligent IT

▶ Intelligent IT refers to technology that is capable of performing the highly complex functions of human intelligence by combining the "intelligence" of artificial intelligence (AI) with the "information" provided by data-processing and network technologies, such as the Internet of Things (IoT), cloud computing, big data analysis, and mobile technologies (referred to collectively as "ICBM technologies").

- **AI technology** encompasses intelligent software and hardware technologies, basic sciences (brain science and industrial mathematics), and other such technologies that are capable of performing human cognitive functions (language, voice recognition, visual perception, emotional support, etc.).

  * At present, Intelligent IT is understood mainly as a weak form of AI that merely simulates human cognitive functions in limited areas of human activity. It is not yet a strong form of AI that is capable of replacing all human tasks requiring intelligence based on creative learning and decision-making.

- **Data-processing and network (ICBM) technologies** are essential ICTs that generate, collect, transmit, store, and analyze data that are crucial to the development, enhancement, and dissemination of AI technology.

  ✔ IoT and mobile technologies continuously gather and transmit various types of data through networks in real time, while cloud and big data technologies store and analyze the data thus gathered/transmitted.

< Intelligent IT: Concept and Characteristics >

Concept	
Characteristics	• **Automatic decision-making:** Machines become capable of performing the highly complex and intelligent tasks involved in decision-making independently, thereby accelerating automation. • **Real-time responses:** ICBM (IoT, cloud computing, big data, and mobile) technologies carry out a series of related tasks (e.g., data gathering/analysis and deduction) instantly to provide real-time responses and actions. • **Automatic evolution:** Machines utilize their deep-learning experiences to evolve independently, achieving astronomical improvements in performance. • **Storage of all kinds of data:** Even data that were impossible to store and use in the past (e.g., biological and behavioral information, amorphous data, etc.) can now be made useful through the machine-learning process.

Intelligent IT possesses characteristics of general-purpose technologies (GPTs)* that can be adapted and applied to diverse fields, and is therefore capable of causing far-reaching and innovative ripple effects.

* GPTs: technologies that (1) spread quickly across different fields of application, (2) are amenable to continual improvements, and (3) trigger society-wide innovations (e.g., steam engine, electricity).

< Comparison of Electricity and Intelligent IT as GPTs >

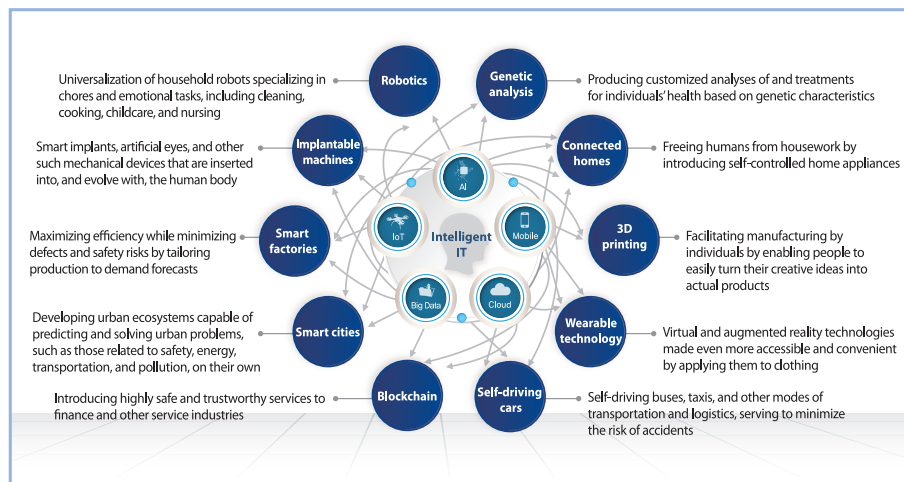|	Electricity	Intelligent IT
Role	Replaces humans' physical labor	Replaces humans' mental labor
Scope of application	All areas of industrial and living activities in need of power	All areas of industrial and living activities in need of decision-making (except for creative and emotional activities, for now)

■ The fields of application for Intelligent IT continue to multiply thanks to the modification and expansion of algorithms and diverse forms of deep learning.

✔ In combination with diverse industrial technologies, Intelligent IT is expected to play a pivotal role in enhancing productivity and efficiency in all industries.

< Examples of the Convergence of Intelligent IT with Other Industrial Technologies >

Universalization of household robots specializing in chores and emotional tasks, including cleaning, cooking, childcare, and nursing

Smart implants, artificial eyes, and other such mechanical devices that are inserted into, and evolve with, the human body

Maximizing efficiency while minimizing defects and safety risks by tailoring production to demand forecasts

Developing urban ecosystems capable of predicting and solving urban problems, such as those related to safety, energy, transportation, and pollution, on their own

Introducing highly safe and trustworthy services to finance and other service industries

Producing customized analyses of and treatments for individuals' health based on genetic characteristics

Freeing humans from housework by introducing self-controlled home appliances

Facilitating manufacturing by enabling people to easily turn their creative ideas into actual products

Virtual and augmented reality technologies made even more accessible and convenient by applying them to clothing

Self-driving buses, taxis, and other modes of transportation and logistics, serving to minimize the risk of accidents

Robotics · Genetic analysis · Implantable machines · Connected homes · Smart factories · AI · IoT · Intelligent IT · Mobile · 3D printing · Big Data · Cloud · Wearable technology · Smart cities · Blockchain · Self-driving cars

" Intelligent IT is expected to revolutionize the modern economy and society by **enabling the mechanization** of formerly unmechanizable **aspects of industries**, thereby maximizing productivity and **completely transforming the industrial structure**. This is what has come to be called the "Fourth Industrial Revolution." "

III

Forecasts of Possible Changes Brought about by Intelligent IT

1 ▶ Transformation of industrial structure

2 ▶ Transformation of employment structure

3 ▶ Transformation of lifestyles and living environments

4 ▶ Impact on the Korean economy and employment

# Ⅲ Forecasts of Possible Changes Brought about by Intelligent IT

1. Transformation of industrial structure

Rise of data and knowledge as new sources of competitiveness

■ Intelligent IT is capable of improving its own algorithms based on machine learning made possible through the accumulation of data, thus making data and knowledge new sources of industrial competitiveness.

✔ Companies capable of developing systems that amass data independently and possess algorithms that allow them to make use of such systems will emerge as industry leaders.

* As of August 2016, seven of the ten most highly valued corporations in the world (i.e., Apple, Google, Microsoft, Amazon, Facebook, GE, and China Mobile) were leading ICT developers that were also investing aggressively in Intelligent IT.
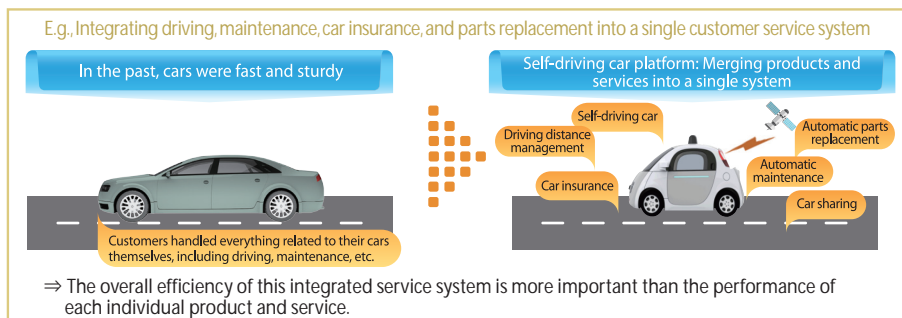
< World's Largest Listed Companies by Market Capitalization (2006 - 2016) >

*Source: Bloomberg
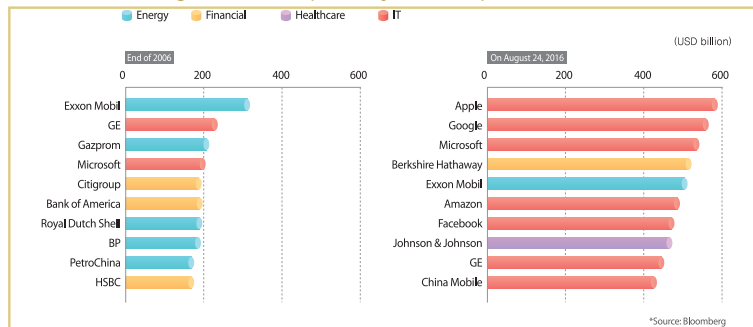
✔ Scales of operating facilities and sizes of workforces will decline in relative importance as it becomes critical for businesses to make timely responses to changes in market demand. Manufacturers will thus increasingly reshore* their operations back to their home countries.

* E.g., Adidas, with its robotic production system, was able to reshore its manufacturing facilities from Asia back to Germany and the United States while also reducing its production period from one week to five hours.

Shifting center of competition to platforms and ecosystems

■ In order to benefit from Intelligent IT, industries need to establish ecosystems and platforms that encourage as many users as possible to participate, so that they can generate data to use and share.

✔ Intelligent information platforms that link multiple products and services have overwhelming advantages over stand-alone products and services.

E.g., Integrating driving, maintenance, car insurance, and parts replacement into a single customer service system

In the past, cars were fast and sturdy

Customers handled everything related to their cars themselves, including driving, maintenance, etc.

Self-driving car platform: Merging products and services into a single system

Self-driving car
Driving distance management
Car insurance
Automatic parts replacement
Automatic maintenance
Car sharing

⇒ The overall efficiency of this integrated service system is more important than the performance of each individual product and service.

- Leading ICT companies, such as Google and Apple, are expanding their platforms to include other products and services, including vehicles and driving.

  ✔ As these major ICT platform providers play leading roles in shaping industrial ecosystems, based on their productivity and popularity, they induce other companies to become platform providers as well,* intensifying the competition among platforms as a result.

  * E.g., In September 2015, General Electric (GE) unveiled the industrial cloud-based platform Predix, which provides preventive maintenance and operational efficiency maximization services for industrial machinery.

Emergence of winner-takes-all platforms and new opportunities for growth

- Intelligent IT improves its performance and precision independently through continuous learning. Therefore, the earlier a company expands into the platform market, the better its chances of monopolizing the market.

  ✔ Over the years, major platform providers have amassed immense amounts of data from countless users, enabling them to provide quality services at affordable costs. This, in turn, attracts even more users by virtue of the network effect, thus allowing platform providers to achieve economies of scale based on their numbers of users and volumes of data.

< Monopolization of the Platform Market >

 Apple's dominance of the mobile market

- Since launching the first iPhone in 2007, Apple has successfully established an expanding Apple ecosystem based on its mobile platform.
  - The ecosystem boasts a virtuous cycle in which the growth in the number of users leads to greater participation by mobile application developers and greater utility of the overall ecosystem.
- With its unique mobile platform and ecosystem, Apple has emerged as the undisputed leader of the global smartphone market.
  ※ Apple's share of the global smartphone market: 62% in 2013, 78% in 2014, and 88% in 2015

- In the meantime, the rise and spread of global mobile platforms for applied services have opened up new opportunities for startups and other small companies to achieve rapid growth.

  ✔ Using these platforms, small businesses can distribute their products and services to consumers worldwide with speed and ease, increasing their chances of becoming "micro-multinationals."

Implications

▶ After being adapted and applied to all industries, Intelligent IT is expected to **revolutionize the current industrial structure.** Businesses therefore need to ensure their continued competitiveness by **adopting and disseminating innovative technologies proactively.**

▶ The lapse of time between early pioneers and latecomers will lead to **widening technology gaps** in the global platform market over time. As the fast-follower strategy has only limited effectiveness in this market, businesses need to **develop first-mover strategies.**

▶ As Intelligent IT depends on the analysis of massive amounts of data, it is critical for policymakers to ensure and **foster the quantitative and qualitative growth of the data market** by supporting the generation and collection of large amounts of data, preventing the monopolization of data by a single company, and improving privacy protection regulations.

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2. Transformation of employment structure

⯈ Automation to eliminate some jobs while creating other jobs in new industries

- Intelligent IT will likely intensify the polarization of the employment structure by not only taking over unskilled and repetitive tasks but also automating complex intellectual tasks, office tasks of intermediate levels of difficulty, and precision manual labor.

- On the other hand, Intelligent-IT-related industries will see increases in demand for personnel, leading to the creation of jobs in new industries, as has been the case in all previous industrial revolutions.

⯈ Human work to become concentrated in creative activities with high value added

- Human workers will become increasingly concentrated in creative and emotional activities, which machines cannot replace so easily. Workers in these fields will enjoy better treatment as well.

  - Machines can easily take over intellectual and physical labor that is characterized by fixed forms or patterns. Therefore, human-machine competition over such work will intensify, leading to increasingly worse treatment and job quality for human workers in these areas.

⯈ Reduced job security vs. greater job flexibility

- ICT platforms will bring down the traditional barriers among industries, as employers increasingly seek out employees with functional expertise rather than industry or trade expertise.

- The terms of labor contracts will become shorter, with even skilled office personnel working on temporary and contract-based terms in greater numbers, providing their services and knowledge for only specific projects.

  - The growth of the sharing economy, online-to-offline (O2O) services, crowd work, and online service platforms will increase demand for non-regular workers, such as platform-dependent workers.*

    * Growing numbers of platform-dependent workers will become self-employed freelancers rather than full-time workers employed by companies.

Implications

- It will become increasingly important for companies to **recruit and hire specialized and skilled personnel with core capabilities** related to the application of Intelligent IT to diverse industries.

- Policymakers will need to **devise measures**, such as **re-training**, for people who lose their jobs due to automation.

- The unemployment security net should be strengthened, particularly for wage workers, with **social security for platform-dependent workers** expanded as well.

3. Transformation of lifestyles and living environments

Reduced cost, enhanced quality, and increased convenience of services

- Intelligent IT will enhance the precision of medical diagnostics and treatments and contribute to decreasing the cost and improving the quality and accessibility of healthcare services.

- Advanced language cognition and machine translation technologies will enhance the accessibility and convenience of services available inside and outside Korea, lowering language and cultural barriers.

Safer living environments

- Patrolling, surveillance, and other dangerous tasks will become increasingly automated. Big data analyses will assist in the development and improvement of crime-forecasting models, with the goal of reinforcing national and public security.

- Real-time updates on traffic information and the intelligent control of traffic flows will help minimize traffic congestion and car accidents.

Personalized and customized services for individuals

- Students will have more opportunities to learn at their own pace. The facilitation of self-directed learning will reduce the demand for, and financial burden of, private education, while enabling teachers to focus more on character-building and creativity-enhancing education.

- Intelligent IT will enhance the precision of welfare demand forecasts and contribute to maximizing the efficiency and effectiveness of welfare services for diverse groups, including seniors, children, people with disabilities, the underprivileged, and unskilled workers.

Negative impacts: polarization, social conflicts, threats to privacy, and alienation

- The tendency of Intelligent IT to strengthen the "winner-takes-all" trend will lead to increased socioeconomic polarization, while the inability of the legal system and social institutions to keep abreast of the latest ICTs will likely result in various social conflicts.

- The data-centered society will pose increasing threats to not only privacy but also national security by increasing the risk of cyber attacks against the national infrastructure and systems governing energy, transportation, etc.

Implications

- Intelligent IT should be applied to the public sector **first to solve social problems**, realize public interests, and **foster market-level demand for the growth** of new industries and improvement of related services.

- Policymakers should seek out balanced approaches toward utilizing and protecting personal information and develop effective **counterstrategies against possible cyber attacks.**

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4. Impact on the Korean economy and employment

Economic impact

- Intelligent IT will pave new ground for new growth. The aggregate economic effects* (including new revenue generated, costs saved, and increased consumer welfare) are expected to amount to KRW 460 trillion by 2030 (McKinsey, 2016).

  * The gross domestic product (GDP) includes the market value of products only, failing to reflect other forms of value, such as decreases in the cost of production and increases in consumer welfare.

  ✔ Intelligent IT is likely to generate KRW 41.9 to 85.4 trillion in new revenue, reduce costs by KRW 109 to 199 trillion, and increase consumer welfare by KRW 76.4 to 174.6 trillion.

- New sources of revenue: data-based marketing (up to KRW 10 trillion), robotics (up to KRW 30 trillion), etc.
- New means of reducing costs: increased precision of medical diagnostics (up to KRW 55 trillion), optimization of manufacturing processes (up to KRW 15 trillion), etc.
- New sources of consumer welfare: reduced car accidents (up to KRW 10 trillion), improved air quality (up to KRW 7.6 trillion), reduced traffic congestion (up to KRW 30 trillion), reduced housework (up to KRW 10 trillion), improved public health (up to KRW 10 trillion), etc.

- Healthcare is likely to benefit the most from Intelligent IT in terms of new revenue generated and costs saved (up to KRW 109.6 trillion), followed by manufacturing (up to KRW 95 trillion) and finance (up to KRW 47.7 trillion).

  ✔ Consumer welfare is most likely to be enhanced in transportation (up to KRW 36.5 trillion), urban management (up to KRW 36.2 trillion), and wellness (up to KRW 17.2 trillion).

< Aggregated Economic Effects of Intelligent IT in South Korea by 2030 (McKinsey, 2016) >
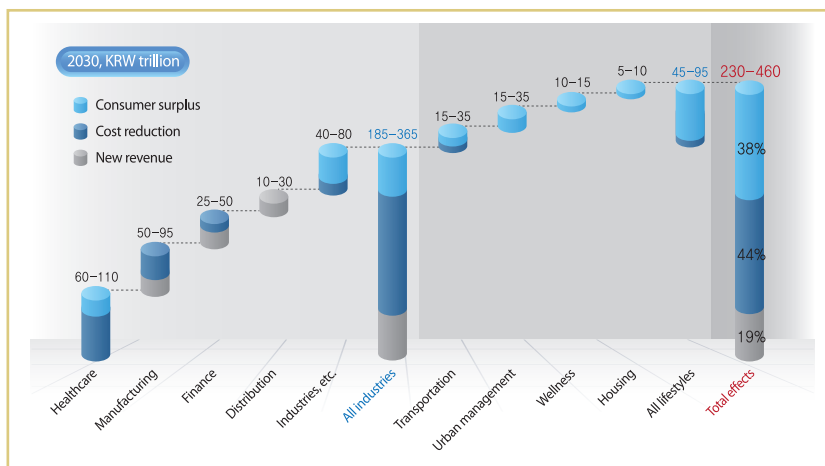
Note 1 — Summary of the Economic Effects of Intelligent IT in Nine Main Areas (as of 2030)

Area	Industry/ domain	Anticipated benefits of applying Intelligent IT	Economic effect (in trillion KRW)	Maximum economic effect by factor/cause
Industries	Health-care	▪ Enhanced effectiveness and efficiency of medical diagnoses and treatments ▪ Optimized efficiency of investment in and operation of hospital facilities and equipment ▪ Maximized efficacy of clinical trials and supply chain management ▪ Reinforced accuracy and safety of surgical processes through use of intelligent robotics	60~110	▪ Up to KRW 55 trillion to be saved in treatment costs through improved diagnostic accuracy
	Manufac-turing	▪ Extended lifespans and reduced equipment failures in six major industries (electronics, automobiles, petrochemicals, machinery, steel, and shipbuilding) thanks to increases in operational efficiency and preventive maintenance ▪ Growth of new robotics manufacturing market ▪ Increased productivity and reduced accident rates through the application of robotics	50~95	▪ New robotics revenue to grow by up to KRW 30 trillion ▪ Cost of maintenance to be reduced by KRW 25 trillion through preventive maintenance for machinery used in electronics manufacturing
	Finance	▪ Enhanced accuracy of customer credit risk assessments ▪ Enhanced traceability of sources, routes, and ends of financial flows	25~50	▪ Up to KRW 30 trillion in transaction costs to be saved by minimizing illegal capital accumulation through capital tracing and analysis
	Distri-bution	▪ Increased revenue through data-based customer management and marketing ▪ Optimization of shop management (inventory, shop location, automatic transactions, etc.) thanks to big data and sensor technology	10~30	▪ Revenue to increase by up to KRW 10 trillion through marketing based on customer and location data
	Indus-tries, etc.	▪ Lowered language barriers thanks to machine translation ▪ Maximized efficiency of office space and energy management and reduced cost of security ▪ Increased efficiency of maintaining and operating agricultural and mining equipment ▪ More effective control of ground transportation routes	40~80	▪ Trade revenue to increase by up to KRW 50 trillion thanks to lowered language barriers through machine translations
Life	Transpo-rtation	▪ Fewer accidents thanks to introduction of (semi) self-driving cars ▪ Reductions in driving hours, fuel consumption, and parking space occupancy due to more efficient vehicle management ▪ Extended lifespans of and reduced maintenance costs for vehicles through connected-vehicle-platform-based preventive maintenance	15~35	▪ Effect of reduced driving hours, thanks to use of self-driving cars, to reach up to KRW 10 trillion ▪ Effect of extended vehicle lifespans to amount to KRW 10 trillion
	Urban manage-ment	▪ Reductions in driving hours, fuel consumption, and carbon emissions through more efficient real-time traffic control based on congestion analyses	15~35	▪ Effect of reduced traffic congestion and driving hours to amount to KRW 30 trillion
	Wellness	▪ Improved health through daily exercise and health-monitoring programs ▪ Reduced prevalence of diseases and lower mortality rates through real-time monitoring of and responses to air and water pollution	10~15	▪ Effects of improved health, through the use of wearable devices that encourage daily exercise, and greater efficiency of environmental improvement activities to amount to KRW 10 trillion
	Housing	▪ Reductions in time spent on chores thanks to automated housework systems ▪ More efficient energy management and security through smart home systems	5~10	▪ Effect of reduced chores to amount to KRW 10 trillion

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Impact on employment
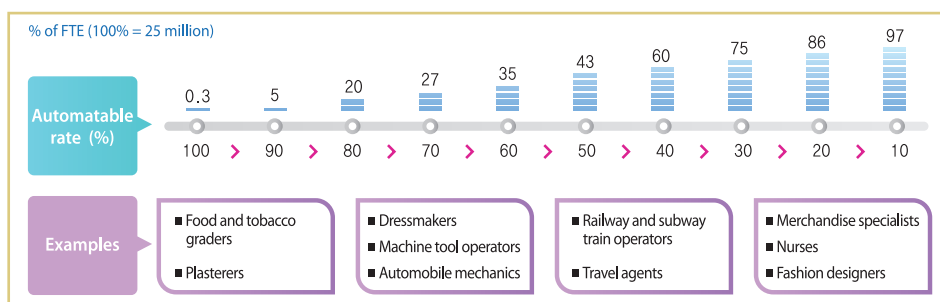
< Changes in the nature and quality of work >

- An analysis of 25 million working people across 414 occupations in Korea showed that about 49.7 percent* of all work hours put in by people in these jobs nationwide could be automated by 2030 (McKinsey, 2016).

  * This forecast is based on the assumption that all automation technologies currently being researched are fully realized.

  ✓ Forecasts of the extent to which the automated tasks will give rise to new human tasks, such as planning and communication, are limited, because such forecasts are subject to a number of unpredictable changes in the economic environment and business strategies.

- Almost 86 percent of all workers in Korea today spend over 20 percent of their working hours on tasks that will one day be automated. Intelligent IT will thus have a profound impact on these people's lives.

  ✓ However, only 0.3 percent of jobs today can be fully automated.

< Cumulative Ratios of People Working in Automatable Occupations >

% of FTE (100% = 25 million)

| Automatable rate (%) | 0.3 | 5 | 20 | 27 | 35 | 43 | 60 | 75 | 86 | 97 |
| | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 |

Examples:
- Food and tobacco graders
- Plasterers
- Dressmakers
- Machine tool operators
- Automobile mechanics
- Railway and subway train operators
- Travel agents
- Merchandise specialists
- Nurses
- Fashion designers

< New jobs created >

- Intelligent IT is also expected to create up to 800,000 new jobs by 2030, especially positions for software engineers and data scientists.

< Job-Creating Effects of Intelligent IT >

Model	Description	Estimates
Other countries' estimates of AI-created jobs	Using estimates of future AI-created jobs in the United States, Canada, Australia, etc., to estimate job-creating effects.	100,000 to 450,000 jobs
Forecasts from outside sources	Adding up new AI- and big-data-related jobs included in the by-industry and by-trade workforce estimates of outside agencies, such as the Korea Employment Information Service.	600,000 to 800,000 jobs

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Note 2 — Job-Creating Effect of Intelligent IT by Occupation in Korea (McKinsey, 2016)
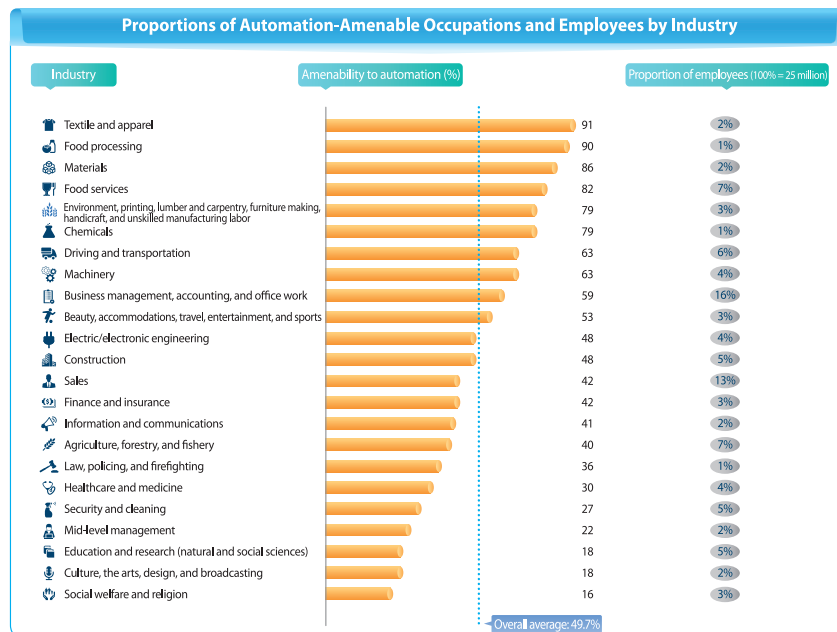
Analysis method

- A total of 414 occupational categories were analyzed in terms of the respective composition of the different types of tasks involved and the types and levels of technical skills required for each task.

< Analysis of the Composition of Tasks and Levels of Technical Skills Required (Sample) >

Occupation	Task composition	Technical skills	Level
Shop clerk	Greeting customers	Sensory perception	2
Teacher	Handling requests related to products and services	Perception of learned patterns	3
Medical practitioner	Cleaning and organizing working spaces	Logical deduction and problem solving	1
…	…	…	…

Findings

- How amenable a given occupation is to automation varies significantly with the characteristics of the tasks involved.

  - ✓ The majority of occupations amenable to automation involve simple and standardizable tasks, such as operating machinery (e.g., dental technician, washing machine operator, plasterer, etc.).

  - ✓ Occupations less amenable to automation tend to require creativity, the ability to empathize, and a high degree of manual dexterity (e.g., nurse, product designer, actor/model, etc.).

Proportions of Automation-Amenable Occupations and Employees by Industry

Industry	Amenability to automation (%)	Proportion of employees (100% = 25 million)
Textile and apparel	91	2%
Food processing	90	1%
Materials	86	2%
Food services	82	7%
Environment, printing, lumber and carpentry, furniture making, handicraft, and unskilled manufacturing labor	79	3%
Chemicals	79	1%
Driving and transportation	63	6%
Machinery	63	4%
Business management, accounting, and office work	59	16%
Beauty, accommodations, travel, entertainment, and sports	53	3%
Electric/electronic engineering	48	4%
Construction	48	5%
Sales	42	13%
Finance and insurance	42	3%
Information and communications	41	2%
Agriculture, forestry, and fishery	40	7%
Law, policing, and firefighting	36	1%
Healthcare and medicine	30	4%
Security and cleaning	27	5%
Mid-level management	22	2%
Education and research (natural and social sciences)	18	5%
Culture, the arts, design, and broadcasting	18	2%
Social welfare and religion	16	3%

Overall average: 49.7%

17

IV

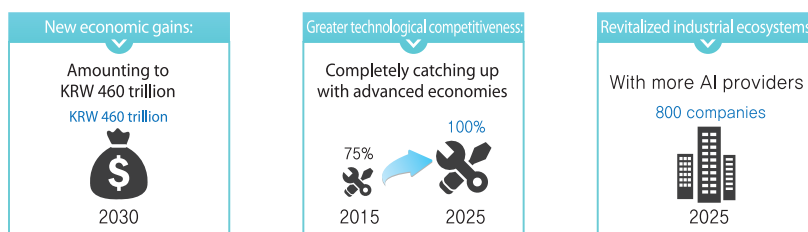# Future Prospects and
Core Factors of Success

IV Future Prospects and Core Factors of Success

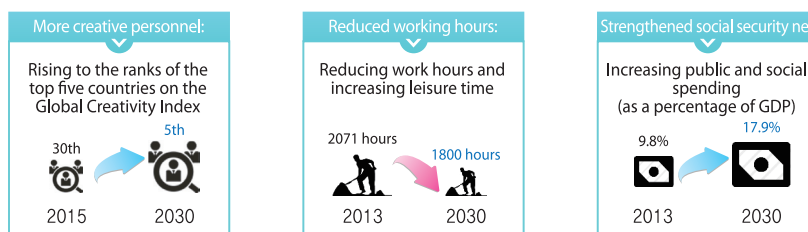## 1. Prospects of Intelligent IT

Prospect 1: A free and competitive economy with significant value added

- With Intelligent IT, we may be able to **overcome the low-growth trap** and foster an environment for sustainable growth by enhancing industrial competitiveness and revitalizing industrial ecosystems.
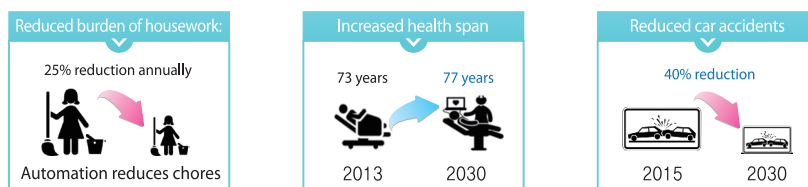
New economic gains:	Greater technological competitiveness:	Revitalized industrial ecosystems:
Amounting to KRW 460 trillion	Completely catching up with advanced economies	With more AI providers
KRW 460 trillion	100%	800 companies
	75%	
2030	2015 2025	2025

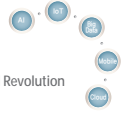### Prospect 2: A society that offers more opportunities for everyone

- Intelligent IT also has the potential to strengthen the **uniquely human** faculties of creativity and empathy. It could also increase the stability and security of people's everyday lives by expanding the social security net.

More creative personnel:	Reduced working hours:	Strengthened social security net
Rising to the ranks of the top five countries on the Global Creativity Index	Reducing work hours and increasing leisure time	Increasing public and social spending (as a percentage of GDP)
30th 5th	2071 hours 1800 hours	9.8% 17.9%
2015 2030	2013 2030	2013 2030

Prospect 3: Greater safety and happiness in people's everyday lives

- Intelligent IT is expected to **enhance consumer welfare** by preventing diseases, increasing the efficacy of healthcare, improving people's living environments, reducing accidents, and facilitating progress in other areas not reflected in the GDP.

Reduced burden of housework:	Increased health span	Reduced car accidents
25% reduction annually	73 years 77 years	40% reduction
Automation reduces chores	2013 2030	2015 2030

2. South Korea's current status: A SWOT analysis

Strengths	Weaknesses
▪ Topnotch ICT infrastructure ▪ Tech-savvy people ▪ Aggressive government investment in R&D ▪ World-class manufacturing infrastructure ▪ Zeal for education	▪ Reluctance to invest in startups with innovative technologies or potential for M&A deals ▪ Lack of entrepreneurial spirit and will to rise to challenges and take risks ▪ Lack of quality data infrastructure ▪ Monolithic education and hiring-centered employment policy ▪ Rigid, vertical regulatory system
Opportunities	Threats
▪ Using Intelligent IT to solve social problems ▪ Using Intelligent IT to strengthen competitiveness of major industries and pioneer new markets ▪ Using knowledge and data to achieve greater growth in the global market	▪ Encroachment by global corporations into Korean industries ▪ Rapidly changing structure of employment and socioeconomic polarization ▪ Fairness-related controversies over platform monopolization and other such issues ▪ Increased risks of hacking and threats to privacy

3. Core factors of success

▶ Enhancing Korea's Intelligent IT capabilities and strengthening its data infrastructure

- As technology, data, and networks are the stepping-stones to the intelligent information society, it is critical to foster and develop innovative technologies, establish super-connected networks, and ensure the active use of data.

- Investment in R&D should be increased in order to bring Korean technology to a level on par with the world standard, ensure the sustained advancement of the nation's network infrastructure, and increase the amounts of quality data being collected and used.

  * Korea is lagging behind the United States by 2.4 years in terms of Intelligent IT, owing to the lack of long-term investment in the development of original and applied Intelligent IT (IITP, 2016).

    • The Korean government's R&D budget for Intelligent IT in 2016, which includes investment in intelligent software, basic technologies, and human resources development, accounts for only 0.7 percent of the overall national R&D budget (KRW 134.8 billion out of KRW 19 trillion).

  * Although Korea possesses first-rate ICT infrastructure, the data utilization rate across Korean industries is a meager 4.3 percent (NIA, 2016).

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Achieving greater convergence between Intelligent IT and existing industries

■ Applying Intelligent IT to existing industries proactively is essential to managing the inevitable changes in the existing industrial structure. It is equally important to identify and foster new industries through convergence with Intelligent IT.

■ In particular, Intelligent IT should be applied first and foremost to public services. Policymakers should also devise a more flexible regulatory regime in order to deal with technologies that are not addressed by the existing legal system and institutions.

  * Of the 33 member states of the Organization for Economic Cooperation and Development (OECD), South Korea is ranked fourth in terms of the indicators of product market regulation (2013).

Reforming the labor market and increasing education for creative personnel

■ The labor market should be made more flexible (with increasing emphasis on meritocracy and the flexibility of working hours and arrangements), employment services enhanced, and the social security net strengthened in anticipation of the likely changes in the employment structure.

  * Korea's rigid employment practices and customs continue to prevent the country's labor market from becoming more efficient (ranked 53rd on the IMD's survey of labor market efficiency in 2016).

■ Education should be designed to foster creativity and the technological capacity of the public, through software- and convergence-based learning, so as to increase the number of globally competent and capable workers.

  * Only two or three dozen skilled specialists with doctorates in AI are produced each year in Korea.

  * Korea ranked 31st among 133 countries on the Global Creativity Index (Martin Prosperity Institute, 2013).

  * Elementary school students in Korea are expected to receive at least 17 hours of software education each by 2019 (compared to 70 hours in China, 180 hours in the United Kingdom, and 240 hours in India).

< Structure of Intelligent Information Society and Core Factors of Success >
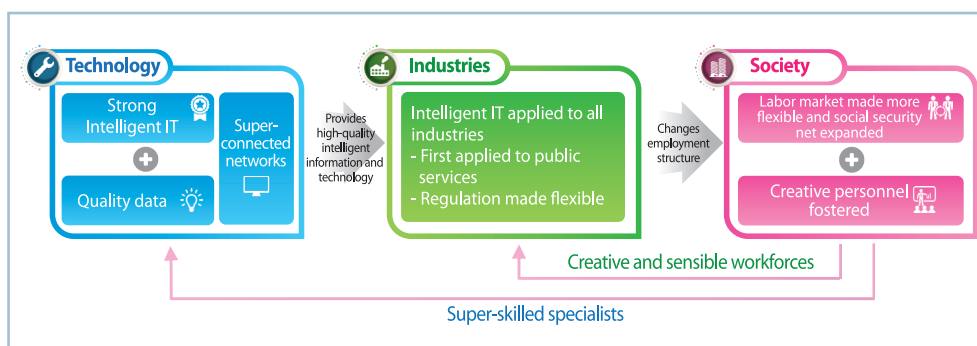
Note 3 | **How Different Actions Could Lead to Different Futures**

	Result if appropriate action is taken	Appropriate action	Result of maintaining status quo
Technology	Rapid development of Intelligent IT industries → leadership in the global market	Secure Intelligent IT ahead of others	Losing leadership in Intelligent IT to the U.S., China, Japan, etc.
	Opportunities to generate new value using data guaranteed for everyone	Acquire, apply, and distribute quality data	Lack of quality data hampering the development of Intelligent IT industries
	Industries and social activities growing increasingly connected, with more data being gathered and disseminated	Develop a super-speed, super-connected intelligent network	Inadequacy of convergence leading to redundancy and inefficiency of resources
Industries	Intelligent IT making actual differences in people's lives, generating demand in the early market stage	Apply Intelligent IT to public services first	Intelligent IT making little difference in people's lives
	New business models, based on new technologies and ideas, proliferating	Achieve innovation in private-sector services	Delays in private-sector development of ideas leading to failure in the global market
	New businesses proliferating, along with "unicorn" companies	Foster the Intelligent IT industry ecosystem	Intelligent IT market growth limited, with only a few multinational corporations dominating
	Health span increasing, with society becoming free from diseases	Achieve innovation in medical services	Delays in healthcare innovation limiting benefits for medical consumers
	Major industries advancing to overcome low growth and pioneer new markets abroad	Reform sources of competitiveness for manufacturing	Korean industries losing leadership in the global market, becoming permanently mired in low-growth trap
Society	Creative workers boosting industrial competitiveness and creating more opportunities for personal growth	Foster creative personnel	Employers finding it increasingly difficult to hire suitable workers, and opportunities for personal growth limited
	Ensuring competitiveness of Intelligent IT with super-skilled personnel	Foster super-skilled specialists	Shortage of skilled specialists leading to delays in the development of Intelligent IT
	People becoming able to work the hours they want and use their spare time for self-development	Enhance labor market flexibility and strengthen unemployment security net	Unemployment becoming a permanent issue, with little job security for contract workers
	Protecting the dignity of the jobless and the underprivileged	Expand the social security net	Declining standard of living and intensifying socioeconomic polarization
	Safe use of technology leading to greater social acceptance	Increase the safety of technology	Fears over safety of technology stifling innovation

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Vision and Strategy

V Vision and Strategy

National Vision

Realizing a Human-Centered Intelligent Information Society

Roles and Responsibilities

Businesses

- Foster a healthy ecosystem of competition over innovative Intelligent IT and services

  - Secure the rights and access to intellectual properties available worldwide through R&D, M&A, and strategic alliances

  - Recognize the value of data and technologies and invest in and develop new services that make use of Intelligent IT

- Fulfill social responsibilities, such as ensuring the timeliness and transparency of decision-making processes, meritocracy in hiring, and reinforced re-training for employees

Citizens

- Enhance creativity, understanding of Intelligent IT, and other core capabilities necessary to lead society into the future

  - Participate actively in new Intelligent IT industries based on an entrepreneurial spirit and the boldness to take risks

- Participate actively in the policymaking process (e.g., suggest ways of using Intelligent IT to solve social problems)

  - Participate in social discourses concerning legal and regulatory reforms, transition to a more flexible regulatory regime, etc.

Government

- Foster the market environment so as to boost and maximize the effectiveness of the private sector

  - Implement a balanced system of market-promoting policies (supporting entrepreneurship, providing test beds, etc.) and regulatory policies (fair competition, privacy protection, etc.)

  - Provide fertile ground for increasing private-sector investment by first applying Intelligent IT to public services

- Develop and foster social and cultural infrastructure to support entrepreneurial endeavors, human resources development, and a new Intelligent IT culture

Research community

- Support the development of technologies and human resources

  - Carry out basic R&D related to Intelligent IT that corporations tend to avoid

  - Support systemic human resources development through convergence- and creativity-oriented education

- Enhance expertise in the intelligent information society and articulate future visions

  - Lead research on the social and economic effects of Intelligent IT

Social Needs

Public's concerns	Loss of jobs Unsafe and inappropriate use of technologies			
Businesses' concerns	Shortage of experts	Excessive regulation	Lack of industrial ecosystem	Lack of infrastructure

Strategy

Foster an intelligent information society on the basis of public-private partnership, with businesses and citizens playing leading roles and the government and research community providing support.

- Foster a market-leading approach that enables businesses and citizens to increase their competitiveness in anticipation of the Fourth Industrial Revolution and related innovations.

- The government and research community should support private-sector initiatives by establishing infrastructure and ecosystems for the development of original technologies and human resources and correcting market failures, particularly with respect to protecting the weakest members of society, while sharing a strong vision regarding future developments.

Devise and implement a balanced policy regime that encompasses technologies, industries, and society and shapes the development of a more humane society.

- Present policy objectives and aims that take into careful consideration the desired, society-wide innovations that the convergence of Intelligent IT, industries, and social activities will bring about.

- Implement a balanced approach to the development of technology and industry policies that aim to enhance national competitiveness, on the one hand, and social policies (employment, education, welfare, etc.) based on public opinion, on the other.

Provide strategic support for the prompt securement of the rights and access to Intelligent IT and other related resources to ensure and foster industrial competitiveness in advance.

- Intelligent IT should first be applied proactively to industries and services with the potential to maximize the network effect, such as public services (national defense, security and administration), healthcare, and manufacturing.

- Concentrate support on the procurement of data, technologies, and core personnel so as to enable businesses to establish early dominance in Intelligent IT ecosystems and enhance their technological expertise.

Reform policies and expand the social security net on the basis of social consensuses.

- Prepare society for industrial transformation by implementing flexible and effective social policies on education, employment, and welfare, backed by public support.

- Raise public awareness of the negative impacts of technological innovation, such as threats to privacy, socioeconomic polarization, and human alienation, and establish a structure for broad public discourses on identifying and managing these risks.

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Policy tasks

Strategic Policy Tasks for the Realization of a Humane Intelligent Information Society: Encompassing Technology, Industry, and Society at Large

	Technology	Industries	Society
Objectives	Establish world-class infrastructure for Intelligent IT	Promote the application of Intelligent IT to all industries	Take proactive steps to reform and strengthen the social support system
Policy focus	• Strengthen technologies and data as sources of competitiveness • Develop networks that ensure secure access to data	• Catalyze private-sector innovation based on public-sector examples • Concentrate support on industries with the potential for significant ripple effects (e.g., medicine and manufacturing)	• Reform the education, employment, and welfare policies that form the social basis for Intelligent IT • Reinforce countermeasures against pending issues (e.g., cyber threats and ethical concerns)
Tasks	○ Generate value from data, the source of future competitiveness ○ Develop infrastructure for Intelligent IT ○ Establish a super-connected networking environment centered on data and services	○ Proactively apply Intelligent IT to public services ○ Support private-sector innovation by forming ecosystems for Intelligent IT industries ○ Generate new value through intelligent healthcare services ○ Ensure the digital innovation of manufacturing	○ Achieve innovation in education for the future ○ Proactively manage automation and the diversification of employment types ○ Strengthen the social security net in response to the rise of the intelligent information society ○ Reform laws and ethics to ensure harmonious human-machine coexistence ○ Counter downsides (e.g., cyber threats and AI failures)

< Analysis of Government's Role in Strategic Policy Tasks and their Urgency >

Government's role (vertical axis: Weak to Strong)
Urgency (horizontal axis: Weak to Strong)

- 10 Strengthen the social security net in response to the rise of the intelligent information society
- 4 Proactively apply Intelligent IT to public services
- 9 Proactively manage automation and the diversification of employment types
- 8 Achieve innovation in education for the future
- 11 Reform laws and ethics to ensure harmonious human-machine coexistence
- 5 Become a partner in private-sector innovation
- 1 Generate value from data, the source of future competitiveness
- 3 Establish a super-connected networking environment centered on data and services
- 2 Achieve competitiveness in Intelligent IT
- 12 Counter downsides (e.g., cyber threats and AI failures)
- 6 Generate new value through intelligent healthcare services
- 7 Ensure the digital innovation of manufacturing

Technology · Industries · Society

VI

Mid- to Long-Term Policy Aims for Intelligent Information Society

VI Mid- to Long-Term Policy Aims for Intelligent Information Society

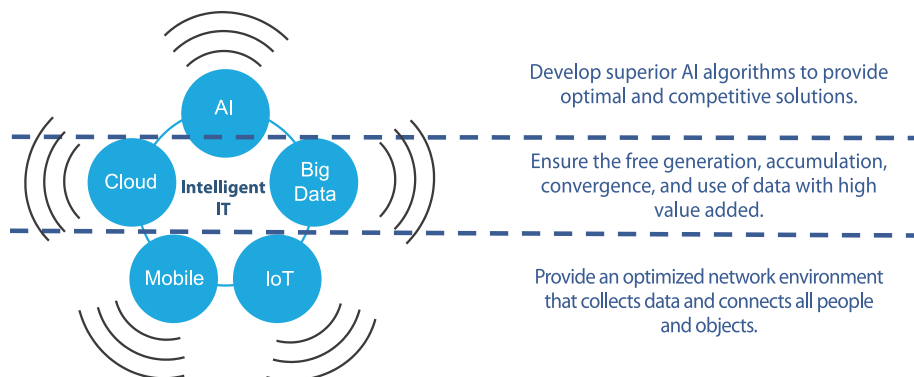# 1. Establishment of world-class infrastructure for Intelligent IT

▶ **Background:** The rapid advancement of Intelligent IT has the potential to transform not only ICT-related industries but also all future industries, profoundly reshaping the sources of national competitiveness.

- Promptly securing the rights and access to advanced Intelligent IT will enable Korean businesses to establish leading positions in the high-value-added industrial ecosystem, based upon which they will be able to easily expand their global presence and grow into world-class corporations.

- Failure to secure the rights and access to innovative technologies will allow the established multinational ICT corporations to maintain their current monopolies in the global Intelligent IT ecosystem, limiting the extent to which Korean businesses can play leading roles in innovation.

  ※ There already exists a sizable technology gap between Korea and other advanced countries, raising fears of the technological subjugation of Korean businesses to multinational corporations.

▶ **Policy objective:** Develop and foster data and network infrastructure with which Korean businesses can develop their own innovative technologies, thereby enabling them to secure leading positions in the global market.

- As economic actors increasingly share, deal in, and utilize data, the quality of their products and services will improve, generating greater value added.

- Original technologies rivaling those of advanced countries should be developed, along with a platform for the application of Intelligent IT to public services in Korea.

- All objects should be designed to generate and transmit data through a nationwide connected network so that data can be gathered, stored, and utilized effectively.

AI

Cloud · **Intelligent IT** · Big Data

Mobile · IoT

Develop superior AI algorithms to provide optimal and competitive solutions.

Ensure the free generation, accumulation, convergence, and use of data with high value added.

Provide an optimized network environment that collects data and connects all people and objects.

"Because all these technologies involve **high risks** and require long-term research and investment, an effective **public-private partnership** needs to be established to create the data and network infrastructure necessary for the development of these technologies."

2. Promotion of the application of Intelligent IT to all industries

▶ **Background:** In an intelligent information society, knowledge and data serve as the central sources of competitiveness. It thus becomes crucial for all industries to make active use of Intelligent IT.

■ Making active use of Intelligent IT is essential to achieving convergence, maximizing productivity, fostering new industries, and overcoming the low-growth trap.

■ Failure to make use of Intelligent IT would lead Korean industries to fall behind in terms of global competitiveness and become permanently caught in the low-growth trap, as well as intensify the problems associated with population aging and cause unemployment to run rampant, thereby compromising overall national competitiveness.

　※ The growth rates of all 10 major Korean industries, including automobile manufacturing, shipbuilding, and steel, are expected to fall.

▶ **Policy objective:** Apply Intelligent IT to public services and the entire private sector to enhance productivity, efficiency, and national competitiveness.

■ Allow existing industries, such as manufacturing, healthcare, and finance, to generate greater value added through convergence with Intelligent IT and data.

■ Foster an industrial ecosystem that encourages new enterprises, possessing innovative ideas and technologies, to emerge and pioneer new growth engines.

■ Provide safe, intelligent, and quality public services for citizens.

· Develop customized and personalized treatments and drugs based on genetic analyses.

· Refine and personalize healthcare services based on enhanced diagnostic accuracy and prescription records.

· Universalize housework robots specializing in cleaning, cooking, childcare, and nursing.

· Minimize production times and manufacture small quantities of multiple product models with a focus on satisfying actual demand using 3D printers.

· Make available self-driving buses and taxis that reduce the risk of accidents.

· Apply blockchain to financial services and enhance the security and reliability of various systems.

· Use intelligent surveillance cameras and big data to prevent and manage international crime and terrorism.

· Design a comprehensive welfare system that provides lifecycle-specific services (unemployment, housing, care services, healthcare, etc.).

· Develop an instant-messaging system that provides immediate updates on public services (laws, taxes, etc.).

· Maximize the convenience of shopping and allow consumers to shop and make purchases no matter the time or place.

· Support energy prosumers, who generate the energy they need on their own and sell surplus energy to others.

· Design robotics-based systems for analyzing wealth management and preventing financial fraud.

" As a partner in private-sector innovation, the government should **encourage greater private-sector investment** by first setting an example for the **application of Intelligent IT to public services, reforming regulations**, and providing related **test beds and ecosystems.** "

3. Proactive steps toward reforming and strengthening the social support system

⫸ **Background:** Automation has the potential to significantly increase the convenience and safety of people's everyday lives; however, it could also threaten job security, intensify socioeconomic polarization, and increase the risk of hacking and cyber crimes.

- Effective management of these socioeconomic changes, however, will lead to greater benefits, such as reduced working hours, more jobs with value added, and simple and mechanical solutions to various social problems.

- Failure to manage these changes, on the other hand, will lead income levels to drop, socioeconomic polarization to intensify, and privacy to face increasing threats.

  ※ Rote education, the rigid structure of the labor market, and other such factors are obstacles to the effective management of Intelligent IT.

⫸ **Policy objective:** Reform and tailor education, employment, and welfare services in response to changes in order to ensure that all citizens are able to enjoy the benefits of the intelligent information society.

- Foster and educate active workers capable of leading the intelligent information society based on their creativity and emotional intelligence.

- Ensure opportunities for a decent and humane standard of living by supporting the re-training of personnel and improving the employment and welfare environments.

- Prepare systemic measures to allow all citizens to make use of Intelligent IT without fears of worsening socioeconomic polarization, alienation, or attacks on privacy.

Employment
- Create Intelligent-IT-friendly jobs.
- Enhance labor market flexibility.
- Strengthen on-demand worker protection.
- Reinforce specialized training in Intelligent IT.
- Expand the employment security net.

Industries
Biotechnology, National security, Healthcare, Welfare, Robotics, Public administration, Manufacturing, Distribution, Transportation, Energy, Security, Finance
AI, IoT, Intelligent IT, Mobile, Big Data, Cloud

Education
- Provide education to foster core capabilities and competencies in the intelligent information society.
- Eliminate rote learning and embrace creativity in education.
- Provide intelligent and customized education.
- Educate and develop super-skilled specialists to lead the development of future technologies.

Welfare
- Expand the social security net for vulnerable members of society.
- Eliminate blind spots in the provision of welfare services.
- Personalize and customize welfare services.
- Establish a sustainable basis for welfare.

> Foster **creative personnel**, prepare for changes in the social structure and possible negative impacts, and strengthen welfare policy and the **social security net** accordingly.

VII

Tasks

1

Identification and generation of value from data as a source of future competitiveness

◆ Realize a data-based society equipped with a rational and data-based decision-making system that enables anyone to easily find and secure the data they need to create new value.

◆ Transform Korea from a data-poor country into a data-rich one.

Establish a national data management system for the development of large-scale data infrastructure that facilitates machine learning.

- Convert public data owned by the government into open formats amenable to machine learning, and ensure their public disclosure. Public agencies and organizations should also identify and disclose their own data.*

  * Starting with 20 public organizations in 2018 → Expanding to all organizations by 2025.

  ✓ Develop and provide data with high utility, such as those concerning medicine, patents, and languages, in data sets amenable to machine learning, with government support.

  ✓ Develop an open system, connected to private and public data platforms, for the systematic storage and utilization of sensor data generated by various IoT devices for smart cities.

- Facilitate the adoption of private cloud computing services and platforms by major organizations holding large amounts of data by reforming relevant regulations and introducing a cloud computing catalyst project (by 2018).

- In addition, introduce other services that promote data sales, such as a support service that matches data-owning with data-analyzing businesses, a data map that indicates the current status of public- and private-sector data use, and Data 114, which is designed to help businesses locate, process, and broker transactions of the data they need.

Find and differentiate measures to support the distribution and utilization of data in accordance with data type.

- Strategies tailored to different types of information, such as general and non-private information, non-identifying information (personal information with identifying data removed), and private and personal information, should be introduced to encourage the distribution and utilization of data without stoking fears over privacy infringement.

Type	Remark	Strategy needed
General (non-private) information	Includes no identifying private information	Convert the existing data system into an open data platform by 2017, and add payment and transaction features so that it may begin to serve as a data exchange by 2018.
Non-identifying information	Personal information with identifying data removed	Designate data agencies authorized to process and transform private and identifying information into non-identifying information and generate value added. - Launch free data zones that give data businesses the freedom to experiment with data synthesis.*
Private information	Resident registration numbers, medical records, etc.	Introduce K-MyData,** a government program that allows businesses to share the personal information of their clients with other businesses, subject to clients' consent, so that more diverse and customized services may be developed.

* Free data zones: Areas in which businesses can access, analyze, and process public data of significant value, such as medical information and statistics, and enjoy the support of advanced legal systems (involving such governmental agencies as Statistics Korea, the Health Insurance Review and Assessment Service [HIRA], and the National Health Insurance Service [NHIS]).

** K-MyData: Start with data that possess high utility and relevance to people's daily lives, such as data concerning telecommunications, finance, medicine, and energy.
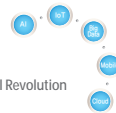
Foster data analysis businesses and workforces.

- Foster businesses specializing in data transactions (from 50 in 2016 to 100 by 2020) by providing consulting on data collection and processing and supporting data refining and pricing decisions.

  - Work with private portal websites to make four major categories of data with great potential in terms of AI development (search, location, purchase, and social media data) available to the public as test materials.

  - Develop and support flagship data-based AI projects* that aim to solve social problems using data so as to raise public awareness of such projects and increase their relevance to people's lives.

- Foster data scientists and engineers with the skills to solve real problems by providing practical education for young people and workers (from 500 people a year in 2017 to 1,000 a year by 2030).

  - Introduce a big data academy and other similar learning programs, data analysis licenses and certificates, and specialized research centers at major graduate schools.

Encourage the use of blockchain technology to enhance data management security.

- Encourage businesses to develop and secure the rights to blockchain technology so that it may come to form the basis for next-generation infrastructure, thereby guaranteeing the integrity and security of data, not only in finance but in various other services as well.

  - Develop roadmaps and promote R&D to enhance non-financial applicability and expandability.

  - Organize and participate in global initiatives and consortia to develop and secure world-class applied blockchain technologies.

  - Reform regulations* with a view to fostering blockchain technology and the early market.

    * E.g., independent overseas remittance services provided by FinTech businesses, etc.

- Launch and support trial projects that aim to enhance data management security in order to foster data industries and minimize the cost of data transactions throughout Korean society.

  - Finance: Blockchain technology can be applied to various services, including overseas remittances, trading of non-listed stocks, and payments and clearing, and may even come to form the basis for a cash-free society.

  - Other industries: Expand the projects to other non-financial industries and applications, including the automatic coordination of IoT devices, public archive management, content and copyright management, trade, electronic voting, and personal identity verification, among others.

2

Establishment of the basis for AI technology

◆ Encourage active basic and applied research at universities and research centers with the aim of developing world-class infrastructure for AI-based industries in Korea.

◆ Combine the innovative R&D activities of businesses with the support and resources of universities and research centers to enable businesses to actively pioneer new markets for AI services and products.

Invest in strategic R&D projects to promote the rapid development of AI technology.

■ **Basic sciences:** Make long-term investments in the basic sciences, such as brain science and industrial mathematics, as these form the foundation of AI technology.

   ✓ **Brain science:** Key to understanding emotional and sensory cognition, as well as the cerebro-neurological mechanisms of human behavior, brain-machine interface (BMI), and complex cognitive functions (language processing, memory), etc.

   ✓ **Industrial mathematics:** Crucial to the development of mathematical methodologies for overcoming the current limitations on the development of AI algorithms.

■ **Original technologies:** Present differentiated goals and targets for the development of different types of technologies (e.g., AI, hardware, and ICBM) in consideration of the current progress and maturity of such technologies.

   ✓ **AI:** Strive to rise to the same level of technological advancement as other advanced economies by 2023, in terms of cognitive technologies related to languages, vision, sensory experiences, and spatial cognition.

   • As Google (TensorFlow) and other major corporations in developed countries have already developed and disclosed advanced algorithms for machine learning and deduction, our goal should be to develop next-generation alternatives* rather than striving to match the technological developments of other countries.

   * E.g., technology that enables machines to learn with even small amounts of data, technology that enables machines to explain the rationales for their deductions, etc.

   ✓ **Hardware:** Continue to support the research, development, and evolution of high-performance computing and intelligent semiconductor technologies and foster pioneering research on next-generation technologies, such as quantum computing and neuromorphic chips.

   ✓ **ICBM:** Encourage research on and the development and evolution of intelligent IoT capable of collecting, learning, and processing data on its own; high-speed cloud computing; technologies for removing noise from and refining data; and other such technologies that are closely related to AI.

■ **Applied technologies:** Encourage research on and the development of service technologies that can be applied to public services early on (e.g., national defense, security, welfare, and culture) to catalyze the development of innovative technologies in the private sector.

   * E.g., national defense surveillance systems, real-time counter-crime and counter-terrorism systems, robotics for elderly care, culture vouchers customized to the individual needs of welfare clients, etc.
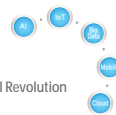
⯈ Optimize research methods and environments for basic sciences, original research, and applied research.

■ **Basic science:** Increase support for brain science research organizations* and universities, designate and support industrial mathematics centers** on university campuses, and foster autonomous and stable research environments centered on universities and research institutes.

  * E.g., Korea Brain Research Institute, KIST Brain Science Institute, Institute for Basic Science, etc.

  ** On-campus organizations tasked with identifying and overcoming various obstacles in technological fields and industries using mathematics (to begin in 2017).

■ **Original technologies:** Establish R&D roadmaps for areas in which technological gaps with advanced economies need to be overcome (linguistic and visual intelligence, intelligent semiconductors, high-performance computing, ICBM, etc.), and present detailed research goals and targets (from 2017 onward).

  ✔ Increase the number of research projects at universities on independent and government-designated topics* related to original technologies in the early stages of development (next-generation learning and deduction technologies, quantum computing, neuromorphic chips, etc.). Foster autonomous and stable environments conducive to long-term research by minimizing governmental evaluation and intervention for a period of three years.

    * Increase the share of research projects on independent and government-designated topics at universities up to 70 percent, beginning in 2017 (from 43.5 percent, in the area of ICT R&D, as of 2016).

■ **Applied technologies:** Foster innovative and bold research with the potential to solve real problems by confining governmental intervention to the provision of broad goals only and introducing a new evaluation system that values boldness and originality.

  ✔ Identify research issues and topics through public-private dialogue and organize the AI Grand Challenge contests (beginning in 2017), through which inventors of award-winning solutions may receive research grants.

    ※ The United States' Defense Advanced Research Projects Agency (DARPA) encourages private-sector innovation by organizing contests under various themes, such as self-driving cars and disaster-response robots.

⯈ Reform institutions to maximize R&D effectiveness.

■ Foster the ecosystems of the AI industry by disclosing and sharing machine learning data, accumulated through national R&D projects, with businesses, universities, and research institutes.

  ✔ Share AI software developed by the public sector in the form of open source software and APIs (2017 onward).

■ Encourage the recruitment of talented researchers and engineers from abroad and promote the expansion of international research collaboration projects by assigning preferential points to R&D agencies vying to carry out national R&D projects, etc.

■ Manage adaptation to and compliance with the latest international standards on linguistic understanding (ISO) and visual understanding (ISO/IEC JTC1) and develop standardized evaluation criteria to enhance the competitiveness of standards (beginning in 2017).

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Creation of a super-connected, data- and service-centered network environment

◆ A super-connected network would ensure the secure and prompt transmission of data generated by all persons and objects at any time and place.

◆ Diverse actors may participate in the effort to create such an environment, thanks to rich telecommunication frequency resources and relaxed regulations, thereby promoting the generation, collection, transmission, and utilization of growing volumes of data.

⯈ Develop flexible, high-performance networks capable of supporting a wide range of convergence services.

■ Launch 5G and Giga Internet services (as of 2020) to accelerate the Fourth Industrial Revolution.

　※ 5G will enable enhanced mobile broadband (UHD, 3D, etc.), ultra-reliable, low-latency communications (for self-driving cars and industrial robots), massive machine-type communications (for smart cities), etc.

　✔ Propose Korean 5G technology as a candidate for the ITU standard (in October 2017), and support the development of core technologies for its application to other industries (starting in 2017).

　✔ Launch interdepartmental test projects for real-time, super-connected network services linking intelligent networks with other industries (self-driving cars, intelligent robots, drones, smart homes, etc.) (starting in 2018).

　　※ Use the test projects to induce private-sector investment, development and verification of innovative technologies, and generation of demand in the early stages.

■ Reform the current hardware-centered, large-corporation-dependent network environment so as to support its evolution into an intelligent, super-connected network environment based on virtual reality, thereby facilitating the market entry of small yet strong companies and latecomers.

　✔ Invest proactively in the R&D of prospective technologies with the potential to set new technological paradigms and generate value added in the global market and that have far-ranging implications for other industries.

　　※ E.g., VR-based and intelligent control technology; programmable RF technology that is energy-efficient, lightweight, and compact in size; network technology that can be applied to vehicles and sensor grids; and wearable sensor grid technology based on the central nervous system.

■ Support the distribution and utilization of data by expanding and connecting diverse IoT sensor grids.

　✔ Launch projects that aim to improve the social infrastructure supporting IoT (electricity, gas, waterworks, etc., beginning in 2017) and catalyze the innovation of IoT networks.

　✔ Reform the technological standards to facilitate the introduction of new IoT technologies (including narrowband IoT) so that IoT services can be provided at mobile communication frequencies.

⊪ Create highly reliable and secure networks.

- Focus policy resources on enhancing the quality and reliability of networks and introduce quantum cryptography technology in phases so as to eliminate the risk of cyber attacks at the root level.

  - ✔ **Phase 1 (2020):** Test quantum cryptography technology on exclusive networks as a means of ensuring maximum security for national facilities and data centers.

  - ✔ **Phase 2 (2025):** Expand quantum-code-protected networks to other facilities and equipment requiring high levels of security (e.g., administrative service, national defense, cloud computing, finance, smart factories, and healthcare networks).

  - ✔ **Phase 3 (2030):** Develop core technology for the "quantum Internet" and establish related infrastructure.

    ※ This will require the development of quantum computing equipment, super-long-distance quantum mediation technology, quantum Internet protocols, etc.

- Develop and commercialize highly reliable and secure control network technologies* based on AI, with built-in mechanisms for codification and invasion detection, and apply them first to emergency networks (beginning in 2025).

  * Develop them into software-based platforms (2020) → Apply AI to network management and control (2025) → Realize AI-based automatic networking (2030)

⊪ Increase frequency support and continue moving forward with network regulation reform.

- Catalyze the wireless revolution by significantly increasing band support and reforming regulations.

  - ✔ Establish a 5G band distribution plan by 2018, secure an additional 4.4 GHz of channels by 2026, and reform allocation prices to reflect changes in the user environment, such as the introduction of super-high-frequency and ultra-wideband technologies.

  - ✔ Provide an additional 28 MHz of IoT-exclusive channels for smart factories and U-health systems and an additional 12 GHz for the control and communication of portable wireless devices by 2026.

- Continue to reform regulations, such as those barring the entry of new players into the market, so as to promote the development of new service networks for IoT and unlicensed channels.

  - ✔ Reduce pre-authorization requirements while simultaneously providing an increasing amount of communication resources (e.g., numbers).

  - ✔ Lift regulations on electronic wave outputs and the use of public facilities to promote IoT distribution.

    * E.g., A service provider seeking to install IoT sensors on street lights will be subjected to overlapping regulations governing electricity, communications, and facility installation.

4

Proactive application of Intelligent IT to national services

◆ Apply Intelligent IT first to public services to improve the quality of services and offer greater benefits for all citizens.

◆ Use the improvements in public services to generate early market demand for Intelligent IT among businesses.

### ⫸ Maximize military efficiency and competency using Intelligent IT.

■ Apply Intelligent IT to defense systems, which currently depend on human cognition and judgment, to prepare for inevitable troop reductions* and enhance the accuracy of military operations and support calculations.

  * The Korean military intends to reduce its number of troops from 630,000 in 2014 to 522,000 by 2022 (White Paper on National Defense, 2014).

  ✔ Develop intelligent surveillance and monitoring systems capable of incredible precision, irrespective of the time of day or weather conditions, and install them in major areas crucial to national defense (from 2017 to 2025). Automate and reinforce surveillance in the Demilitarized Zone (DMZ).

  ✔ Integrate and analyze the immeasurable amounts of data accumulated along the chain of command and national defense networks to develop an "AI-based assistant chief of staff" that works to support command-level decision-making (by 2030).

  ✔ Develop and establish a deep-learning-based system for forecasting military equipment demand so as to minimize budget waste and establish a system for providing personalized medical care (2017 to 2025).

⫸ Prevent crime and strengthen the capacity of police to make arrests through an intelligent crime response system.

■ Increase the arrest rate by at least 10 percentage points by developing AI systems for the analysis of crime information and carrying out prompt responses to crime (from 78 percent in 2014 to 88 percent in 2030).

  ✔ Develop a crime information analysis program capable of integrating all crime-related data currently held by the National Policy Agency to create a centralized database, and perform detailed and accurate analyses of the collected data (by 2022).

  ✔ Develop a system capable of detecting signs of and preventing crimes before they happen based on comprehensive analyses of behavioral anomalies and situations detected by surveillance cameras, IoT sensors, etc. (by 2022).

  ✔ Develop a program for generating accurate portraits of criminals based on limited information (e.g., photographs showing only criminals' profiles or criminals wearing hats) (by 2030).
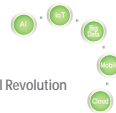
⯈ Use Intelligent IT to customize administrative and welfare services to the needs of individual citizens.

- Use Intelligent IT to customize a wide range of administrative services and better respond to citizens' diverse and changing needs.

  - ✔ Establish an AI-based administrative service system capable of responding to service requests automatically (2017).

    ※ Establish intelligent legal and tax service systems by 2017 and provide an AI-based system for consultations on a comprehensive range of services and subject matter from 2021.

  - ✔ Analyze the history of citizens' service use and related trends on social media using Intelligent IT so as to improve the quality of administrative services and develop new services (2018 onward).

    ※ Create a G-cloud computing environment and introduce an intelligent analysis system to facilitate the sharing of public information by 2020.

  - ✔ Complete MeGov, a comprehensive system that customizes government services by automatically recognizing* the needs and circumstances of individual citizens, by 2020.

    * Identifies, recommends, and provides necessary services proactively by analyzing the sociodemographic characteristics and personal circumstances of individual citizens.

- Use information networks and Intelligent IT in proactive ways to find people in need of welfare support so as to eliminate blind spots in the social security net and provide effective and customized services for all citizens.

  - ✔ Expand the reach and scope of the welfare need identification system to prevent such problems as child abuse and people dying alone. Use Intelligent IT to enhance the efficiency of social workers' efforts to locate and help the needy (2017 onward).

    ※ This intelligent system can identify citizens who are having difficulty making a living by collecting data on suspensions of electricity or water supply services, unpaid insurance premiums, suicide attempts, etc. (increasing the number of welfare clients so identified from 27,000 in 2016 to 100,000 by 2025).

  - ✔ Establish an intelligent social service case management service system that automatically manages the service histories of welfare clients in relation to income records and determines and provides the services they need, such as National Basic Livelihood Security Program (NBLSP) benefits (from 2020 onward).

- Innovate the working processes of public administration to make the government more responsive and adaptable to the changing needs of citizens in the intelligent information society.

  - ✔ Introduce AI-based service operation systems to gather public opinions in real time and simulate possible policy results to promote optimal decision-making.

    ※ Use VR (simulation) technology to manage conflicts and enhance emergency response systems.

⫸ Use Intelligent IT to realize next-generation infrastructure for transportation, distribution, and urban activities.

- Establish intelligent transportation infrastructure that connects all vehicles and traffic facilities so as to optimize traffic signals and operations in real time and provide customized traffic updates.

  - ✔ Develop an intelligent transportation system, backed by real-time, high-precision, traffic-data-collecting technology that incorporates all types of transportation-related big data, including the GPS records of smart cars and data from other sensors (by 2019).

  - ✔ Develop a congestion-minimizing system that quickly identifies the causes of traffic congestion (accidents, cars parked on roads, etc.) and distributes traffic flows accordingly (by 2020).

  - ✔ Establish safety requirements for self-driving cars, reform the laws and institutions governing car insurances and recall procedures, and develop supporting infrastructure (test cities, precise maps, etc.) for the commercialization of self-driving cars (by 2020) and innovation in the private sector.

  - ✔ Develop a sharing-based public transportation system, incorporating information on self-driving cars and car sharing services, so that people can easily rent and drive cars without having to own one (by 2025).

- Use Intelligent IT to optimize postal and logistics processes, thereby maximizing the efficiency of postal and courier services, and introduce an advanced drone-based traffic logistics system.

  - ✔ Launch test operations of drone-based courier services (2017 onward), projects for upgrading logistics systems using big data, and robotization/automation of postal centers and postal logistics centers (2020 onward).

  - ✔ Promote R&D that aims to improve the drone traffic management system, including the development of models to ensure the safe operation of numerous drones in uncontrolled airspaces (150 meters or less) (2017-2021).

- Bring together both public- and private-sector urban data and Intelligent IT to establish a smart city platform capable of optimizing the management of urban resources, such as roads, water, and energy (by 2022).

⫸ Continue identifying and developing public service areas to which Intelligent IT can be applied.

- Continuously expand the reach and scope of Intelligent IT applications to include a wide range of public services (emergency management, environmental protection, energy, etc.) with the aim of enhancing public safety and convenience.

Examples of Applications of Intelligent IT to Public Services

- **Predicting earthquake damage:** Intelligent IT can be used to perform factor analyses on the histories, densities, and building materials of urban structures to identify urban areas that are likely to be hit the hardest in the event of an earthquake or other such natural disaster.

- **Protecting endangered species:** IT sensors may be installed in forests and wilderness areas to collect data on the sounds and behavior of wild animals and assist in efforts to induce endangered birds to relocate to safer habitats.

- **Saving energy:** Intelligent IT can be used to measure and analyze energy-consuming factors (lighting, ventilation, etc.) and enhance the learning of energy-management facilities and systems.

5

Mid-to Long-Term Master Plan in Preparation for the Intelligent Information Society: Managing the Fourth Industrial Revolution

Creation of Intelligent IT industry ecosystems and facilitation of private-sector innovation

◆ Expand and diversify support for entrepreneurism and business growth in order to encourage entrepreneurs to experiment freely with their business ideas, and reform business regulations to make it easier to launch new products and services.

◆ Personalize a wide range of services (finance, distribution, broadcasting, etc.) and allow service providers to compete freely in an environment of fair competition without fear of interference from platforms.

Operate test beds to support the development of innovative technologies.

■ Create large-scale test beds, in consultation with all government ministries and local governments concerned, to support innovation in smart city services, intelligent robotics, self-driving cars, etc.

✔ Establish connections between these test beds and regulation-free zones to foster strategic local industries and improve the existing industrial clusters and zones with Intelligent IT infrastructure.

※ E.g., smart cities (Seoul/Gyeonggi-do, by 2019), intelligent robotics (Gyeongsang-do/Jeolla-do, by 2021), smart tourism (Gangwon-do, by 2023), etc.

✔ Disclose and share the test data accumulated at the test beds with startups and small and medium enterprises (SMEs) to help them develop new services and technologies.

■ Develop and organize a large-scale pool of test specialists and personnel capable of performing pre-launch service tests.

※ As Intelligent IT requires large quantities of data in order to learn and evolve on its own, it is critical to test new products and services on as many testers and developers as possible to accumulate the feedback and information needed to make improvements.

Adopt a technology regulation paradigm.

■ Intelligent IT will likely usher in changes never predicted or seen before, making it critical for policymakers to embrace a new technology regulation paradigm and remove regulatory obstacles to innovation.

✔ Update the current provisional licensing program* to prevent any possible delays in the materialization of Intelligent IT due to legal or institutional obstacles and introduce a regulatory sandbox.**

* E.g., By requiring government agencies to prepare proper and formal licensing requirements while the provisional licenses are still in effect (period of up to two years).

** A policy program that allows the testing of new technologies and services for fixed targets and fixed periods of time without being restrained by current regulations (suitable for the testing of universal Intelligent IT).

✔ Develop and present cost-benefit analysis frameworks and alternative regulations for the use and application of Intelligent IT (including AI and big data technologies) in relation to urban activities, medicine, public services, and other areas of importance.

※ E.g., Relax regulations and offer cost-effective alternatives for the (human) use of Intelligent IT.

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⊪ Foster entrepreneurism in the basic and applied industries* of Intelligent IT.

* Concept: Basic industries (AI + ICBM) + applied industries (AR/VR content, wearable devices, self-driving cars, robotics, automation, Fintech, biotechnology, smart cities, etc.).

- Use the Korea Fund of Funds, the Korea Institute of Finance (KIF), and other such financial resources to foster and accelerate the growth of tech startups and SMEs specializing in Intelligent IT and data.

  * Use the KIF to raise an exclusive fund of KRW 30 billion by 2017, and increase that amount by at least KRW 100 billion every year afterward.

  ✓ Ensure effective monitoring and regulation of large corporations attempting to misappropriate the technologies and technical workforces of smaller companies* and enhance supervision to prevent data theft, thereby minimizing any potential obstacles to merger-and-acquisition (M&A) deals.

    * Despite the reinforcement of punitive damages (May 2013) and establishment of an arbitration council for technological disputes (January 2015), only one and six cases, respectively, have been filed under these two new institutional shields.

  ✓ Upon suspicion of technology theft, the relevant government departments or agencies may exercise their authority to investigate, file accusations, and discipline offenders.

- Organize the Intelligent IT Challenges, Multinational Intelligent IT Startups Camp, and other such events to discover and recruit prospective startups, and support their participation in international competitions* (2018 onward).

  * Mass Challenge (U.S.), La French Tech (France), Start-Up Chile (Chile), etc.

- Support the R&D and business activities of startups by giving them access to the technological infrastructure and resources of public research institutions, including the assignment of preferential rights to, or quotas for the use of, supercomputers.

  ✓ Support the development of large corporations' mutually beneficial partnership plans that aim to give startups access to their communications infrastructure, service platforms, and the like as a means of aiding in their research and development activities and expansion of services (2018 onward).

- Create ICT Valleys (Startup Campus, Innovation Center, university IT research centers, and Pangyo Valley I) and hubs of Intelligent IT industries* (Pangyo Valley 2, to promote business clustering) (starting in 2018).

  * Support businesses in their efforts to become tenants of Venture Space (Venture Campus, 60,000 square meters) and Innovative Enterprise Space (Innovation Town, 80,000 square meters).

⊪ Generate early market demand for Intelligent IT by first making public purchases.

- Use the Public Procurement Innovation (PPI)* program to foster Intelligent IT (2018 onward).

  * PPI: A program via which the government enters into agreements with innovative businesses for the development and supply of new products, services, and solutions that do not yet exist on the market (e.g., drones, unmanned farming equipment, etc.).

- Encourage businesses to make active use of Intelligent IT by reflecting their use of such technology in decisions regarding the amounts of business subsidies and financial incentives they are to receive while participating in the Social Impact Bond projects* (2018 onward).

  * Social Impact Bond projects: These are projects that foster business approaches to solving social problems, such as rehabilitating short-term prison inmates in order to reduce the likelihood of them returning to a life of crime (U.K.) and support education businesses that assist mentally challenged children in their efforts to support themselves (Seoul). Such projects are currently being carried out in 11 countries worldwide, including the United States and the United Kingdom.
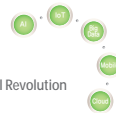
Encourage service industries to adopt Intelligent IT by implementing customized support measures.

- **Finance:** Reform institutions and support testing* to enable Fintech, robotic advisor, and other such businesses to customize financial services using Intelligent IT.

  * Direct banks (through amendments of relevant laws), Fintech (transaction certification tests), investment software (reliability and security tests), etc.

- **Distribution:** Encourage the development of O2O services* based on online platforms by diversifying the means of identity verification (iris or finger vein recognition) and improving the use of location information.**

  * O2O (online-to-offline) services can be made even more productive by applying AI and other technologies so that, whenever transactions occur on the given online platforms, customer and order data can be collected and stored in online databases and analyzed automatically.

  ** Support the de-identification of personal location information and provide for a partial opt-out.

- **Broadcasting:** Create an environment in which an AI service identifies, recommends, and provides broadcast programs users are likely to enjoy, across all broadcasting channels, including cable and the Internet.

- **Logistics:** Create two state-of-the-art urban logistics complexes that combine logistics, distribution, and cutting-edge industries (2017 onward) and ensure the broad application of self-driving transportation robots at logistic center sites (starting with the Gunpo Logistics Center in 2017).

Establish an environment of fair competition in the platform industry.

- Minimize the monopolistic and oligopolistic practices* of platforms using the networking effect by finding and fostering an appropriate environment of fair competition.

  * E.g., Google, wielding a dominant influence over the OS platform market, requires its applications to be pre-loaded onto Android-based mobile devices, without giving users any choice in the matter, so as to consolidate its dominance in the Intelligent IT service market.

  ✔ Reinforce platform-neutrality laws and regulations* so that, even after a business rises to dominance in a given service market, it will not wield similar dominance over other markets via its platforms (beginning in 2018).

    * Before: The Korean government enacted standard agreement and implementation rules regarding platform operations and made it mandatory for administrative authorities to conduct previews.

    After: Authorize the MSIP to make requests regarding the filing of charges against businesses suspected of violating the provisions of the Fair Trade Act concerning Intelligent IT.

6

Generation of innovation and new value through intelligent healthcare services

◆ Enable all citizens to receive safe and effective healthcare treatments and better manage their health with customized services made possible through Intelligent IT.

◆ Use Intelligent IT to read and analyze massive amounts of genetic and diagnostic data and foster new healthcare industries, including an industry involving the design of effective and personalized treatments.

▶ Establish a data environment that supports the provision of effective and quality healthcare services.

■ Enable all medical institutions (some 65,000) nationwide to share their electronic medical records (EMRs) so that patients can receive the services they need at any hospital without having to produce their medical records themselves.

  ✔ Develop an EMR-sharing network on par with the global standard (HL7)* and push for the standardization of EMR formats, which currently vary from hospital to hospital (by 2025).

    * An international standard for clinical data architecture (CDA) that governs medical record formats and data exchanges.

■ Develop the databases needed to provide intelligent and personalized hospital services and develop new drugs, and integrate all relevant data, currently dispersed across public and private organizations, so as to establish a comprehensive data infrastructure.

  ✔ Establish a 100,000-person medical data cohort and a platform for sharing six core categories of medical data* in order to increase the precision of medical care.

    * EMRs, prescriptions, personal health information, genetic information, lifestyle information, and environmental information.

  ✔ Develop an AI-based knowledge database using data from the National Health Insurance Service (NHIS), Health Insurance Review and Assessment Service (HIRA), and hospitals, properly converted into machine-learning formats. Develop a system to integrate EMRs and genetic information.

▶ Foster intelligent healthcare to better cope with population aging and prevent disease.

■ Use Intelligent IT, healthcare robotics, and other such technologies to tackle problems associated with the aging of the population and increasing number of single-person households, such as the growing shortages of nursing and medical care professionals and rising social cost of health.

  ✔ Develop intelligent public healthcare service applications (e.g., a "personal health aide" that checks the user's health every day and an instant messenger to allow convenient exchanges of health information) (by 2020).

  ✔ Use ICT to eliminate blind spots in the public healthcare system (starting in 2017) and develop and distribute innovative healthcare devices, such as caretaker robots capable of understanding the emotions and needs of the elderly, nursing robots, and muscle-enhancing wearable suits (by 2022).
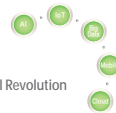
- Develop and distribute next-generation diagnostic equipment and enhance the intelligence of the national counter-epidemic system in order to protect the public against outbreaks of infectious diseases.

  - ✓ Develop and distribute non-tactile, intelligent body scanners based on electromagnetic waves for use in the provision of non-invasive (blood sugar levels), non-sensory (vital signs), and pain-free (disease detection) diagnostic services (by 2030).

  - ✓ Develop an intelligent epidemic prediction and warning system to secure the capability to identify and prevent outbreaks of infectious diseases in the early stages, and enhance the intelligence of the comprehensive information system for preventing and controlling infectious diseases (by 2025).

Personalize diagnostic and treatment processes using nano-biotechnology and precision medicine.

- Use the latest technology, such as nano-biotechnology, to further enhance diagnostic and therapeutic services and perhaps even make the replacement of body parts with artificial ones possible.

  - ✓ Develop 4D bio-printing technology capable of producing skin grafts and transplant organs that can adapt to and evolve, in vitro, in response to each patient's physical and environmental characteristics (by 2025).

  - ✓ Develop and improve body-insertible, super-compact robots that are capable of moving through blood vessels and organs to perform diagnostic and therapeutic functions (by 2030).

- Develop personalized treatments designed to assist doctors in rendering diagnoses and providing effective care based on individual patients' health status, genetic makeup, lifestyles and habits, etc.

  - ✓ Develop precision diagnostic techniques and treatments for three major cancers (lung, stomach, and colorectal), a next-generation medical information system based on cloud computing (by 2021), and an intelligent diagnostic and treatment support system (Clinical Decision Support System [CDSS]).

  - ✓ Develop AI-based software capable of learning and analyzing genetic, pharmaceutical, and clinical trial information and, based on the results, reduce the time and costs involved in developing new drugs (by 2021).

Create infrastructure to promote the use of Intelligent IT in healthcare services.

- Establish infrastructure, foster skilled personnel, and reform institutions to expedite the development and use of Intelligent IT solutions and services in healthcare, as well as their globalization.

  - ✓ Establish a test cluster for the testing of healthcare robotics and services (by 2019) and support the development and commercialization of IT-converged medical equipment and devices throughout the entire process of clinical trials and licensing.

  - ✓ Establish specialized graduate schools and provide other forms of support to foster personnel specializing in precision medicine (1,000 graduates) and enact the Special Act on Precision Medicine to foster related R&D.

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Digital innovation of manufacturing

◆ Platform-based production systems that collect and analyze consumer and market data will be introduced, and Intelligent IT applied to products so as to enhance their quality and value.

◆ Intelligent robots, 3D printing, and other advanced technologies will increase the productivity of manufacturing, allowing the sector to overcome its current limitations and rise to new heights.

⯈ Develop a cyber-physical system (CPS) to allow for mass customization.

■ Introduce a CPS* into the manufacturing process to allow the mass, and perfect, customization of products as a means of enhancing the productivity and competitiveness of businesses.

> * CPS: A system for optimizing the manufacturing process in real time based on the cyber processing and analysis of big data gathered via an IoT network.

✔ Foster CPS developers and suppliers (sensors and IoT, communications, and AI technologies) by supporting the development of core technologies needed to create a manufacturing CPS* and designating "mother factories"** for different industries.

> * IoT convergence technologies (KRW 6.1 billion earmarked by the MSIP for 2017) and smart factory advancement technologies (KRW 8.0 billion earmarked by MOTIE for 2017).

> ** Precision machinery (Gumi, 2017), medical devices (Ulsan, 2017), pharmaceuticals and cosmetics (Ansan, 2018), etc.

✔ Foster the development of a manufacturing CPS as a strategic project aiming to simultaneously ensure the globalization of the resulting CPS and enhance the competitiveness of the Korean manufacturing sector (starting in 2018).

> * SK: Plans to develop the "SCALA" solution (for its HP printer assembly line in Chongqing, China, etc.).

> POSCO: Designated its heavy steel plate plant at Gwangyang as a test bed (for collecting and analyzing data on each part of the manufacturing process).

✔ Establish a public-private partnership council, with the participation of large corporations and their suppliers, multinational ICT corporations, software companies, and startups, so as to develop, standardize, and disseminate the technologies involved (by 2017).

> * Launch Manufacturing CPS Partnerships at the 17 creative economy and innovation centers nationwide.

⯈ Prepare the foundation for smart manufacturing involving the use of robotics, 3D printing, etc.

■ Support the development and distribution of robots, 3D printers, and other such devices needed to innovate the manufacturing process and minimize the cost and time required for mass customization.

✔ Introduce cutting-edge manufacturing robots* to smart factories and support the development of next-generation manufacturing, logistics, and social robots** capable of decision-making (2018 onward).

> * Start with test projects, and later move on to the distribution of the devices, starting with industries in which their effectiveness has been proven (up to 20 industries by 2018).

> ** Designate and support the research labs of robotics businesses as "cutting-edge robotics commercialization research centers," investing at least KRW 100 billion (from both public and private sources) over four years with the goal of launching at least 20 innovative robotics products by 2020 (MOTIE).

✔ Encourage the manufacturers of complex jewelry products, precision automotive and aircraft parts, and the like to adopt 3D printing so that they may create innovative product designs and minimize manufacturing times (2017 onward).

 * Establish the Master Plan for Fostering 3D Printing Industries (MSIP-MOTIE, by 2017).

Create an ecosystem for the servitization of manufacturing.

■ Provide a comprehensive range of services for manufacturers that are attempting to converge their products and services with online service platforms* so as to maximize product value and revenue.

 * E.g., "Before Service" for heavy machinery and equipment based on an IoT network to prevent malfunctions or breakdowns, prevent theft, and offer lifecycle-wide management services for machinery, from production to disposal, etc.

✔ Develop smart service platforms for different businesses and industries and match manufacturers with platform service providers (starting in 2018).

✔ Introduce subsidization and other such financial incentives to encourage businesses to voluntarily adopt smart service technologies and systems (by 2020).

 * The German government subsidizes up to 50 percent of the costs of the development of Intelligent IT products and software, and provides tax deductions of up to 40 percent for manufacturers that adopt these solutions.

Support the reshoring of manufacturing through deregulation, human resources, and R&D support.

■ The rising cost of labor in developing countries and innovation of the manufacturing process has already set the stage for reshoring, which Korea should expedite by providing effective support.

✔ Reinforce smart factory (process automation), R&D, brand development, and marketing support* for reshoring manufacturers, and induce them to produce high-value-added products in Korea (by 2018).

 * Prioritize the return of smart factories, resume R&D support for reshoring businesses (2014 to 2015, Small and Medium Business Administration), and subsidize management and marketing consultations (up to KRW 20 million per business; MOTIE).

✔ Improve the business environment by producing more skilled personnel, reducing tax rates, and deregulating location requirements and establish a global value chain in Korea that allows both the manufacturers of finished products and parts manufacturers to grow together (by 2017).

8

Innovation of education for the intelligent information society

◆ Provide all citizens with the customized education they need to reach their full potential, thereby allowing them to generate and enjoy new opportunities in the intelligent information society.

◆ Enhance the global competitiveness of Korean workers by coordinating effective support from the government, schools, research institutes, and businesses.

Move beyond rote education to realize problem-solving- and critical-thinking-centered education.

■ Increase software and STEAM* education for elementary and middle school students to enhance their computational thinking and problem-solving capabilities.

* STEAM: convergence-oriented education on science, technology, engineering, arts, and mathematics.

✔ Start providing software education for all primary and secondary school students in 2018, establish software education agencies, and ensure that there is at least one software club at every school.

※ Train software teachers, install computer labs at all schools, and devise a detailed action plan for the establishment of a comprehensive software education service system (by 2017).

✔ Increase the number of schools participating in the Creative Convergence Leadership Program (from 52 in 2016 to 100 by 2018) as well as the number of multidisciplinary and convergence-oriented major programs at universities, with the aim of producing creative and consilient workers.

■ Support students' autonomous capability development and preparations for their future careers by reforming class styles, degree requirements, and curricula.

✔ Boost students' class participation by linking and expanding the free-semester programs to regular-semester programs and giving students greater freedom to choose credit subjects in high schools.

✔ Allow individual schools, in the intermediate to long term, to permit students to choose levels of subjects with sequential learning objectives, such as math classes, that suit their levels of understanding and mastery, irrespective of their school grades.

■ Establish new college entrance and screening procedures that support the establishment and practical application of innovative education policies and induce effective educational reforms.

Establish an adaptive learning system using Intelligent IT.

■ Develop an adaptive learning system capable of maximizing the learning effect for students by analyzing their learning histories and progress using Intelligent IT.

✔ Develop an intelligent learning platform that can analyze students' academic records, assign educational activities suited to their interests and levels of progress, and help improve their learning.

✔ Develop digital textbooks featuring AR/VR content (from 2017 to 2019) and distribute them (2018 to 2020) along with an open online market on which students can browse and purchase learning materials suited to their interests and aptitudes.
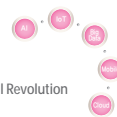
- Share advanced video lectures on a wide range of subjects via a massive open online course (K-MOOC) system in Korea and increase incentives* for the creation of a sustainable learning system (2017 onward).

  * By having universities grant students credits for the K-MOOCs they complete, etc.

Develop core personnel specializing in Intelligent IT that are capable of leading new industries.

- Develop and educate 50,000 IT prodigies, specializing in computer science, data analysis, software development, and other forms of Intelligent IT, through a STEAM-oriented education curriculum.

  ✓ Expand specialized education to produce at least 5,000 Intelligent IT prodigy graduates, ready to enter the workforce, every year, beginning in 2020 (reaching a total of 50,000 by 2030).

    ※ Expand the scope of the IT prodigy education system by developing more programs and enhancing the class structure (by 2017).

  ✓ Increase the number of schools for the education of IT prodigies and consider establishing a high school for Intelligent IT prodigies that provides systemic support for the education and development of such students, not only in terms of science and technology but also in the humanities and other convergence subjects.

  ✓ Provide education on cloud-based supercomputers and applied program development for students enrolled at science and prodigy high schools (approximately 1,800 students per grade) to foster convergence-oriented education (2018 onward).

- Establish an intensive education curriculum, backed by the participation of industries, academia, and researchers, and faculties comprising the top experts in their respective fields, and increase scholarships for students in master's and doctoral programs, with the goal of producing Intelligent IT leaders.

  ※ Recruit talented master's and doctoral students to take intensive classes with the top experts in their respective fields and participate in cutting-edge R&D projects.

- Establish topnotch graduate-schools-turned-research-centers to lead the development of Intelligent IT, including AI, and provide them with comprehensive support for 10 years.

  ※ Support these schools with Research Innovation Grants, extensive research infrastructure and resources, and subsidies for hiring renowned scholars and professors from abroad.

Train teachers and expand infrastructure for the intelligent information society.

- Enhance teachers' software capabilities on a continual basis by providing software training for 60,000 or so teachers every year as well as customized training programs that reflect their seniority and experience.

- Install wireless Internet networks at all schools and develop a model for cutting-edge schools that incorporate AI and VR into learning and support adaptive learning (test operations to begin in 2017).

9

Active response to automation and employment diversification

◆ Technological innovation is expected to increase the number of high-value-added jobs, increase labor market flexibility, and lead to a transition of workers from traditional industries to new industries.

◆ It is important to free workers from the fear of losing their jobs and transitioning into new fields by enhancing the employment security net for non-regular workers and providing jobseekers with customized information and training.

Increase labor market flexibility, with a focus on shifting from input to output.

■ Expand flexible working hours programs* and introduce a working-hour account system to foster work environments in which employees can work no matter the time or place (by 2017).

  * To allow workers to work remotely, commute to and from work at varied hours, choose the number of hours they work, and apply to work at home or through other flexible arrangements.

■ Establish a government agency tasked with fostering a better culture of work-life balance at workplaces (e.g., provisionally named the Work-Life Balance Promotion Agency) and develop criteria for assessing workplace cultures and share relevant examples (by 2018).

■ Start by fostering meritocratic hiring and performance-based wage systems in the public sector so as to encourage the private sector to recruit more creative personnel and improve productivity (2017 onward).

Expand the employment security net in anticipation of employment diversification.

■ Develop standard labor contract and employment policy templates for major occupations in anticipation of the increasing number of non-regular types of workers (including platform-dependent workers*) and the diversification of work arrangements (such as working from multiple locations) (by 2017).

  * Workers who are active in online-platform-based shared economies, O2O services, and crowd work.

  ✔ Redefine the concept of "worker" to encompass and account for the increasingly diverse types of employment (including workers of specific types) and update labor standard laws accordingly in the intermediate to long term.

■ Expand the scope of unemployment and workers' compensation insurances incrementally to increase the number of beneficiaries (including workers of specific types) regardless of employment type (by 2017).

  ✔ Expand the scope of the Earned Income Tax Credits (EITCs), and the tax benefit amounts it provides, so as to guarantee baseline income for working individuals and households (by 2018).

Improve employment support services to better support inter-sector job transitions.

■ Analyze big data from WORKNET and unemployment insurance files* in order to customize employment support services (including job-seeking information, training information, and financial aid) to individual workers (by 2017).

  * Conduct comprehensive analyses of jobseekers' lifecycles, characteristics, service-use patterns, and education, training, and job-seeking histories.
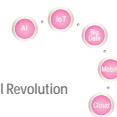
- Enhance the capacity and competency of employment support services to ensure that they are able to provide prompt aid to jobseekers in their efforts to find and make transitions to new jobs.

  ✔ Share the job-related information and services of the national and local governments as well as private-sector agencies via WORKNET (online) and the Successful Employment Package (offline) (2017 onward).

- Expand, on a phase-by-phase basis, the scope of the Return-to-Work Capability Enhancement Service* offered at the Employment Support Center for Middle-Aged Professional Manpower for former workers of small and medium enterprises (4,000 workers in 2016 to 6,000 in 2017).

  * Provide counseling, work history consultations, and training to help workers transition to suitable jobs.

  ✔ Encourage retirees to participate in job-transition training by increasing incentives, such as greater financial aid and diversification of training formats* (2017).

  * Massive Open Online Courses (MOOC) based on mutual participation, flipped learning (online courses first, followed by offline classroom debates), blended learning (mix of online and offline learning), etc.

- Provide workers hoping to make career transitions with education and training on founding new technology businesses, with the potential to create many new jobs, in the areas of big data analysis, AI, VR, etc. (2017 onward).

  * Increase the number of graduates of the Entrepreneurial Success Package for Intelligent IT to 1,000 by 2030.

Produce skilled personnel capable of working in the new industries of the intelligent information society.

- Refine the workforce supply and demand forecasts and enhance the capabilities of the organizations in charge in order to better forecast the labor substitution effect of automation in each industry and the demand for workers in new industries and occupations (2018).

- Use public training institutions (polytechnic universities) as test beds for developing and testing new Intelligent IT education and training curricula before distributing them to private training agencies (2017 onward).

  ✔ Designate and support capable private training agencies as Leading Intelligent IT Training Institutes, and provide them with intensive support for new technology training in their first two or three years.

  * KRW 9 billion for polytechnic universities to develop three new public courses and another KRW 10 billion for the creation of 10 new private-sector training courses by 2017.

- Produce 3,000 new master's and doctoral degree holders specializing in new Intelligent IT industries* through the Specialized Industrial Workforce Development Program (Korea Institute for the Advancement of Technology) (2017 onward).

  * Expand the program to include support for the education of personnel in the areas of future vehicles, industrial drones, operation and design of smart factories, etc. (KRW 20 billion by 2017).

- Increase software education for humanities majors and office workers to help them find productive ways of applying technology to the humanities (2018 onward).

  * For students, improve the short-term and intensive training courses at the Young Jobseekers Academy and Software Boot Camp.

  For workers, increase the number of introductory software courses at e-Koreatech.

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10

# Reinforcement of the social security net for the intelligent information society

◆ Apply Intelligent IT to people's daily lives to achieve an open, discrimination-free society in which everyone is able to enjoy the benefits of technological innovation and maintain stable livelihoods despite job losses or transitions and the rising cost of healthcare.

Guarantee security and safety for all citizens by reinforcing the social security net.

■ Expand the reach of social security services and improve their quality to ensure that the public is better able to manage the rapid changes that will accompany the rise of Intelligent IT and minimize socioeconomic polarization.

✔ Increase the amounts of unemployment and social insurance benefits and extend the periods for which they are provided. Increase the scopes and amounts of the NBLSP and basic pension benefits incrementally (starting in 2017).

✔ Enhance the guarantees of the National Health Insurance scheme and lower the costs of essential services (birthing, dementia care, etc.)

※ Introduce a five-year plan for citizens' post-retirement lives (2017-2021) as a means of providing systemic and substantial support for the aging population.

✔ Continue to identify and discuss new welfare issues related to the intelligent information society via the Social Security Commission.

Enhance the efficiency of welfare administration and maintain the soundness of welfare finance.

■ Apply Intelligent IT to the entire range of welfare administration services and enhance the fiscal soundness and sustainability of welfare.

✔ Apply Intelligent IT to the social security net information system (by 2020) in order to analyze income and wealth information and verify the eligibility of welfare claimants, thereby minimizing budget waste.

✔ Find measures to improve the fiscal administration of welfare services based on mid- to long-term forecasts of the National Health Insurance and National Pension schemes, reflecting future demographic changes.
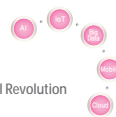
Support the development of Intelligent IT for the elderly, the underprivileged, and people with disabilities.

- Channel technological innovation toward supporting and assisting human activities (eating, using the bathroom, moving about, etc.) so as to solve many of the daily problems and difficulties faced by the elderly and people with disabilities.

  - ✓ Set up an interdepartmental council, with the participation of the MSIP (technology), Ministry of Health and Welfare (policy), and local governments (execution), to establish a phase-by-phase roadmap for the development and implementation of welfare technologies (2017).

    ※ E.g., machine-learning-based mobility aids and systems for people with disabilities.

  - ✓ Connect welfare facilities and homes in need of such new devices with technologies under development so that real-world needs and concerns can be reflected in the resulting products. Subsidize purchases of these products to help generate market demand.

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Legal and ethical reforms for the intelligent information society

◆ A normative substructure is needed to prepare the public for the revolutionary changes that will accompany the emergence of the intelligent information society. It will therefore be necessary to reform existing laws and institutions in order to enable individuals and businesses alike to use Intelligent IT freely and safely.

Enact framework legislation to present a vision and aims for the intelligent information society.

■ Amend the Framework Act on National Informatization, a foundational law, and rename it the "Framework Act on National Intelligent Information" (provisional title) to present a national vision and aims for the intelligent information society.

✓ Reform and improve the entire legal system to grant rights and responsibilities to "electronic persons" in preparation for the dissemination of AI and self-learning machines.

✓ Establish an Intelligent Information Society Strategy Committee (provisional title), tasked with identifying issues related to legal reform and improvement and drafting new legislation for different government departments.

Establish human-centered ethics to govern data-collection processes and AI algorithms.

■ Establish a charter of ethics for Intelligent IT to minimize any potential abuse or misuse of advanced technology by presenting a clear ethical guide for developers and users alike (2018).

※ Given the nature of new Intelligent IT systems, featuring advanced algorithms for data-based self-learning, they may cause or exacerbate a wide range of issues and social problems if left without an ethical guide or means of intervention (e.g., socioeconomic polarization, biases and discrimination against minorities, etc.).

✓ Research and develop protocols* with which developers must comply when collecting data and developing algorithms to ensure that the resulting algorithms do not reflect or perpetuate social prejudices.

* As the massive quantities of data involved and high complexity of AI algorithms will make it nearly impossible for humans to rid these systems of biases once they begin operating and evolving, policymakers may well need to develop and establish refined methods for applying and testing ethical standards for their development at every stage (e.g., requirements for testing the fairness and reliability of data, enforcing the fiduciary duty of developers, preventing reverse choices, etc.).

■ Establish a public-private partnership council tasked with monitoring, researching, and preventing technological trends and risks that may perpetuate the negative impacts of new technologies.

✓ It may be necessary to establish a systemic process through which people may raise formal objections to the evaluations made by AI systems and have AI-based decisions reviewed and tested.

■ Provide education for the underprivileged with the goal of minimizing the information gap and foster and spread a human-centered technological culture that accords due respect to technology and the humanities alike.
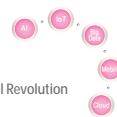
⫶⫶ Reform the legal basis for Intelligent IT.

- Recognize the value and ownership of data collected by private-sector entities as equivalent to the ownership of movable and real estate assets, and devise legal measures to prevent unauthorized third parties from gaining access to and using such data (including claims for damages).

- Amend the Software Industry Promotion Act and update other legal provisions to ensure better reliability and security tests for Intelligent IT applied to various industries, such as automotive parts and medical devices.

⫶⫶ Update the legal system to expedite and facilitate the application of Intelligent IT to industries.

- Clarify manufacturers' liabilities for accidents resulting from AI-related errors involving their products. Consider introducing specialized insurance products to ensure consumer protection.

    ※ The current law on product liability limits liabilities to natural and legal persons only, making it difficult for victims to file claims against software or hardware developers for AI-related accidents.

    ※ Lengthy debates will likely be held between manufacturers and users regarding whose responsibility is greater, such as in the case of the death of the driver of a self-driving Tesla car in May 2016.

- Amend legal provisions to recognize the rights involved in creative AI products, including products in the areas of literature, music, semiconductor design, etc.

- Update the current provisional licensing program* to prevent any possible delays in the materialization of Intelligent IT due to legal or institutional obstacles and introduce a regulatory sandbox.**

    * E.g., By requiring government agencies to prepare proper and formal licensing requirements while the provisional licenses are still in effect (period of up to two years).

    ** A policy program that allows the testing of new technologies and services for fixed targets and fixed periods of time without being restrained by current regulations (suitable for the testing of universal Intelligent IT).

⫶⫶ Introduce proactive legal reforms and changes to better prepare for social changes in the future.

- Increase the availability of software education and reform the legal basis for adaptive, creative, and convergence-oriented learning to accommodate future changes in the industrial structure (automation, etc.).

- Through amendments to the Labor Standards Act, etc., redefine the concept of "worker" to encompass and account for increasingly diverse forms of employment and incrementally expand the reach of the unemployment and workers' compensation insurances to increase the numbers of workers.

    ✔ Expand flexible working hours programs and introduce a working-hour account system in order to foster a work environment in which workers can work more flexibly and thereby better adapt to the increasingly automated and platform-dependent industrial structure.

- Prepare the legal basis for improving social security in consideration of the increasing job losses and transitions, income polarization, and aging of the population.

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Prevention and management of negative impacts

◆ Effectively predict, prevent, and manage all possible negative impacts of Intelligent IT, such as cyber threats and AI errors, to mitigate peoples' fears and sense of insecurity over the rise of the intelligent information society.

Establish an intelligent, automatic national defense system with reinforced capability to counter cyber threats.

- Expand the range of data to be collected in the event of a cyber threat (including data from AI-based devices such as surveillance cameras, cars, and robots as well as amorphous and irregular data), and use the data thus collected to establish a big-data-based cyber security center (2017 onward).

- Develop AI-based cyber immunity and automated defense systems.

  ✔ A cyber immunity system would routinely collect a wide range of information on diverse types of malicious code and cyber vulnerabilities to prepare for possible cyber attacks (2018 onward).

  ✔ An automated defense system would conceal and cipher core data, change transmission routes, and independently reinforce the defense capability of national systems in the event of an attack (2020 onward).

    * Real-time threat transmission and blocking system: international networks by 2020, connected networks by 2025, and corporate networks by 2030.

- Develop the Personal AI Shield, which automatically identifies and troubleshoots security threats* to personal AI devices and services connected via networks (by 2025).

    * Small IoT devices can be used to launch DDoS attacks, possibly even causing the Internet across a region as large as the East Coast of the United States to collapse (October 2016).

  ✔ The system should be developed in the form of security chips that can be inserted into devices, thereby ensuring its wide applicability, and may be modified and tailored to different user environments, such as homes and offices.

Establish an intelligent and integrated security certification system encompassing humans and objects.

- Develop a compact certification system* for objects so that AI technology can be expanded to more devices and systems that currently permit electronic certification for humans only (by 2020).

    * The new certification system should be lightweight and super-compact so that it can fit into various wearable devices, sensors, etc.

  ✔ Support the development of quantum-code-based electronic certification technologies, even by establishing a support center if necessary.

- Develop intelligent and automatic certification technology with which AI would be able to verify identities without human or object actors first having to do so (e.g., by entering passwords) (2020 onward).

  ✔ Develop an intelligent system designed to prevent false identifications and certifications, and connect it to a real-time response system to prevent and counter identity falsification attempts (2020 onward).

Develop a system for assessing the security of Intelligent IT software.

- Research ways of adding software-related evaluation requirements and criteria to established security verification systems in various industries, such as the automotive parts and medical device industries (2018).

  ✔ Research and develop ways of detecting and determining whether secure and appropriate data have been input into the machine learning process of Intelligent IT software, and whether such software is capable of quickly identifying and resolving errors.

< Existing Software Security Certification Systems >

Industry	Certifying agency	Status	Remarks
Automotive parts	Korea Testing Laboratory	Voluntary	Required by American and European manufacturers.
Medical devices	National Institute of Food and Drug Safety Evaluation	Government-required	Tests available for both hardware and software, as well as for software only.
IT	Telecommunications Technology Association	Voluntary	Separate tests for software.

- Ensure the security of industrial-use AI devices and systems from the design phase onward by developing a security evaluation system and linking it to international certification programs (by 2030).

Produce AI security professionals and enhance global partnerships.

- Establish counter-cyber-attack training facilities and provide machine-learning-based training. Organize counter-hacking contests to find and recruit AI security system developers and operators (2018 onward).

- Expand global collaboration on cyber security research and establish a system for expanding the sharing of information and organizing concerted responses to cyber threats (2016 onward).

  ✔ Launch a global partnership platform led by Korea (2017 onward), and transform it into an international organization of multilateral participation, solidifying Korea's leadership in the area.

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▷ **Guiding aim:** The government should confine its role to that of a partner for spontaneous innovation in the private sector.

■ All stakeholders involved, including the national government, local governments, private-sector agencies, experts, businesses, and academia, should work together to ensure concerted, coordinated, nationwide responses to the emergence of the intelligent information society.

< Roles and Responsibilities >

Businesses	Citizens
▪ Provide innovative technologies and services and foster a healthy ecosystem of competition and cooperation. - Broad participation of businesses of all sizes, with the help of the Korea Chamber of Commerce and Industry (KCCI) and Korea Federation of Small and Medium Business (KBIZ), etc.	▪ Increase creativity and comprehension of technology and participate in policymaking processes. - Students, parents, consumers, minorities, etc. (e.g., consumer groups, university entrepreneurship clubs, etc.).

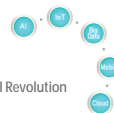| Government	Experts and Academia
▪ Support innovation and reinforce the social security net. - Coordinate government-wide participation across both national and local governments, legislatures, and the judiciary.	▪ Support human resource development and suggest policy solutions. - In science and technology, medicine, education, welfare, future forecasts, etc. (e.g., the Korea Society of Management Information Systems [KMIS], Korean Educational Development Institute [KEDI], Korea Association for Future Studies [KAFS], etc.).

▷ **Implementation Framework:** Expand and reform the Strategic Committee for ICT,* which has its basis in the Special Act on ICT, and turn it into a hub of public-private partnership to build nationwide and social consensuses on innovation.

* A policy review committee created under the Special Act on ICT that consists of 12 ex-officio members (including the Prime Minister as the chairperson, Minister of Science, ICT and Future Planning as the administrator, and other Cabinet ministers) and 13 non-official members.

■ Expand the non-official members of the committee to include members of local governments, civil society activists, and representatives of businesses and transform the organization into the "Intelligent Information Society Strategy Committee" (provisional title) to prepare for and manage the Fourth Industrial Revolution.

New committee structure (draft)

- ▪ **Co-chairs:** Prime Minister and one non-official member
- ▪ **From the national government:** all Cabinet ministers (with the Minister of Science, ICT and Future Planning serving as the administrator)
- ▪ **From local governments:** Governors Association of Korea
- ▪ **From academia:** professors, experts, researchers, etc.
- ▪ **From businesses:** KBIZ, KCCI, etc.
- ▪ **From civil society at large:** university entrepreneurship clubs, consumer groups, etc.

- Four subcommittees tasked with holding in-depth discussions on and coordinating policy issues:

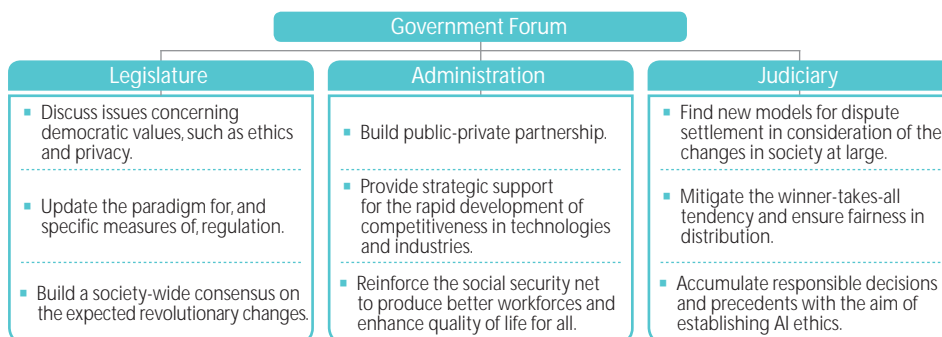|	Strategy Committee			
	Planning & Supervision	Industries & Services	Society	Technology
Ex-officio members	▪ Ministry of Strategy and Finance ▪ Ministry of the Interior ▪ Ministry of Government Legislation ▪ Korea Fair Trade Commission ▪ Korea Communications Commission	▪ Ministry of Trade, Industry and Energy ▪ Small and Medium Business Administration ▪ Ministry of Employment and Labor ▪ Ministry of National Defense, etc.	▪ Ministry of Education ▪ Ministry of Health and Welfare, etc.	▪ Ministry of Trade, Industry and Energy ▪ Ministry of Culture, Sports and Tourism
Non-official members	▪ Economists ▪ Education experts ▪ Futurologists ▪ Business associations, etc.	▪ Korea Federation of SMEs ▪ Korea Research Institute for Vocational Education and Training, etc. ▪ Korea Chamber of Commerce and Industry	▪ Teachers' unions ▪ Parents' associations ▪ Welfare experts ▪ Local governments	▪ AI developers ▪ Intelligent IT entrepreneurs ▪ AI societies ▪ Professors and researchers, etc.

▶ **Tripartite coordination:** To ensure administration-wide and nationwide responses, the government should form a loose yet effective partnership with the legislature and judiciary.
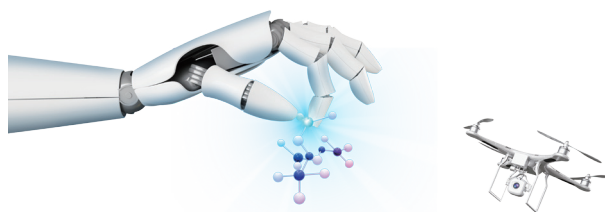
- The three branches of government may organize the "Government Forum for the Intelligent Information Society" (provisional title) to discuss and coordinate measures of cooperation for the Fourth Industrial Revolution.

Government Forum		
Legislature	Administration	Judiciary
▪ Discuss issues concerning democratic values, such as ethics and privacy. ▪ Update the paradigm for, and specific measures of, regulation. ▪ Build a society-wide consensus on the expected revolutionary changes.	▪ Build public-private partnership. ▪ Provide strategic support for the rapid development of competitiveness in technologies and industries. ▪ Reinforce the social security net to produce better workforces and enhance quality of life for all.	▪ Find new models for dispute settlement in consideration of the changes in society at large. ▪ Mitigate the winner-takes-all tendency and ensure fairness in distribution. ▪ Accumulate responsible decisions and precedents with the aim of establishing AI ethics.

▶ **Governmental support organizations:** Establish the Intelligent Information Society Bureau, tasked with establishing and implementing mid- to long-term plans (September 2016).

- MSIP officials and outside researchers have come together to form the Intelligent Information Society Bureau, which is responsible for drafting and reviewing mid- to long-term as well as annual master plans for the intelligent information society.

- Other government ministries and agencies also devise and implement annual action plans, according to the master plans drafted by the Bureau.

  ※ With the pending amendment of the Framework Act on National Informatization, the plan will be elevated to the status of a government-wide strategy of interdepartmental partnership.

Mid- to Long-Term Master Plan
in Preparation for
the Intelligent Information Society

Managing the Fourth Industrial Revolution