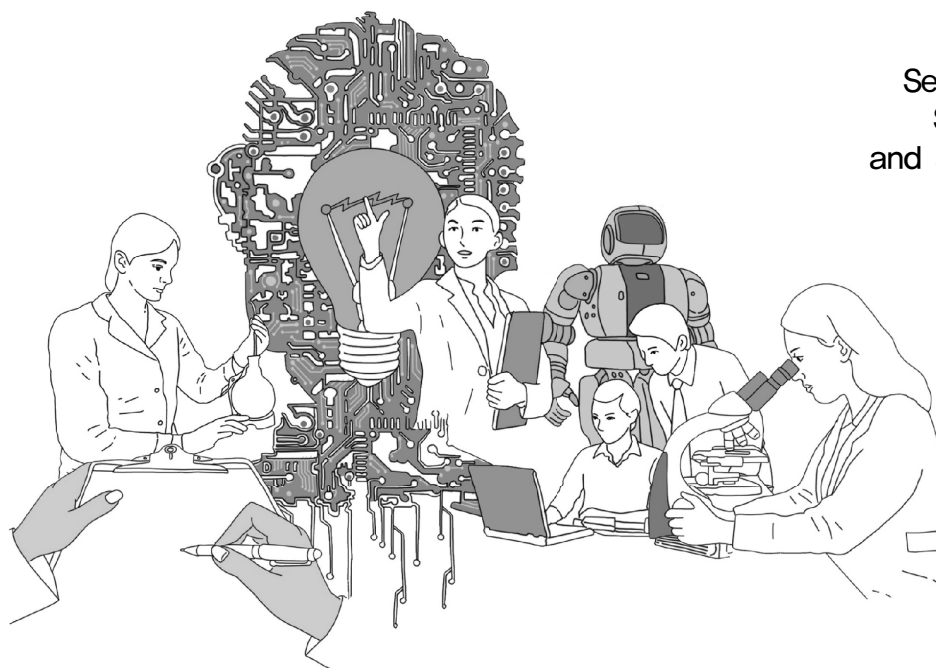


ISSUE PAPER 2016 - 02

KISTEP 10 Emerging Technologies in 2016: Enhancing the Quality of Life and Social Trust

Seung-Kyu Yi,
Sang-II Kim,
and Jun Woo Yu



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Message from the President



While Korea's GDP is now the 11th highest in the world (IMF, 2015), the subjective well-being by Koreans is ranked as the 47th (UN, 2015). Once economic growth reaches a certain point, growth itself can no longer improve quality of life. This is *Easterlin's Paradox*, and is a phase that our nation may have entered.

The 2015 World Happiness Report published by the UN emphasizes *social support*, or people helping each other out, as a crucial factor of happiness. John F. Helliwell, another "happiness economist," suggested that Koreans need to *connect* and develop *trust* between each other to be happy. In the new social network of the hyper-connected society of the future, in which everyone and everything is connected to each other, the importance of social support and trust in determining the quality of life will increase significantly.

Science and technology have contributed consistently to social development, through economic growth and technological progress. Now, it is needed to address various social issues and to expand its role in new areas in response to the changes of the future society. To enforce the social role of science and technology, KISTEP has chosen the important issues of our society every year since 2013, and selected *KISTEP 10 Emerging Technologies* based on an overall analysis not only of technological and economic impacts but also of the ability to cope with social issues. This year, *Enhancing the Quality of Life and Social Trust* has been identified as an issue that Korean society needs to resolve, and *KISTEP 10 Emerging Technologies* have been selected accordingly. In addition, possible economic and social impacts have been suggested, with a focus on the people and the industries that the fulfillment of these emerging technologies may influence.

I hope this issue paper helps us to reflect on the importance of quality of life and social trust, seek ways that science and technology can contribute, and lead to the implementation of good public policy in the process of preparing for the future society.

March 2016

Youngah Park

President, Korea Institute of Science & Technology Evaluation and Planning



I . Introduction

- Due to the rapid development and increased economic and social influence of science and technology, expectations of promising future technologies and their social role have grown.
 - Given its role in developing countermeasures to key issues in our society, such as securing growth engines by creating new industries as well as addressing social polarization, low birthrate, aging, and climate change, social problem-solving R&D and projects to enhance living convenience for the public have been promoted at the national level in recent years.
 - To use limited resources efficiently, strategic selection of the promising technology based on the principle of *Selection and Concentration* is needed. In addition, a study on methodology, which can efficiently determine the crucial countermeasure technologies, needs to be carried out through a careful analysis of the changes and the demands of the future society.
- KISTEP has annually selected and announced *KISTEP 10 Emerging Technologies* since 2009, and since 2013, the perspective of preparing for Korea's future society has been considered.
 - KISTEP has identified the key issues in the future Korean society, selected the emerging technologies as countermeasures to these issues based on their technological and economic impacts, in addition to reflecting the social role of science and technology.
 - In the past, *10 Emerging Technologies* were chosen by analyzing the social needs to resolve selected issues such as the aging of the population, increased safety hazards, disparity and inequality.
- In recent years, with the increased awareness for quality of society such as mutual growth, enhancement of well-being, and the improvement of the social system, people have been paying more attention to how science and technology can play its role as a more universal capital.
 - The universal social capitalization of science and technology indicates that it is being developed with wider application in life and society, beyond its limited usage in the technical and specialized fields (KISTEP, 2016).



II . Selection Criteria

A. Issue Selection

▣ Quality of life and social trust are chosen as Korea's key issues for selection of emerging technologies.

● Based on news, media, reports on future issues, and reviews by internal and external experts, well-being (the quality of life) has been identified as Korea's key issue in 2016.

- OECD's *How's Life?* survey ranked Korea at 26th out of 36 nations (2013).
- The UN's *World Happiness Report* ranked Korea at 47th out of 158 nations (2015).
- The Future Preparatory Committee under the Ministry of Science, ICT and Future Planning suggested lifestyle focusing on quality of life as one of the two strategic issues to prepare Korea for 10 years from now (2015).
- KISTEP proposed the enhancement of social quality to improve quality of life as one of the three major issues that Korea needs to prepare for 50 years ahead, and mentioned the formation of social trust among specific target issues (2016).

● As the main measure for improving life satisfaction and the plan to use science and technology as universal capital for our society, social trust was selected as a related issue.

- Social capital refers to social assets, including social trust, social norm and social network that generally facilitate collaboration among people and social transactions (Chang, 2006).
 - ※ Social trust means trust in society in general, including the social system as the basic elements (Han, 2007).
- Social capital is necessary to improve the quality of and the benefits to the society at large.
 - ※ The society as a whole is the owner of the capital, which exists in the form of trust and unity in social connections rather than individual transactors. The greater the capital, the greater the benefit of obtaining information and creating social engagement (Chang, 2006).
 - ※ Social capital improves the yield on investments on corporeal and human capital (Putnam, 1993).
 - ※ Social capital was conceptualized from the realization that trust is a crucial issue in the market that pursues economic efficiency. It influences social efficiency and growth, and its benefits are shared in the society at large, unlike other forms of capital that return the gains exclusively to the owner (Yu & Chang, 2002).



- Social capital has an effect on the quality of life and happiness.

※ Social capital affects non-economic factors in relation to life satisfaction (Park *et al.*, 2003).

※ Social capital directly influences the happiness of individuals and groups (Putnam, 1993).

※ The higher the satisfaction with life, the stronger the social trust (Chung, 2014).

※ Institutional factors such as satisfaction with the public service affect well-being (Bae, 2014).

● The quality of life and social capital work in a virtuous cycle. Thus, considering both at the same time will address social needs more effectively.

- It is possible to accelerate the virtuous cycle through emerging technologies that enhance the well-being of Korean society as well as strengthen social trust, a crucial factor of social capital.



Source: OECD (2011), *How's Life?: Measuring Well-being*, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264121164-en>.

Figure 1. The OECD Framework for Measuring Well-being



B. Selection Process

▲ The selection process is divided into the analysis of future needs and the selection of the emerging technologies.

Table 1. Analysis of Future Needs

Process	
<p>(1) Analysis of the OECD Report and Index</p>	<ul style="list-style-type: none"> - Well-being is divided into material living conditions and quality of life (including 11 different dimensions of life in total) <ul style="list-style-type: none"> : (Material living conditions) income and wealth, job and earnings, housing : (Quality of Life) health status, work-life balance, education and skills, social connections, civic engagement and governance, environmental quality, personal safety, subjective well-being - Only subjective well-being is a subjective index, while the other 10 are objective indices - Korea's ranking in these 11 dimensions among OECD members were analyzed, and low-ranking areas were identified
<p>(2) Literature Review</p>	<ul style="list-style-type: none"> - Focusing on the indices from (1) where Korea ranked low, study on specific issues, current status and causes (considering the conceptual relation between well-being and social trust) was conducted
<p>(3) Big Data Analysis</p>	<ul style="list-style-type: none"> - Korea's specific issues in each of the 11 dimensions in step (1) were identified and verified · Period of data collection: Jan 2012 - Dec 2014 (3 years) · Data source: EBSCO news (English) and KINDS news (Korean) · Keywords: English keywords based on OECD's well-being reports, and Korean keywords by translating the English keywords · Main issues of each specific area were identified by topic modelling method
<p>(4) Identification of Needs</p>	<ul style="list-style-type: none"> - For each of the 7 dimensions deducted through the preceeding steps (income and wealth; jobs and earnings; health status; work-life balance; social connections; the environmental quality; and personal safety), specific needs that require countermeasures were analyzed
<p>(5) Solutions using Science & Technology</p>	<ul style="list-style-type: none"> - Based on results of (4), social needs that can be addressed using science and technology were identified - Ways or directions to address the needs through science and technology were identified



Table 2. Selection of Emerging Technologies

Process	
<p>▼</p> <p>(6) Compilation of Technology Pool and Matching Needs</p>	<ul style="list-style-type: none"> - Exploration of candidate technologies <ul style="list-style-type: none"> ① Emerging technology DB ② New ideas suggested by technology experts ③ DB of domestic press news in papers and online ④ Reports on the emerging technologies by international press such as Forbes, WT VOX and NMC - Relevance with the specific needs derived from (4) was considered
<p>▼</p> <p>(7) Experts' Workshop and Review by Internal Research Team</p>	<ul style="list-style-type: none"> - Through the workshop of experts in the related technology and the review by the internal research team, technical level and similar or overlapping technologies were adjusted
<p>▼</p> <p>(8) Identification of Candidate Technologies</p>	<ul style="list-style-type: none"> - Through assessment of adequacy in three criteria, 20 candidate technologies were identified
<p>▼</p> <p>(9) Selection of Emerging Technologies</p>	<ul style="list-style-type: none"> - Based on priority evaluation candidate technologies from step (2) by KISTEP's internal/external technology experts, candidate technologies on the effectiveness of applications and the ability to cope with future issues were reviewed in order to select the final 10 emerging technologies
<p>▼</p> <p>(10) Analysis Report on the Trends and Impacts of Technologies</p>	<ul style="list-style-type: none"> - Technological/industrial trends of each emerging technology were examined - The individuals and the industries that the implementation of the technology will impact were identified, and the economic and social impacts likely to follow were suggested



C. Analysis of Specific Issues

Identification of Future Needs

For 11 dimensions from *How's Life?*, the OECD's report on quality of life (well-being), the specific issues and needs closely related to the well-being and the improvement of social trust of the Korean society were identified, and reorganized into 3 future trends.

Table 3. Needs Related to Well-being and Social Trust in Korea

Future Trends	Issue Areas	Specific Issues and Future Needs
Enhancing Trust in the Hyper-connected Society	Social Connections	<ul style="list-style-type: none"> Improving social connections to overcome personal difficulties Preventing damage to online social network (reinforcing trust)
	Income and Wealth	<ul style="list-style-type: none"> Preventing/resolving/eliminating the risk of bank fraud Preventing the public from being victims of economic crimes (other than bank fraud) Tax saving (preventing the outflow of ordinary people's wealth) Improving the reliability of tax policy (supporting small-loan finance)
Work-Leisure Balance	Jobs and Earnings	<ul style="list-style-type: none"> Vitalizing the knowledge industry Reducing safety accidents affecting children to facilitate the return to work of child-rearing women
	Work-Life Balance	<ul style="list-style-type: none"> Increasing personal time (in comparison to work hours) Increasing participation in social communities
Healthy and Safe Life	Health Status	<ul style="list-style-type: none"> Addressing the social causes related to mental health concerns, such as impulse and anger Managing and resolving psychological trauma experienced by members of community due to social disasters such as the Sewol ferry disaster Increasing confidence in the national response system to infectious diseases
	Environmental Quality	<ul style="list-style-type: none"> Reducing population density in the work environment Maintaining indoor air quality (having confidence in policies on work environment) Reducing hazardous substances and pollutants in the atmosphere Preventing and treating the influx of non-biodegradable materials including non-point source pollution



D. Current State and Future Needs of Each Trend

1. Enhancement of Trust in the Hyper-connected Society

Social Connections

● Korea remains the lowest-ranked among OECD members in the dimension of social connections. Social connections have a positive impact on personal and social well-being, in addition to the fundamental pleasure of spending time with one another.

※ A person who has a wide support network tends to be healthier, live longer, and is more likely to be employed. Also, social connections, in terms of the society at large, can create shared value (such as trust in others and the norm of reciprocity) and influence diverse outcomes such as economic growth, democratic participation and the level of crime.

- Korea is in the lowest group among OECD members in terms of the ratio of social network support*, the index representing social connections, and its gap with the OECD average is very large.

* Ratio of people who responded that they had relatives or friends to rely on.

Table 4. Korea's Rank in Perceived Social Network Support

Division	2011	2013	2015
Korea's Rank (total number of countries reviewed)	37 th (40)	34 th (36)	34 th (34)
Ratio of People Having Relatives or Friends to Rely on	79.8	77	72.37
OECD Average	91.1	90	88.02

※ Source: *How's Life?* by OECD (2011, 2013 and 2015)

- Loneliness may cause a wide range of health issues, from hypertension, cardiovascular disorder, weakened immunity to depression (The Wall Street Journal, 29 June 2015).

※ Dr. Julianne Holt-Lunstad's research team from Brigham Young University claims that living alone or having lots of alone time may have harmful effects on physical and mental health, regardless of the person's enjoyment of solitude.

※ People who responded either that they lived alone, had lots of solitary time or often felt loneliness had a 30% higher probability of dying in the next 7 years than those who said no to all three.



● For people experiencing personal/social adversity or the socially underprivileged, it is not only important to strengthen the social safety net, by providing both material and non-material aid, but is also critical to devise means to establish trust in one's social network in the hyper-connected society of the future.

※ Lack of conversation partners or professionals who can consult and advise on loneliness, sadness, anger, distrust, frustration, rage, and despair.

- With the emergence of new and diverse types of relationships in the hyper-connected society of the future—that is, person to person, person to device, and device to device—utilizing online social networks will become very frequent and universal.

- For this reason, it is necessary to form relations using diverse online networks and to prepare means to prevent damage to trust in this process.

Income and Wealth

● Economic resources increase the freedom to make choices in life, and protect against economic and personal hazards (OECD, 2013). However, household net-adjusted disposable income per capita* and net financial wealth** in Korea are below the OECD average.

* Maximum amount of income that a household member can spend without reducing asset or increasing debt

** Amount obtained by subtracting household financial debt from monetary gold, cash and deposits, securities excluding shares, loans, shares and other equity capital (including stocks issued by investment funds), technical insurance reserve funds, other trade receivable and sales debt

Table 5. Korea's Rank in Income and Wealth (Among OECD Members) (Lower Group Index)

Division	2011	2013	2015
Net-adjusted Disposable Income Per Capita	25 th (33 nations)	22 nd (31)	20 th (29)
Net Financial Wealth	23 rd (30)	18 th (29)	20 th (32)

※ Source: *How's Life?* by OECD (2011, 2013 and 2015)

- Incidents of bank fraud have been increasing, and many people have been victimized more than once (Korea Financial Investors Protection Foundation, 2015).

※ Self-reported cases of bank fraud has remained at 4.0%, the same as the previous year. However, reports of people who have been exposed to bank fraud attempts have been gradually increasing from 17.4% in 2012, 21.4% in 2013, and to 25.1% in 2014.



- Due to new types of scams involving altered caller ID, card loan and phishing websites, the number of fraud victims dramatically increased in 2011 (Financial Supervisory Service's Annual Report, 12 Nov 2014).

※ These cases started in 2006, and reached about 45,000 cases by 2013. Total damages amount to almost 450 billion won, of which the damage from phishing amounted to 88.6 billion won (13,000 cases), which was 87.7% (34.1% based on the number of cases) higher in a year-on-year comparison.

- A economic recession and the global financial crisis lead to general hardship for ordinary people. This has contributed to increased financial crimes such as illegal private loan and fraud, and raised the possibility of the outflow of their assets, various kinds of tax evasion, tax fraud and waste of public finance.

Table 6. Occurrences of Major Financial Crimes

(Unit: Number of occurrences)

	Year	Total	Fraud	Embezzlement	Misappropriation	Violation of Subordinate Law
Number of Occurrences	2009	268,613	221,796	26,637	6,266	13,914
	2010	252,425	203,835	25,767	14,365	8,458
	2011	262,287	223,470	26,767	4,812	7,238
	2012	277,156	235,366	31,273	4,267	6,250
	2013	313,891	269,082	34,892	4,617	5,300

※ Source: Korean National Police Agency's 2014 White Paper.

❶ Persistent occurrence of damage to general wealth due to increased cases of bank fraud not only threaten economic resources but also reduce the credibility of the financial system and associated institutions. For this reason, it is crucial to devise plans to resolve these issues.

- Net financial wealth is threatened by the decreasing credibility of the existing financial system (statute of frauds) given that the risk of exposure to bank fraud has increased.

- Also, roughly half of people are unsatisfied with their income, and financial hardship among the general public results in increased occurrences of financial crimes, including fraud and embezzlement. Therefore, economic resources are depleted and the net financial wealth's growth potential is threatened/damaged.



2. Work-Leisure Balance

Jobs and Earnings

Unemployment has adverse effects on physical and mental health. Employment rate and average total earnings per year for full-time workers are relatively low in Korea.

※ Jobs help people to develop new skills and capacities, and provide the opportunity for social and occupational networking (OECD, 2013).

Table 7. Korea's Rank in Jobs and Earnings (Among OECD Members) (Lower group index)

	2011	2013	2015
Employment Rate	23 rd (out of 36)	23 rd (out of 36)	20 th (out of 34)
Average Total Earnings Per Year for Full-time Workers	19 th (out of 26)	18 th (out of 34)	17 th (out of 30)

※ Source: *How's Life?* by OECD (2011, 2013 and 2015)

- The employment rate of the productive population in particular (25~54 years old) in 2015 was ranked 27th among the 34 OECD members, and the main reason for this ranking appeared to be the relative lack of economic activity among women.

※ Male employment rate is 17th rank (75.6%), a little above the OECD average (74.1%), whereas the female employment rate is 28th (55.8%), lower than the OECD average (58.5%).

- The number of women discontinuing careers is increasing, and more than half of them are in their 30s. The main reason for the discontinuation is marriage, childbirth and child rearing.

※ As of April 2014, some 2,139,000 women had discontinued careers. The number of discontinuations is 822,000 for marriage; 627,000 for child rearing; 436,000 for pregnancy and childbirth; 162,000 to care for family; 93,000 for the education of children (Press release from the Ministry of Strategy and Finance, 26 Nov 2014).

- Women face various obstacles in jobseeking, such as the burden of childcare. However, the majority of the population believe that women should have jobs, regardless of their involvement in family care.

※ The biggest obstacle to female employment is the childcare burden (46.6%), followed by social prejudices against women (20.8%) and discriminatory work conditions (10.0%).

※ Around 84.5% of people believe it is good for women to have jobs, and only 6.9% responded that focusing exclusively on family care was more important. More than half of the people (52.1%) replied that women should work continuously regardless of family care (Press Release from Statistics Korea, 4 Dec 2013).



Table 8. Women who Discontinued their Careers

(Unit: one thousand, %, year-on-year comparison)

		Jun 2011	Sep 2012	Apr 2013	Apr 2014	Difference	Rate of Change
Married women between 15~54 years of age (A)		9,866	9,747	9,713	9,561	-152	-1.6
Unemployed (B)		4,081	4,049	4,063	3,894	-169	-4.2
Ratio (B/A)		(41.4)	(41.5)	(41.8)	(40.7)		
Women with Career Discontinuation	Including Family Care (C)	-	-	-	2,139	-	-
	Ratio (C/A)				(22.4)		
	Excluding Family Care (D)	1,900	1,978	1,955	1,977	22	1.1
	Ratio (D/A)	(19.3)	(20.3)	(20.1)	(20.7)		

※ Source: Press Release from the Ministry of Strategy and Finance (26 Nov 2014)

● Unemployment of women with involuntary career discontinuation, especially in cases due to conflict with the social and cultural system in regard to childbirth and care, puts their health and well-being at risk, indicating the need for a plan to resolve this issue.

- In order to overcome social prejudices and discriminatory work conditions, the knowledge industry needs to be employed to develop jobs and individual start-ups.

- In addition, children of employed women have greater risk of accidents than those of unemployed women, and the frequency of changing personal caretaker/childcare institution is higher with employed than unemployed women. This implies distrust in the childcare system, and require a solution.

※ The frequency of accident/poisoning of a child is higher with an employed mother (1.52 cases) than that with an unemployed mother (1.32 cases) (Lee *et al.*, 2011).

※ Working mothers have a higher rate of changing personal caretaker / childcare institution compared to unemployed mothers (Lee *et al.*, 2011).

Work-Life Balance

● Maintaining the right balance between work and personal life is a core factor in quality of life (OECD, 2013), but in terms of leisure time* Korea is in the middle and lower ranks among OECD members, which indicates that health and personal life are under threat, and can negatively affect the quality of life.

* Collected via a survey of time use by having the respondents write activity logs for one or more days during the specified period.



Table 9. Leisure and Personal Time Spent by a Full-time Worker

	2011	2013	2015
Korea's Ranking (Number of countries surveyed)	11 th (20)	12 th (20)	15 th (20)
Daily Leisure Time Spent by a Full-time Worker	14.79	14.63	14.70
OECD Average	14.80	14.87	14.91

※ Source: *How's Life?* by OECD (2011, 2013 and 2015).

- The yearly hours worked by Koreans is decreasing each year. However, Korea still remains one of the countries in which people live a work-focused life for the longest hours (The Ministry of Culture, Sports and Tourism, 2013).

※ Although the working hours of Korean labourers has decreased steadily each year, from 2,351 hours in 2005 to 2,090 hours in 2011, it still remains the second longest after Mexico among OECD members in 2013, and has a wide gap with OECD average of 1,770 hours (OECD, 2013).

- The average leisure time in Korea is similar to that of the US and Spain, but is less than that of Norway and Germany.

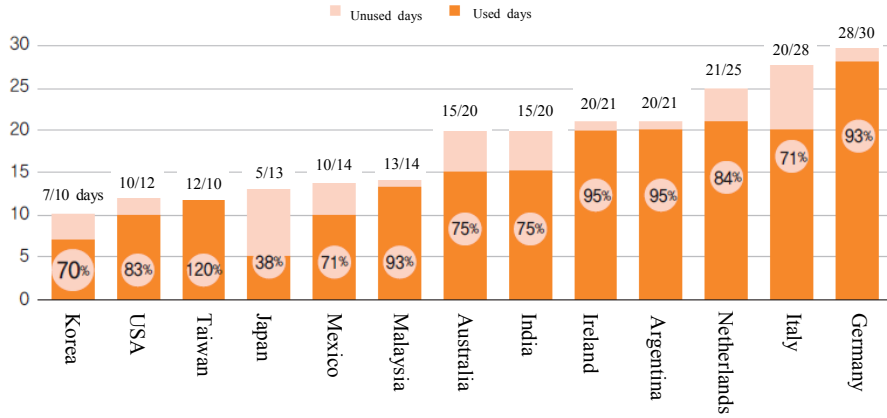
※ A recent survey conducted in 2006 shows that Korean average leisure time is 21.6% (5.2 hours out of 24 hours per day), which is similar to the US, Spain, and Poland, but less than Norway (6.4 hours), Germany and Finland (6.0 hours), and Belgium (5.9 hours).

- Korea has attained an astounding level of material wealth but the quality of life has reduced due to factors inhibiting personal freedom such as leisure activity and leisure time (The Ministry of Culture, Sports and Tourism, 2013).

※ In the Legatum Prosperity Index, Korea ranked 64th in personal freedom (www.prosperity.com, 2013 The Legatum Prosperity Index).

- Downshifting is increasing among workers who prefer more leisurely lifestyles, even to the point of accepting a lower wage. Nevertheless, the number of days off and legal holidays in Korea is lower than in advanced countries such as the European nations, and people are unable to spend even their given holidays (The Ministry of Culture, Sports and Tourism, 2013).

※ The average Korean worker has 10 days of paid holidays per year, which is the lowest among 22 countries surveyed. The rate at which such paid holidays are used in Korea is 70%, placing Korea just behind Japan in terms of the number of unused days (Japan used 5 out of 13 days on average (38%)).



Source: *Expedia*, www.expedia.co.kr

Figure 2. Used and Unused Holidays Per Year in Major Countries

● In order to ensure that people have enough time to spend networking with one another and participating in community activity, a plan is needed to better distribute time for work and personal life in a balanced way.

- Since personal time is relatively lacking in Korea due to long working hours, more efficient and easier access to means of leisure need to be developed.
- Additionally, rather than individual one-time leisure activities, community activities that lead to trust building opportunities need to be promoted.



3. Healthy and Safe Life

Health Status

Being healthy can enable one to get a job, earn adequate income, and take an active part in society (OECD, 2013). Nonetheless, in Korea, it is common to evaluate one's health status negatively. In the event of an accident or disaster, particularly with the recent incidents of the Sewol ferry disaster and the MERS outbreak, social anxiety has become widespread and the confidence in the related system has weakened in many cases.

- Korea remains the lowest-ranked among OECD members in terms of self-reported health status* with a large differential from the average.

* Proportion of people over 16 years of age who reported their health status as "good" or "very good"

Table 10. Ranking in Self-Reported Health Status (Lower Group Index)

Division	2011	2013	2015
Korea's Rank (The number of countries evaluated)	None	34 th (35)	34 th (34)
Ratio of the people reporting a health status of "good / very good" (unit: %)	None	36.8	35.1
OECD average (unit: %)	None	69	68.8

※ Source: *How's Life?* by OECD (2011, 2013 and 2015).

- Recently, impulsive and incidental crimes have increased and spread widely from within the family to society at large, and these come from the social and economic environment.

※ Sisa Press, the Weekly Newsmagazine, mentioned that the diversification of society has contributed to an increase in stress beyond the threshold due to widespread stress factors, and the building up and intensification of stress can lead to radical actions, such as crimes due to rage. For this reason, a social solution is necessary. (29 Oct 2015).

※ Half of the adult population in Korea has difficulty controlling anger, with 1 in 10 requiring treatment (Source: Association of Neuro Psychiatric Practitioners (KANPP)).



- Personality and behavioral disorders in adults* have become a social issue, and the number of male patients in their 20s with behavioral disorders has continuously increased for the past 5 years (Health Insurance Review & Assessment Service, 3 Mar 2015).

* Mental illnesses include personality disorders like paranoia and aggression; habit and impulse disorders such as pathological gambling, arson and kleptomania; and gender identity disorders.

※ The number of male patients in their 20s is the group with the largest increase compared to the level 5 years ago, and its proportion among total patients is becoming gradually larger (20.2% in 2014).

- The number of deaths from suicide and the suicide rate have increased constantly since 2000 (Press Release from Statistics Korea, 27 Nov 2014).

※ The number of deaths in Korea in 2013 was 266,257. Of this number, 5.4% (14,427) of all deaths were from suicide, an increase of 1.9% (267) from the previous year, and deaths from suicide have shown a tendency to increase continuously since 2000.

- More than half of the people over 13 years of age* are under stress in their daily lives.

* Around 66.6% of the population over 13 years of age is under stress in their everyday lives, with 6.8% having contemplated suicide at least once in the last year (Press Release from Statistics Korea, 27 Nov 2014).

- With the constant risk of new types of infectious diseases being introduced, the recent widespread MERS outbreak has led to a decrease in public trust in the public health care system.

* Seven out of 10 people distrust the government's control and management measures for MERS (Chosun Biz, 5 Jun 2015).

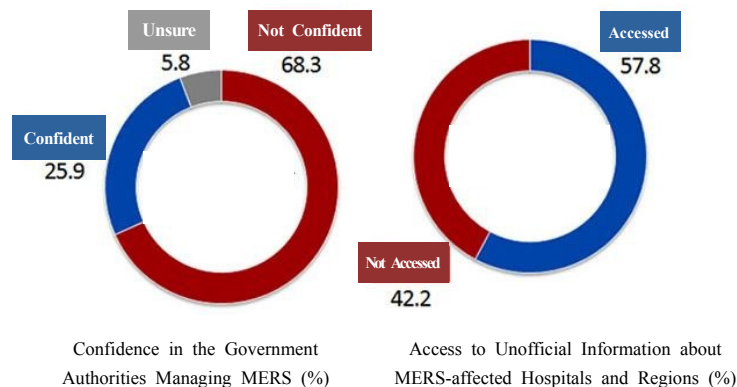


Figure 3. Confidence in the Government's MERS Control and Management Measures
(Chosun Biz, 5 Jun 2015)



● Measures that enable the provision of diagnoses and treatments for mental health status at the individual, national and social levels is necessary.

- It is important to establish a program that promotes the maintenance and enhancement of one's mental health when it is good and the control and management of it when it is weakened. To overcome anger management disorder, awareness of one's emotional state; continual interest in, support for and communication with others to alleviate the anger of the socially disadvantaged; and strong trust of community members in one another is necessary.
- When there is an accident or disaster that may lead to mental trauma in society at large, diagnoses and treatment for social mental health are needed.
- In regard to the public health issues that may cause social turmoil such as the emergence of new infectious diseases, it is essential to strengthen the confidence in the associated government authority (quarantine and medical systems).

▣ The Quality of the Environment

● Quality of life is significantly influenced by a healthy physical environment, and factors that can jeopardize it, such as environmental pollutants, toxic substances and noise, have a significant impact on people's health (OECD, 2013). Despite this fact, Korea's air* and water** quality are ranked very low among OECD members, and its gap from the OECD average is huge.

* Yearly atmospheric concentration of particulate matter smaller than 10μ (PM10) in diameter in urban residential areas with more than 100,000 residents is measured by population-weighted average.

** Subjective evaluation of the water quality in one's residential area

Table 11. Korea's Ranking in terms of Air and Water Quality (among OECD members)

	2011	2013	2015
Quality of the Air (The number of countries evaluated)	31 st (40)	31 st (36)	34 th (34)
Quality of the Water (The number of countries evaluated)	29 th (40)	26 th (36)	26 th (34)

※ Source: *How's Life?* by OECD (2011, 2013 and 2015)

- Population density at the workplace in Korea is higher than that in advanced countries, which makes building a pleasant and healthy physical environment relatively difficult.



- Among environmental issues, harmful substances and pollutants from the influx of yellow dust and particulate matter are considered the most serious issue causing anxiety among the public.

※ Roughly 77.9% of respondents felt anxious about “influx of yellow dust and particulate matter,” and 68.1% are also concerned with “exposure to harmful chemical substances and radiation” (Statistics Korea, 2014).

Table 12. Concerns due to Environmental Issues

(Unit: %)

		Total	Not Anxious			Moderate	Anxious		
				Never	Slight			A little	Very
Climate Change Due to Global Warming	2014	100.0	10.2	1.2	8.9	27.0	62.9	49.6	13.3
	Urban	100.0	9.8	1.2	8.6	27.0	63.2	50.0	13.2
	Rural	100.0	12.2	1.5	10.6	26.8	61.1	47.6	13.5
	Male	100.0	11.8	1.7	10.1	28.6	59.6	47.7	11.9
	Female	100.0	8.6	0.8	7.8	25.4	66.0	51.4	14.6
Exposure to Toxic Substances and Radiation	2014	100.0	7.6	0.8	6.7	24.4	68.1	47.8	20.3
	Urban	100.0	7.0	0.7	6.2	24.1	69.0	48.0	20.9
	Rural	100.0	10.3	1.3	9.1	25.8	63.8	46.6	17.3
	Male	100.0	8.8	1.1	7.7	26.3	64.9	47.4	17.5
	Female	100.0	6.4	0.5	5.8	22.5	71.1	48.2	22.9
Influx of Yellow Dust and Particulate Matter ¹⁾	2014	100.0	4.0	0.5	3.5	18.2	77.9	48.6	29.3
	Urban	100.0	3.5	0.5	3.1	17.4	79.1	48.8	30.3
	Rural	100.0	6.0	0.7	5.2	21.9	72.1	47.7	24.4
	Male	100.0	4.5	0.7	3.8	20.1	75.5	48.9	26.6
	Female	100.0	3.5	0.3	3.2	16.3	80.2	48.4	31.8
Use of Agricultural Pesticides and Chemical Fertilizer	2014	100.0	8.0	1.0	7.1	37.1	54.8	42.7	12.2
	Urban	100.0	7.6	0.9	6.6	36.5	55.9	43.4	12.6
	Rural	100.0	10.3	1.1	9.2	39.9	49.8	39.4	10.4
	Male	100.0	9.2	1.2	8.0	39.4	51.4	40.8	10.5
	Female	100.0	6.9	0.7	6.2	34.9	58.2	44.4	13.8

※ Source: Press Release from Statistics Korea (27 Nov 2014)



- Pollution levels of particulate matter have been reduced consistently starting from the metropolitan area, but still remains higher than advanced countries. In particular, due to effects of the weather and other countries, the level has changed little since 2013 (Ministry of Environment, 2015).
- However, the main causes of high concentration of particulate matter are the increased inflow and delayed diffusion of long-distance pollutants from overseas such as yellow dust and smog. Considering the weather situation, such as inadequate air circulation, and the difficulty in reducing pollutant emissions from China and other surrounding nations in a short period of time, the incidence of high concentration of particulate matter is likely to occur very often for a while.
- In terms of water pollution, changes in rainfall patterns due to climatic change lead to the increased outflow of nonpoint pollution sources and the occurrence of turbid water on a large scale (Ministry of Science, ICT and Future Planning, 2015).
 - ※ Nonpoint pollution sources represent 68.3% of enrichment ratio of river contamination in 2010, and are predicted to reach 72.1% by 2020 due to the expansion of impervious surfaces from construction projects. That is, the enrichment ratio of nonpoint pollution sources is continuously increasing, so an optimum management plan is needed.
- Point pollution source-centered water improvement business has shown limitations in terms of achieving target water quality, and non-degradable materials of nonpoint pollution sources are flowing into public waters as a result of rainfall effluent, resulting in more water pollution.

● Systematic monitoring and plans to forecast and respond to high concentration of particulate matter and nonpoint water pollution sources need to be established.

- For particulate matter, a systematic plan for prediction, proactive response and air purification of indoor and living environment based on long distance and constant monitoring needs be made a priority.
- For water pollution, the water quality management plan needs to be expanded from point pollution source-centered water quality improvement to nonpoint pollution source.



E. Seeking Solutions through Science and Technology

Scientific and technological measures that can contribute to solving specific issues and addressing future needs were explored.

- Conceptualizing technologies, products and services that can address future needs, and perform associated functions
- Increasing accessibility including economic (cost reduction), time-based and physical accessibility
- Enabling easy and convenient use and with enhanced application

Table 13. Specific Issues and Future Needs in Each Dimension, and Scientific and Technological Solutions

Dimension	Specific Issues and Future Needs	Scientific and Technological Solutions
Social Connections	<ul style="list-style-type: none"> • Enhancing social network to overcome personal difficulties • Preventing damage to online social network (strengthening its reliability) 	<ul style="list-style-type: none"> • Alleviating, sharing and empathizing negative situations • Social Robot <ul style="list-style-type: none"> - AI technology based on emotion sensitive-ICT - Social dining system device • Data confidence technology • Security technology for online social network
Income and Wealth	<ul style="list-style-type: none"> • Prevention, resolution and recovery of bank fraud damage • Prevention of financial crime targeting individuals (other than bank fraud) • Tax saving (preventing outflow of people's wealth) • Improving the reliability of tax policy (financial support for people) 	<ul style="list-style-type: none"> • Big data-based bank fraud search and prevention • Fraud prevention by FinTech security • Encouraging wise consumption using FinTech technology
Jobs and Earnings	<ul style="list-style-type: none"> • Vitalization of knowledge industry • Reducing accidents among children to facilitate women's return to work 	<ul style="list-style-type: none"> • Development of one-man knowledge services business <ul style="list-style-type: none"> - Knowledge-on-demand based on big data and AI • Supporting in childcare and baby monitoring
Work-Life Balance	<ul style="list-style-type: none"> • Increasing personal time (relative to working hours) • Encouraging participation in community 	<ul style="list-style-type: none"> • AI-based work support • Smart working • Self-enrichment and healing via VR <ul style="list-style-type: none"> - Supporting employees' personal leisure in their spare time
Health Status	<ul style="list-style-type: none"> • Resolution of economic and social causes of mental health issues, such as impulse and rage • Relieving trauma of the community after social disasters (ex. Sewol ferry accident) • Strengthening confidence in government to control and manage infectious diseases 	<ul style="list-style-type: none"> • Constant monitoring of mental status, and forecasting possibility of impulse and rage • Emotion sensitive-ICT • Self-diagnosis and real-time monitoring for home use • Diagnosis of lifestyle disease based on biometric data • Predicting the possibility of occurrence and spread of infectious diseases
Environmental Quality	<ul style="list-style-type: none"> • Reducing population density in workplace • Maintaining pleasant indoor air (confidence in workplace-related policy) • Reducing toxic substances and pollutants in the atmosphere • Purifying air and preventing the influx of non-biodegradable substances such as nonpoint pollution source 	<ul style="list-style-type: none"> • Smart working technology (VR, Cloud and telecommuting) • Control and reduction technology of particulate matter (indoor/outdoor) <ul style="list-style-type: none"> - Indoor and outdoor particulate matter concentration monitoring and alarm - Personal protection measure of particulate matter (portable) • Research and development of nonpoint pollution source management technology suitable to Korea



F. Selection of Candidate Technologies

After studying candidate technologies through various approaches and reviewing their appropriateness, social trust-improving candidates were identified to enhance well-being.

Candidate technologies were studied through 4 different approaches to ensure a balanced reflection of technical, industrial and social views, within and outside of Korea.

- (Emerging technology DB) Candidates related to this year's issue were selected from the emerging technologies selected by domestic and overseas institutions and KISTEP's technology DB.
- (Expert review) Candidate technologies identified above via input from technology experts were reviewed, and technologies that can address the issues and needs of social trust and well-being were identified.
- (Technology featured in media) Relevant technologies reported in the science, technology, economics and education sections of the news in the domestic press from 1 Jan to 11 Nov, 2015 were reviewed.
- (Latest global trends) Media data of emerging technologies by international press, such as Forbes, WT VOX and NMC were analyzed.

Through the experts' workshop, the appropriateness of selected technologies was evaluated. Twenty candidate technologies were selected.

- Three standards were applied to evaluate the appropriateness of technology: concreteness; novelty; and realization possibility.

Table 14. Appropriateness Evaluation Standards of Emerging Technologies

Criteria	Evaluation Standard
Concreteness	<ul style="list-style-type: none"> • Exclude the products and services for which it is impossible to derive applicable technology
Technological Advancement	<ul style="list-style-type: none"> • Exclude the products that can be manufactured and services that can be provided at current technology levels when sufficient resources, political and institutional support are given ※ Consultation with experts in each area of technology
Social & Technological Realization Possibility	<ul style="list-style-type: none"> • Exclude technology with significantly low technical and social realization possibility in the next 10 years ※ Determine the realization possibility of the technology based on time of technical actualization predicted by the 4th science and technology foresight study on 652 emerging technologies, and time of economic and social supply and expert reviews of each technology.



G. KISTEP 10 Emerging Technologies Selection

After prioritizing 20 candidate technologies by KISTEP's internal and external experts, and the final review by the experts, 10 emerging technologies were selected.

The candidate technologies were prioritized based on four evaluation criteria, considering the weighting of each criterion.

Table 15. Evaluation Criteria for the Selection of Emerging Technology

Evaluation Criteria	Standards
Realization Possibility in 10 years	The possibility of the completion of technology development and social practicality in about 10 years time
Capability to Respond to Future Needs	The scale of impact that can be expected from the realization of the technology in terms of the resolution of key issues in the future
Economic Impacts	The potential of creating added value expected from the realization of the technology
Technological Impacts	The degree of leading innovative development in the same or other fields of technology

After determining the overall evaluation results by reflecting the weight of each criterion, priority for each of the dimensions was set.

Table 16. Results of the Priority Evaluation by the Experts

Future Trend	Dimensions	Rank	Evaluated Candidate Technologies	Overall
Foundation of Trust in Hyper-Connected Society	Social Connections	1	IOT Security	1.06
		2	Social Robot	0.98
		3	Information of Everythings	0.97
		4	Big Data-based Prevention of the Government Institution-related Fraud	0.93
		5	Data Trust Technology	0.91
	Income and Wealth	1	Big Data-based Bank Fraud Prevention Technology	1.02
		2	Biometrics-based Security Technology for Financial Transaction	1.01
		3	Online/Mobile Financial Transaction Security Technology	1.00
Work-Leisure Balance	Jobs and Earnings	1	Knowledge-On-Demand Production Technology (KOD)	0.94
	Work-Life Balance	1	Miscellaneous Work Technology based on Machine-learning	0.97
		2	Virtual Reality Technology for Leisure	0.97
		3	Mind Device / Autonomic Software Agent in Control Field	0.92
Healthy and Safe Life	Health Status	1	Big Data-based Prediction / Information System of Infectious Diseases	1.01
		2	Diagnostic Technology for Organizational/Community Mental Health	0.95
		3	Super-speed Diagnostic Technology of Infectious Diseases	0.93
		4	Empathy Program and the Associated Technology	0.92
		5	Safety Smartware	0.90
		6	Neuromarker and the Associated Technology	0.88
	Environmental Quality	1	System-based Particulate Matter Technology	1.00
		2	Personal Particulate Matter Technology	0.91



III . KISTEP Emerging Technologies

A. KISTEP 10 Emerging Technologies in 2016



Quality of life and social trust were defined as key issues. Major needs in Korean society were analyzed, and emerging technologies that can enhance the quality of life and social trust were selected accordingly.

Final 10 emerging technologies were selected based on the priority evaluation on candidate technologies, and KISTEP researchers' review.





※ Technologies similar or related to each other are integrated in the final selection.

Concreteness and details of selected 10 emerging technologies were reviewed and their names were altered to make them easy to understand for the public.



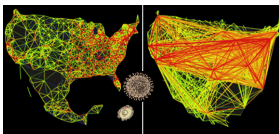

Table 17. KISTEP 10 Emerging Technologies in 2016

Name of Technology	Details
 <p>Big Data-based Fraud Detection and Prevention Technology</p>	<p>(Definition) Technology for detection, prevention and post management of misconduct and abnormal transactions through pattern recognition, which collects and analyzes various big data with other statistical techniques</p> <p>(Application) Bank fraud prevention technology using electronic financial transaction related big data; and prevention of misconduct associated with government institutions, such as unlawful receipt of subsidy, tax evasion, corruption in procurement, and unjust claims</p>
 <p>Security Technology for Online/Mobile Financial Transaction</p>	<p>(Definition) Financial transaction technology to ensure both user convenience and secure transaction from internet and mobile based platforms with high customer access</p> <p>(Application) Development of financial instruments and promotion of consumption with big data; fostering simple payment processes with diverse authentication techniques; construction of systems to support safe processing and management of mobile financial transaction information; and development of new financial transaction services to secure the transparency and safety of transaction details</p>



Name of Technology	Details
 <p>IoT Security (IoT: Internet of Things)</p>	<p>(Definition) Technology that fosters a safe IoT environment by preventing and managing diverse types of infringement and security threats to IoT devices, networks, and the service-platform of IoT</p> <p>(Application) Management of malware and hacking of IoT devices; safe data communication between IoT devices and anomaly detection; authentication/privacy protection and security solutions suitable for IoT service environments</p>
 <p>IoE Technology (IoE: Information of Everything)</p>	<p>(Definition) Technology for processing raw data generated (collected) through IoT, producing useful, high value-added information, and providing users with convenient service</p> <p>(Application) Services such as health care, smart home, smart grid, and intelligent transportation system (ITS) through IoT; mashup services combining various web-based smart devices; and on-demand knowledge/information producing service to meet user needs</p>
 <p>Digital Assistant based on Deep Learning</p>	<p>(Definition) Technology that enables computers to run cognition-based tasks for humans and assist in decision-making and improving work efficiency by learning huge amounts of related data</p> <p>(Application) Tasks through information search and preliminary analysis for personal tasks and decision making; effective scheduling and errand running; utilization in various areas including private secretary work, effective work direction/supervision, automation process of manufacturing business, and education</p>
 <p>Virtual Reality Technology for Leisure</p>	<p>(Definition) Technology that enables users to experience diverse leisure activities without the limitations of time and space by recreating a virtual environment and circumstances similar to reality based on ICT and by reenacting visual, auditorial, and sensational information during leisure activities</p> <p>(Application) Products and services that allow users to experience virtually varied cultures and environments such as virtual sports, trips and experiences of diverse spaces, cyber museums and large-scale concerts, and interactive games</p>



Name of Technology	Details
 <p>Mental Health Diagnosis and Treatment Technology</p>	<p>(Definition) By developing an algorithm that analyzes the correlation between various biometric signals received by a sensor module, data transmission and communication module and mental health symptoms, and predicts illness, this technology can forecast the aggravation of symptoms, and control, prevent and provide early treatment for the physiological and behavioral signal changes that reflect maladjustment and psychopathological processes from mental stress</p> <p>(Application) Various mental health improvement and management services using IoT and smart devices; organization's mental health or social anger status monitoring system; and prediction, early diagnosis, and new treatment for mental illness based on brain-behavior</p>
 <p>Social Robots</p>	<p>(Definition) Machine and software which increases emotional satisfaction by fulfilling the mental and physical needs of human users through interacting with the user in daily life</p> <p>(Application) Various personal services for emotional dependence or bonding through empathy; treatment of mental illness (dementia, autism, etc.); emotional stability support for the underprivileged; and emotional ICT-based products and services</p>
 <p>Big Data-based Infectious Disease Prediction and Alert System</p>	<p>(Definition) Technology that predicts the potential regional spread of infectious diseases, by utilizing diverse data such as the dissemination process of diseases, infected patients, and population data.</p> <p>(Application) Real-time big data analysis assists the government authority with disease management policy and improves the infectious disease control and management plan at the national level, securing public health and safety</p>
 <p>System-based Technology for Particulate Matter Control</p>	<p>(Definition) Measures, classifies, samples, purifies, predicts, and monitors PM10 in the atmosphere to allow people to engage in daily activities safely</p> <p>(Application) Particulate matter prediction and monitoring alert system; portable guide programs for Particulate matter measurement and management; particulate matter removal (purification) system for indoor environments</p>



B. Economic & Social Impacts of Emerging Technologies

▣ The economic and social impacts of the 10 selected emerging technologies were analyzed.

● The economic and social impacts that are likely to follow the adoption of the 10 emerging technologies were analyzed, focusing on the individuals and the industries that the implementation of each technology will affect.

Table 18. Economic & Social Impacts

Emerging Technology	Social Impacts	Economic Impacts
Big Data-based Fraud Detection and Prevention Technology	<ul style="list-style-type: none"> Invigorates advanced financial service industry and protects personal financial assets by reducing the risks and damage from bank fraud Reduces misuse of national budgets and enhances social trust and fairness by preventing unlawful receipt of subsidy, corruption in procurement, and conspiracy to commit fraud 	<p>Global market for detecting abnormal transactions: \$7.5 billion ('18)</p> <p>Global market for fraud detection and prevention: \$20.5 billion ('19)</p>
Security Technology for Online/Mobile Financial Transaction	<ul style="list-style-type: none"> Explosive increase in direct banks in association with ICT-based FinTech security companies, while the market share of offline banks decreases Appearance of a new shopping culture with different on/offline shopping payment methods through simple but high-security technology of biometric authentication Reduces cost of financial transactions and related fees due to centralization of the financial system structure, and expands customized financial services while increasing the precision of personal credit evaluation based on a range of personal information 	<p>Global market for mobile payment: \$1,476 billion ('17)</p> <p>Global market for mobile biometric authentication: \$33.3 billion ('20)</p>
IoT Security	<ul style="list-style-type: none"> Increase in the importance of establishing a full cycle security system for detection and prevention of physical/behavioral defects or anomalies of IoT devices and networks in real-time, and for swift responses to issues, as the targets and scope that IoT connects become diversified and expand 	<p>Global market for convergence security: \$126.3 billion ('20)</p> <p>Global market for IoT security: \$28.9 billion ('20)</p>



Emerging Technology	Social Impacts	Economic Impacts
IoE Technology (IoE: Information of Everything)	<ul style="list-style-type: none"> Enhances productivity/efficiency of traditional industry and creates a new IoT industry from diverse and huge accumulation of IoE and development of IoE Analytics Promotes major changes in society through smart transportation and smart city, as well as smart homes, smart health care, and smart cars Invigorates intelligence-based service industries with Open API and IoE Analytics using IoE 	Global market for IoT: \$1,710.4 billion ('19)
Digital Assistant based on Deep Learning	<ul style="list-style-type: none"> Enhances each individual's task efficiency and reduces work-life imbalance across society as computers run tasks on behalf of humans such as work of routine patterns, primary information search and analysis Introduction of intelligent systems across society and industries may raise controversy on related laws/systems such as jobs replaced by computers, the calculative/ethical model that such programs should have, and legal basis 	Global market for artificial intelligence: \$165 billion ('17) Global market for smart machines and digital assistants: \$41.22 billion and \$8.08 billion ('24), respectively
Virtual Reality Technology for Leisure	<ul style="list-style-type: none"> Creates a new market for virtual experiences and tours of a variety of cultures or environments never experienced before Enhances quality of life across society by increasing access to recreation for office workers with limited leisure, as well as the underprivileged including the elderly, disabled, and people on low incomes 	Global market for virtual reality: \$29.9 billion ('20) Global market for virtual reality for leisure (excluding games): \$5 billion ('20)
Mental Health Diagnosis and Treatment Technology	<ul style="list-style-type: none"> Realizes a healthy society, relieves social anger, and reduces social loss by introducing system for prevention, treatment and management of mental/behavioral disorders, both for individuals and social organizations/communities Medical paradigm shift of mental disease as the market for brain behavior-based medicine/medical device expands and diverse mental health management service industries develop 	Global market for health care monitoring: \$16 billion ('23) Global market for behavior/mental health software: \$1.49 billion ('19)



Emerging Technology	Social Impacts	Economic Impacts
Social Robots	<ul style="list-style-type: none"> Relationships between humans and robots become more common as robots' ability for emotional communication and sympathy bonding improve, as well as their supply. Wider medical use for emotional stability, treatment, and stress-related disease prevention for the underprivileged and patients (dementia, depression, autistic children, etc.) Enhances emotional satisfaction and quality of life at home through service robots 	Global market for service robots: \$18 billion ('20)
Big Data-based Infectious Disease Prediction and Alert System	<ul style="list-style-type: none"> Relieves social/economic anxiety, minimizes the influence of diseases on society and enhances public trust in the national disease control system Changes immigration processes and monitoring/management systems by introducing global infectious disease prediction and alert systems 	US market for IVD technology for infectious diseases \$740 million ('19)
System-based Technology for Particulate Matter Control	<ul style="list-style-type: none"> Enables accurate prediction of particulate matter and managing products/services More buildings with efficient ventilation and air conditioning, equipped with indoor air quality management systems responsive to outdoor conditions Development of related technologies and industries for personal air purifiers, particulate matter collection home appliances, cleaning robots for enclosures that are hard to manage 	Global market for atmospheric environment industry: \$55.4 billion ('13)



IV. Conclusions and Implications

● *KISTEP 10 Emerging Technologies*, by applying the vision of the desirable future society, is distinct from other promising future technology reports in Korea.

- Selection of Korea's emerging technologies is done by public research institutes, and technologies with high economic and social impact are selected and announced. However, *KISTEP 10 Emerging Technologies* is the only assessment that presents a balanced reflections of the ability to cope with needs in the future society and the economic and social impacts.

- ※ Each institution that releases selected emerging technologies applies many different topics in economy, technology and society. In particular, economic and industrial topics represent a large proportion: of seven major institutions, three of them are business industry-associated topics.

- *KISTEP 10 Emerging Technologies* forecasts the changes of the future based on a different issue every year, and adjusts perspectives based on the core issue selected. Through developing new methodology based on each years' issue, it holds significance research-wise.

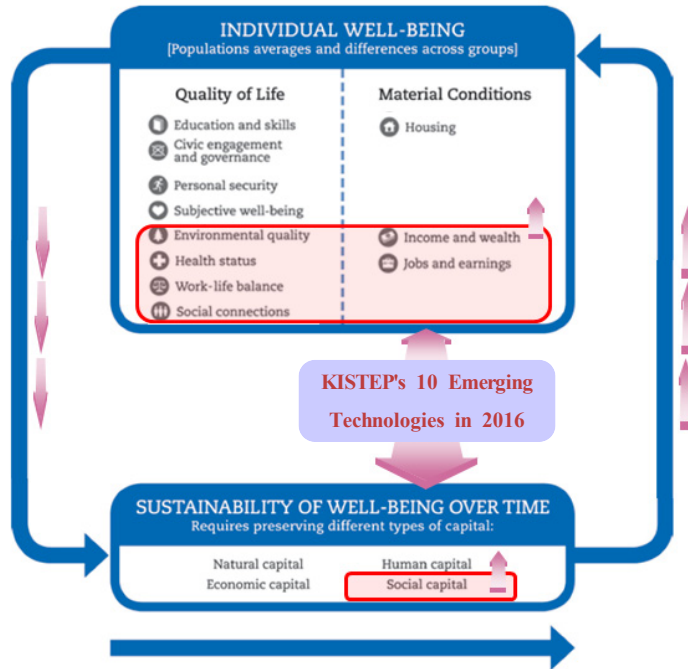
- ※ This year, specific issues and needs were identified through comprehensive analysis of domestic and international media data and literature review, allowing objective examination of dimensions where Korean society is relatively weak.

● This year, the emerging technologies that can improve the sustainability of well-being in the Korean society, by enhancing the quality of life and social trust, were selected.

- Quality of life and social capital are in a virtuous cycle with each other (OECD, 2015).

- The virtuous cycle can be accelerated by the emerging technologies that aim to improve the quality of life in Korean society, and at the same time, strengthen the social trust, a core factor of the social capital.

- Selection was based on 6 dimensions where scientific and technological solutions are partially applicable, in order to simultaneously improve the average quality of life (well-being) of individuals, and strengthen the social trust as a core factor of the social capital.



Source: OECD (2011), *How's Life? Measuring Well-Being*, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264121164-en>.

Figure 4. Measurement Frame of the Quality of Life (Well-being) by OECD and the Role of KISTEP 10 Emerging Technologies in 2016

- The role of science and technology to advance the future of Korea was emphasized.
 - As quality of life is no longer guaranteed by economic development, it is necessary to invest in R&D for improving the well-being and fundamental reformation of the related policies.
 - To achieve sustainable well-being over time, it is necessary to realize the importance of securing not only economic, human and natural capital but also social capital (OECD, 2015).
 - Reflecting these observations, the government's R&D policy on emerging technologies needs to break away from a manufacturer-centered and performance-centered system that is mainly focused on technology development and economic achievement.
 - In particular, the effect of the expansion of social capital (trust) needs to be reflected in balance in addition to the economic factors that are traditionally prioritized, such as land, labor and capital. In addition, it is predicted that the significance of social capital will increase in the hyper-connected society of the future.



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Authors

- Seung-Kyu Yi
 - Associate Research Fellow, Division of Technology Foresight, KISTEP
 - Tel: 82-2-589-2983
 - Email: skyist@kistep.re.kr
 - Sang-Il Kim
 - Associate Research Fellow, Division of Technology Foresight, KISTEP
 - Tel: 82-2-589-2258
 - Email: cappy@kistep.re.kr
 - Jun Woo Yu
 - Researcher, Division of Technology Foresight, KISTEP
 - Tel: 82-2-589-2292
 - Email: junwyu@kistep.re.kr
-

English Edition

- Center for International Affairs
 - Email: yhkim@kistep.re.kr
-

KISTEP Issue Paper 2016-02

| Date Issued | March 2016

| Publisher | Youngah Park

| Published by | Korea Institute of S&T Evaluation and Planning

9~12F, Dongwon Industry Bldg. 68, Mabang-ro, (Yangjae-dong)

Seocho-gu, Seoul, Korea

Tel: 82-2-589-2200 / Fax: 82-2-589-2222

<http://www.kistep.re.kr/en>

| Printed by | Viontech Systems Ltd.
