Asian Journal of Innovation and Policy (2019) 8.1:058-072
DOI: http//dx.doi.org/10.7545/ajip.2019.8.1.058

Toward a Policy for the Big Data-Based Social Problem-Solving Ecosystem: the Korean Context[1]

Sung-Uk Park[*], Moon-Soo Park[**]

Abstract The wave of the 4th Industrial Revolution was announced by Schwab Klaus at the 2016 World Economic Forum in Davos, and prospects and measures with the future society in mind have been put in place. With the launch of the Moon Jae-in administration in May 2017, Korea has shifted all of its interest to Big Data, which is one of the most important features of the 4th Industrial Revolution. In this regard, this study focuses on the role of the public sector, explores related issues, and identifies an agenda for determining the demand for ways to foster Big Data ecosystem, from an objective perspective. Furthermore, this study seeks to establish priorities for key Big Data issues from various areas based on importance and urgency using a Delphi analysis. It also specifies the agenda by which Korea should exert national and social efforts based on these priorities in order to demonstrate the role of the public sector in reinforcing the Big Data ecosystem.

Keywords Big data, social problem-solving ecosystem, big data issues, agenda of big data

I. Introduction

After Schwab Klaus mentioned the ‘4th Industrial Revolution’ at the 2016 World Economic Forum in Davos and the Moon administration was inaugurated in 2017, the ‘4th Industrial Revolution’ became the hottest keyword in Korea. The ‘4th Industrial Revolution’ refers to an era of revolution achieved by the convergence of information and communications technology, and the key to this revolution is new technological innovations such as Big Data analytics, artificial intelligence, robotics, and the Internet of Things (Moon and Seol, 2017).

Submitted, January 29, 2019; 1st Revised, February 26, 2019; Accepted, February 28, 2019
1 This work was supported by the Korea Institute of Science and Technology Information [K-19-L04-C03-S01], Original idea presented at Park et al. (2014) and revised one Park et al. (2014).
[*] Corresponding, Korea Institute of Science and Technology Information, Daejeon, Korea; supark@kisti.re.kr
[**] Korea Institute of Industrial Technology, Korea; mspark@kitech.re.kr

We have seen an unprecedented amount of data collected, stored and communicated within organizations and over the web. This so-called 'Data explosion' has drawn attention to the utilization and analytics issues in Big Data, and raised academic interest in the social transformation that will result from the usage and application of Big Data (Jun et al., 2018).

Google's chief economist, Hal R. Varian, highlighted the importance of Big Data, stating that "the ability to take data - to be able to understand it, to process it, to extract value from it, to visualize it, to communicate it - that's going to be a hugely important skill in the next decades."

While the Big Data have many characteristics, the following points are worth noting: First: volume. The volume in a Big Data system is so vast that it cannot be handled by existing systems. Second: variety. Big Data are formed when a variety of types of data are brought together. Third: velocity. The velocity at which data are created and processed is very fast. Fourth: veracity. To utilize Big Data properly, reliable data should be obtained by sorting out inconsistency and uncertainty between data and inaccuracy in approximations. Fifth: value. Since there is so much data along with unnecessary data in Big Data, it is necessary to identify the data from which significant value can be extracted. Sixth: variability. In the Big Data environment, even the type of data changes rapidly.

Big Data aims to provide an alternative to the traditional solution based on databases and data analysis. Big Data is not just about storage or access to data; it aims to analyze data in order to make sense of them and exploit their value. Big Data refers to datasets ranging from terabytes to petabytes (and even exabytes) in size, and the massive size of these datasets extends beyond the ability of average database software tools to capture, store, manage, and analyze them effectively (Bello-Orgaz et al., 2016).

The particular properties and challenges that the current Big Data context opens require specific architectures for information systems particularly designed to retrieve, process, analyze and store such volume and variety of data (Blazquez and Domench, 2018).

Big Data, as data currency, have the potential to create enormous value in the near future. As there are huge financial benefits that can be obtained from Big Data, many countries around the world have shown strong interests and have already invested heavily in Big Data research (Dykes, 2016).

This article focuses on the role of the public sector; it explores related issues, and identifies major agendas for determining demand, from an objective perspective, to set up policies to foster Big Data industries. Through an extensive literature review, this study discovers key issues from various points of view, such as social problem-solving issues in Korea and around the world, the applications of public sector data, and inhibitory and facilitative factors for the use of Big Data. We also classify these issues into the categories of policy, technology, use of Big Data science and technology, and social problem-solving. Moreover, this study identifies priorities for key issues based on importance and urgency criteria from the Delphi analysis. By specifying the agenda that should be addressed nationally and socially based on certain priorities, this article clarifies the role of the public sector in reinforcing the Big Data ecosystem.

II. Exploring Key Issues Related to Big Data

By examining science and technology policies from two major ministries in Korea - the Ministry of Science and ICT and the Ministry of Trade, Industry and Energy - as well as the '4th Science and Technology Basic Plan (2018-2022)'- the highest statutory plan in Korea - this article analyzes the key directions of national science and technology policies. The social problem-solving technology development project, pursued by the science and technology community, aims to improve people's quality of life: (1) by solving social problems closely relevant to their lives through science and technology, (2) by creating products and services whose effect can be felt by people in their daily lives, (3) by linking technological development with the law, institutions, and service delivery.

Table 1 Policies for utilizing Big Data and key issues in the technology area

	Policy Area	Technology Area
1	Establish policies to open-up and utilize public institutions' Big Data	Collect data in real time
2	Establish and provide infrastructure that jointly stores and utilizes Big Data	Store Big Data
3	Establish policies for data standardization	Process unstructured data
4	Establish policies for data quality assurance	Process distributed data
5	Establish ways to solve social problems using Big Data	Analyze data
6	Create and operate dedicated national-level institutions	Transmit data
7	Establish policies to foster the Big Data industry	Visualize data
8	Establish policies related to intellectual property protection (to protect the property value of data)	Establish the data sharing environment
9	Protect and manage personal information in accordance with the use of Big Data	Process personal information and security technology
10	Train and nurture experts	Ensure low-energy, high-performance computing

Source: Lee et al. (2013), Study on the PSI Service Development in the Science and ICT Field.

In this context, this study selects key issues in the policy and technology areas required to directly reinforce the use of Big Data from the data user's viewpoint.

There is an increasing emphasis on applying science and technology to solve global and social problems, and in particular, science and technology Big Data produced by the public sector need to be utilized strategically. In this respect, by using classification standards for the types of public sector data produced by 45 institutions under or affiliated with the Ministry of Science, ICT and Future Planning, six areas where Big Data can be used were further split into 18 areas and organized in Table 2. The areas were specified to identify more practical areas where Big Data can be used in order to derive an action plan for the agenda from this study.

Table 2 Specification of science and technology areas that utilize public sector data

Area	Issue Description
Health/medical care	Issues related to activities to prevent and treat people's diseases, maintain and improve their physical health
Safety/welfare	Issues related to activities to safely protect the country or individuals' lives and property from disasters or catastrophes and mitigate social inequalities
Environment/energy	Issues related to activities to conserve nature and pursue society's sustainable growth
Living convenience/culture	Issues related to activities to invest in making daily life for individuals, families, and society more convenient
Science commercialization/job creation	Issues related to activities to improve national competitiveness by promoting education, business, science and technology, and commercialization
R&D/information /telecommunications	Issues related to activities to accumulate academic and research competencies

Note: Public administration was excluded from the types of public sector data owned by institutions under the Ministry of Science, ICT and Future Planning.
Source: Lee et al. (2013), Study on the PSI service development in the science and ICT field

III. Identifying Priorities for Big Data Issues

This article applies the Delphi method to analyze demand-based key issues and identifies the issue agenda, recruits experts, and gathers their opinions for the sake of analyzing current national issues of high importance and urgency from an objective perspective and to find ways to utilize Big Data to solve these issues. In order to reflect social needs, the expert pool in this study ranges from policy and high-level experts who were actively utilizing Big Data directly or indirectly in industry, academia, and researchers. Proceeding with the choice is important since the Delphi analysis aims to rely on experts' subjective and intuitive judgments to draw reasonable results. Thus, we attempt to maintain objectivity and reliability in the selection of experts. For instance, the reports about Big Data, papers, seminar presentations, and recommendations from other related experts were used to screen a pool of experts whose professional-ism and expertise were officially confirmed. To ensure diversity and avoid bias, the number of experts per institution was limited to two. The purpose and content of the questionnaire survey for the Delphi analysis were clearly explained via email, and 20 Korean experts who gave their consent to participate in the analysis were finally selected. Table 3 details the pool of experts. Those from businesses consisted of representatives and directors.

Table 3 Pool of experts

Category	Number of experts
Universities	6
Government Research Institutes	8
Businesses	6
Total	20

Three Delphi questionnaires were developed. The first questionnaire was designed by combining open and closed questions to refine the key issues. While examining key issues identified from the literature review, and looking at the importance and urgency of the areas using Big Data, we instructed the experts to directly bring up additional issues if there were any. Open questions were used for the questionnaire to identify the tasks that use Big Data at the national level, and more specifically, the experts' opinions were collected about "the role of public institutions in strengthening the use of Big Data in the public sector" and "inhibitory factors to the overall use of Big Data and their solutions".

The second questionnaire re-examined the importance and urgency of the issues refined by the first questionnaire. Overall, it consisted of closed questions, but mixed open and closed questions for issues related to areas that use science and technology Big Data. The mean values of the importance and urgency of each issue produced by the first questionnaire, and the numbers given by the individual experts in the first questionnaire survey were presented to allow the experts to re-adjust their opinions after comparing both numbers.

Finally, the third questionnaire incorporated the experts' opinions about the importance and urgency of the issues refined by the first and second questionnaire surveys. It presented the mean value of all respondents' and individual experts' response values from the second questionnaire to allow the experts to revise their opinions.

Table 4 Key big data issues identified from a policy perspective

	Related Issue	Mean of Importance Responses			Mean of Urgency Responses		
		1st	2nd	3rd	1st	2nd	3rd
1	Establish policies to open up and utilize public institutions' Big Data	4.53	4.63	4.63	4.21	4.42	4.53
2	Establish and provide infrastructure that jointly stores and utilizes Big Data	3.47	3.53	3.47	3.53	3.47	3.37
3	Establish policies for data standardization	4.00	3.84	3.79	3.74	3.47	3.68
4	Establish policies for data quality assurance	3.26	3.05	3.21	3.28	2.89	2.95
5	Establish ways to solve social problems using Big Data	3.89	3.95	3.84	3.89	3.95	3.84
6	Create and operate dedicated national-level institutions	3.56	3.68	3.63	3.56	3.68	3.47
7	Establish policies to foster the Big Data industry	3.89	4.00	4.00	3.89	3.84	3.79
8	Establish policies related to intellectual property protection (to protect the property value of data)	3.47	3.53	3.47	3.28	3.26	3.11
9	Protect and manage personal information in accordance with the use of Big Data	4.32	4.37	4.32	4.11	4.11	4.16
10	Train and nurture experts	4.21	4.05	4.11	4.11	4.05	4.26
11	Support and share data analytics competencies*	-	3.79	3.79	-	3.84	3.79
12	Establish polices to support the use of Big Data by small- and medium-sized enterprises*	-	3.74	3.58	-	3.32	3.21
13	Establish policies to converge public sector data and private sector data*	-	4.05	4.16	-	3.79	3.68

Note: * are issues additionally suggested by experts in the first Delphi analysis.

As a result of the Delphi analysis, key issues were refined regarding the policy, technology, use of Big Data for science and technology, and social problem-solving areas. In terms of policy, problems that should be solved in order to expand the opportunities to use Big Data and strengthen analytics competencies in the private sector were presented as key tasks. The results highlighted the following key issues: (i) opening and utilizing public sector data, (ii) protecting and managing private information, and (iii) training and nurturing experts.

In terms of technology, "collecting data in real time" from collection and storage, "analyzing data" from processing and analytics, "visualizing data" from service, and "processing personal information and security technology" from security were identified as key issues. The results showed that in terms of importance and urgency, (i) analyzing data, (ii) visualizing data, and (iii) processing personal information and security technology scored more than 4 and were thus selected as key issues.

Table 5 Key Big Data issues identified from a technology perspective

Technology Area		Mean of Importance Responses			Mean of Urgency Responses		
		1st	2nd	3rd	1st	2nd	3rd
1	Collect data in real time	4.21	4.11	4.11	4.05	3.84	3.95
2	Store Big Data	3.89	3.74	3.74	3.84	3.74	3.63
3	Process unstructured data	4.11	3.95	4.11	3.89	3.74	3.68
4	Process distributed data	3.84	3.68	3.68	3.58	3.53	3.42
5	Analyze data	4.68	4.74	4.84	4.47	4.58	4.79
6	Transmit data	3.26	3.21	3.11	3.42	3.21	3.00
7	Visualize data	4.00	4.11	4.26	3.74	3.95	4.05
8	Establish the data sharing environment	3.89	3.47	3.58	3.63	3.42	3.47
9	Process personal information and security technology	4.32	4.21	4.21	4.26	4.21	4.21
10	Ensure low-energy, high-performance computing	3.56	3.32	3.28	3.22	3.16	3.06
11	Develop a Big Data cloud technology and platform*	-	3.84	3.84	-	3.79	3.79
12	Control the quality of data*	-	4.11	4.21	-	3.42	3.58
13	Standardize data*	-	3.95	4.00	-	3.68	3.74

Note: * are issues additionally suggested by experts in the first Delphi analysis.

In terms of using science and technology Big Data, it was found that healthcare and disaster response had the highest social demand, and key issues were extracted in eight areas. Among the total 18 areas that could use Big Data presented in this article, the first Delphi analysis analyzed 13 of them as key areas; 8 of the 13 were refined from the second analysis, and the third analysis examined the importance and urgency of key issues in each of these areas.

Table 6 Key issues viewed in terms of the use of science and technology Big Data

Key Area	Key Issue		Mean of Importance Responses	Mean of Urgency Responses
Healthcare (1st)	1	Predict the occurrence, cause, and spread pathway of key national diseases	4.32	4.11
	2	Predict diseases in a personalized way	4.21	3.74
	3	Protect private medical information	4.05	3.68
	4	Deregulate medical laws	3.61	3.61
	5	Connect medical data and Big Data analytics systems	4.32	4.21
Disaster response (2nd)	1	Constantly monitor and preemptively respond to environment and daily life disaster data	4.37	4.32
	2	Predict disaster situations based on past data analytics	4.37	4.11
	3	Integrate, link, and jointly use disaster data	4.42	4.11
Public safety /security (3rd)		Collect and analyze public safety data in real time	4.32	4.16
	2	Predict crime areas and factors	4.16	4.05
	3	Sort out non-reliable data	3.53	3.21
	4	Solve information sharing obstacles (e.g., protect personal life and privacy)	3.95	3.79
	5	Link crime data and state power	3.67	3.61
Residential transport (4th)	1	Predict the possibility of using future space	3.37	3.21
	2	Use data for public transport plans such as expanding the roads or establishing a traffic signal system	3.89	3.68
	3	Resolve traffic jams, reduce car exhaust and noise, and optimize road lanes	4.32	3.89
	4	Integrate and analyze data from transport institutions	3.89	3.79
Education /employment (5th)	1	Provide data-based personalized job and employment services	3.63	3.42
	2	Predict jobs with high demand in the future and establish a plan to provide personnel	3.63	3.42
	3	Establish policies by sharing data between educational and employment institutions	3.79	3.37
	4	Provide various data required for higher education	3.42	3.11
Others	1	Use Big Data in manufacturing	4.42	4.26
	2	Use Big Data in culture and tourism	3.63	3.53

Note: Key issues were identified by experts through Delphi analysis.

In terms of social problem-solving, the value of using Big Data was evaluated as high for disaster response and prevention, crime prevention, school violence prevention, increasing/new disease, and elderly health. For disaster response and prevention, it is important not only to integrate and analyze data from multiple institutions, but also collect global data. In addition, data monitoring and preemptive prevention are important not only for natural disasters, but also industrial disasters. For crime and school violence prevention, it is necessary to share data between institutions, link data with state powers, and establish data-based policies. Since healthcare is directly related to people's health and quality of life, social demand for data sharing was relatively higher, but there was a limitation in that the legal foundation should be established to protect personal private information.

Table 7 Key issues viewed from a social problem-solving lens

Social Problems		Mean of Importance Responses			Mean of Urgency Responses		
		1st	2nd	3rd	1st	2nd	3rd
1	Elderly health management	4.05	4.05	4.05	4.00	3.89	3.89
2	Medical service imbalance	3.95	3.84	3.95	3.53	3.37	3.37
3	Increasing/new disease	4.05	4.16	4.32	3.83	4.05	3.95
4	School violence	4.16	4.00	4.16	4.16	4.26	4.26
5	Crime prevention	4.37	4.32	4.26	4.32	4.37	4.26
6	Transport safety	4.00	3.95	3.89	3.95	3.74	3.79
7	Food safety	3.79	3.84	3.79	3.63	3.68	3.63
8	Disaster response/prevention	4.63	4.63	4.68	4.47	4.53	4.42
9	Nuclear safety	3.79	3.63	3.63	3.11	3.21	3.11
10	Terrorism	3.74	3.58	3.53	3.26	3.05	2.95
11	Energy saving	3.79	3.84	3.84	3.72	3.84	3.58
12	Renewable energy	3.42	3.32	3.32	3.32	3.05	2.89
13	Power supply	3.95	3.84	3.84	3.74	3.58	3.58
14	Air pollution	4.00	3.89	3.89	3.74	3.53	3.58
15	Water pollution	3.83	3.74	3.79	3.68	3.58	3.58
16	Household and industrial waste treatment	3.47	3.42	3.37	3.53	3.32	3.26

IV. Deriving the Agendas

1. Sharing Public Sector Data and Supporting Infrastructure

The roles of the government, private sector, and market are supposed to be distinguished. It would be better if governments and public institutions focused on actively opening up their public sector data and establishing an infrastructure that can be used by the private sector, while the private sector serves as Big Data service developer and operator. To obtain social and economic value from Big Data, it is necessary to create an environment where the economic benefits of data or analytics are not monopolized, but shared. In other words, it is vital not just to open up the data, but also to share and support analytics competencies in the private sector. The biggest entry barrier to the use of Big Data by the private sector was found to be a lack of analytics competencies. While there are high expectations that Big Data will create jobs and new business, it could undermine the competitiveness of individuals or small and medium-sized enterprises (SMEs), which lack analytics competencies.

In terms of data sharing, it is important to go beyond opening up the data itself and establish the technology and related systems that can converge public and private sector data. While it is expected that Big Data will create new business and added value, this expectation assumes that data producers or owners open up their data. In a situation where it is practically difficult to force individuals and companies to open up their data, the value of using Big Data can be maximized in the public sector. It is extremely difficult to identify, extract, and analyze the data that the private sector wants simply by providing public sector data. The government must recognize the opening up of public sector data as a "service" that goes beyond simply providing data. In other words, public institutions analyze related data through demands from information the private sector needs and develop it into a service that provides only the final outcomes that are necessary for the private sector. Due to the nature of Big Data, it is vital to converge and connect heterogeneous data. To do this, data standardization must be first achieved. Standardization should be recognized as a concept that encompasses not only the type of data, but also data quality measurement and assurance or metadata management. Since this task is not something that can be completed in the short term, a long-term plan should be established (Kim et al., 2014).

In terms of sharing analytics competencies, analytics technologies or services should be supported so that SMEs and individuals like entrepreneurs- who find it difficult to obtain analytics technologies- or experts can expand their existing business areas through Big Data analytics or create new services.

SMEs or individual business owners have limited resources to acquire Big Data analytics technologies, hardware, or experts, which might further widen the competitiveness gap with large companies or overseas markets. Especially for Korea, where SMEs account for a high proportion of the economy, this situation could be a major factor to decrease national competitiveness. It is necessary to build a platform that directly provides data extraction or analytics required to implement services or matches those who need analytics with experts. In addition, a training center or program needs to operate on the national level to nurture data scientists from a long-term perspective; it is important to lay the foundation to ensure national and social competitiveness through Big Data.

2. Developing Visualization and Simulation Technology

To solve the current social problems, it is essential to analyze a vast amount of data, like sensor data, and converge and analyze highly complex and diverse heterogeneous data. Visualization and simulation technologies, the integral part of such an analytics or prediction process, need to be developed and actively expanded into the private sector.

For instance, in order to respond to a nuclear power plant accident, as an example of a disaster response, a variety of data covering sea currents, terrain, atmosphere, species of fish and their habitats, satellites, and radioactive matter need to be integrated and analyzed to predict the affected area and the degree of damage. Simulating and visualizing related data under various conditions and providing them in real time can ensure swift and accurate decision-making.

As an example in healthcare, it is very difficult for researchers and health professionals to investigate the human body, so visual data processing and simulation are required for virtual autopsies, virtual surgery, or surgery training. Researchers can perform a virtual experiment with a replacement human body, and in terms of industry, simulation can ensure medical equipment's precision and safety.

Data analytics skills are recognized as a new form of competitiveness in the era of Big Data. While the importance of past trend analysis or prediction functions has been highlighted, the value of competencies to visualize data is expected to grow. In addition, since there are limits to domain experts acquiring rapidly growing information technology and operation knowledge, a system is needed at the national level to operate and support related equipment, technologies, and experts. To visualize and simulate Big Data, it is essential to have elementary technologies such as data partitioning and distribution, parallel visualization algorithms, real-time rendering, image merging, and remote visualization. It is extremely difficult for working-level employees in companies to acquire such high-level information technology competencies.

Visualizing the results of data analytics and providing them, as visuals to policy makers would better deliver on the purpose and effect of Big Data. The awareness level of decision makers about the need to use big data is very low, which could lead to their failure to introduce or project Big Data. Through visualization to help top decision makers more clearly recognize the possibility and importance of using Big Data, a catalytic opportunity can be provided to spread the use of Big Data in the public and private sectors (Ko et al., 2017).

Big data connection and analytics between different areas or institutions for healthcare and disaster response

To guarantee people's happiness and safety, national-level efforts are needed to use Big Data in healthcare and disaster response. There is a high demand in healthcare and disaster response to use public sector Big Data and solve the current social problems. Many different scenarios involving the use of Big Data can be identified in these areas, and more importantly, its use value increases when it is linked to services for people through system-based decision making.

In the healthcare field, predicting and diagnosing diseases, which was previously the realm of researchers and health professionals, can be supported using a Big Data-based system.

In disaster response, predicting and preemptively responding to natural and man-made disasters are now possible by linking various data, analyzing data in real time, and simulating the future situation beyond simply integrating statistics or data from the past.

V. Conclusion

Creating a new value from Big Data begins with data sharing between different areas. Since data produced in the private sector are controlled thoroughly for profit, it is hard to promote data sharing. Hence, it is necessary to build an institutional, technological, and cultural environment where the private sector voluntarily converges their data with public sector data. With the enactment and enforcement of the 'Act on the Promotion of Public Data Provision and Use' in 2013, Korea's central and local governments are spreading the openness of public data. The goal is to increase credibility and transparency of public open data, and to provide new business opportunities for the private sector. The government selected 36 major data items with high demand, high value, and large capacity, and opened them to the nation's key open data. In addition, the 17 local governments, including Seoul City, have discovered hundreds to thousands of public data to be utilized. Of the more than 25,000 open data in the 'Korea Public Data Portal (https://data.go.kr)' operated and managed by the Ministry of Public Administration, local government public data accounts for more than 70%. Although each local government has been expanding its openness to find public data in various fields, business utilization including business start-up is minimal. A total of 567 official use cases were posted on the self-disclosure portal by local governments, accounting for only 3.2% of the total open data (Etnews.com, 2018).

With the inauguration of the Moon administration in 2017, the 4th Industrial Revolution has spread through Korea as a keyword, and each government department is actively making efforts to open up and share public information. Their efforts, however, have so far focused on "opening up" public sector data, when "using" them in the private sector should be the goal.

Up to the present, Big Data projects by government departments and agencies have focused on identifying best practices and they have sought not only to open up data, but also to develop services. In other words, it is highly likely that, where the Big Data foundation is not firmly established, low-quality services will be provided as they pursue top services, data analytics, and utilization. The public sector should serve as a sponsor for the Big Data value chain to establish data storage, analytics, or platforms as early as possible, and focus on creating an ecosystem that uses Big Data. To do so, clear milestones need to be set up in a long-term perspective.

Recently, although Big Data has been highlighted as a tool for creating new added value, it could weaken the competitiveness of organizations that lack Big Data analytics competencies. To reinforce the use of Big Data in the private sector, it is important not only to open up public sector data, but also to share analytics competencies. To extract meaningful information from a vast amount of data, humanity qualities and business insights, as well as mathematics and statistics, are needed, and it is difficult for SMEs or individuals to acquire related expertise or experts' access.

This article mentioned healthcare and disaster response, as both of these areas are most in need of Big Data and are high-priority social problems. These areas are directly linked to people's safety and health, and can enhance the innate role of the private sector without infringing on it. Due to the complexity and diversity of today's world, the type of and damage from disasters are becoming complex. If the early response to a natural disaster fails, it leads to a man-made disaster in many cases, and sharply increases the extent of the damage. Hence, it is necessary to establish an integrated disaster response decision-making system (Park, 2015; 2016).

The existing disaster response system focuses on building a platform that integrates various data in real time in one place and leaves judgments on the situation or decisions on how to respond up to human decision-makers. System-based disaster response and prediction are needed by filtering and analyzing real-time unstructured data such as non-structured videos or tests, ensuring data reliability, and establishing a real-time sharing system for all disaster information.

Furthermore, a system that connects and analyzes various data such as complex human gene data, disease symptom and treatment data, correlations between diseases, and data on environmental factors is required to treat and prevent diseases. While there is very high demand to share medical data, data collection is very limited due to personal information problems, making it different from other scientific areas. Therefore, the legal basis should be revisited to mandate the sharing of data by researchers and medical institutions.

The limitations of this study are that all the discussion here is from the standpoint of Korea.

Reference

Bello-Orgaz, G., Jung, J.J. and Camacho, D. (2016) Social big data: recent achievements and new challenges, Information Fusion, 28, 45-59.

Blazquez, D. and Domenech, J. (2018) Big data sources and methods for social and economic anaylses, Technological Forecasting & Social Change, 130, 99-113.

Dykes, B. (2016) Data storytelling: the essential data science skill everyone needs, Forbes.

Etnews.com (2018) Issue Analysis - opening of public data in local government 5 years.

Jun, S.P., Yoo, H.S. and Choi, S. (2018) Ten years of research change using Google trends: from the perspective of big data utilizations and applications, Technological Forecasting & Social Change, 130, 69-87.

Kim, E.J., Park, S.U., Lee, Y.H. and Jeong, D.B. (2014) A study on the use of big data in the public domain - focusing on Delphi analysis, 2014 Korea Technology Innovation Society Fall Conference, 31st October, 661-665.

Klaus Schwab (2017) The fourth industrial revolution, World Economic Forum.

Korea Pubic Data Portal (2019) Https://www.data.go.kr.

Ko, M.H., Lee, S.C. and Park, S.U. (2017) Public data utilization case study-classification and utilization plan of utilization type, 2017 Korea Management Science Society Spring Conference, 27th April.

Lee, P.W. and Kim, J.S. et al. (2013) Study on the PSI Service Development in the Science and ICT Field, ICT and Future planning, Ministry of Science.

Moon, Y.H. and Seol, S.S. (2017) Evaluation of the theory of the 4th industrial revolution, Asian Journal of Innovation and Policy, 6(3), 245-261.

Park, S.U. (2015) Scientific data policy plan for supporting the resolution of national social issues, Scientific Data Legislation Conference, 24th April.

Park, S.U. (2016) Promising technology for the future with big data, 2016 Korea Information Technology Application Society Fall Conference, 25th November.

Park, S.U., Kim, E.J., Lee, Y.H. and Jeong, D.B. et al. (2014) A Study on the Development Strategy of Big Data and Planning of New Projects based on Cooperation among KISTI Research Areas, ICT and Future planning, Ministry of Science.