Big Data — Key to the 4th Industrial Revolution

By Kazumasa Oguro

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"Data" Key to Success of 4th Industrial Revolution

Today we see many government as well as private initiatives to promote a data-based industrial revolution in the world. In the "Industry 4.0" initiative in Germany, the government, industry and academic institutes are all collaborating with each other in promoting a strategy to achieve a more knowledge-intensive manufacturing industry by using IoT (Internet of Things) — a system of mutual control among the various product items through exchange of information among themselves being connected to the Internet. In the United States, the "Industrial Internet" initiative proposed by General Electric is now in progress, that is an attempt to analyze Big Data collected through IoT for future product development and business activity.

The key to achieving the success of both initiatives is "Data". Therefore we call such initiatives a "Data-based Industrial Revolution" and the perception is steadily prevailing today that a Data-based Industrial Revolution will follow the Information and Communication Technology (ICT) Revolution. The significantly rapid progress of AI today symbolizes this development, as seen in the victories of AI equipped with data over human champions in Go or Shogi chess matches. A Go play software called "Alpha Go" created by AI venture DeepMind kept winning over the human European champions for five matches in a row from 2013 until 2015 and even beat one of the best players in the world.

In addition, in the arena of financial investment, the development of another use of AI is making progress. They are now working on raising the capacity to predict stock prices in a few minutes by AI equipped with Big Data on prices and transactions. If this attempt is combined with another technological development such as "super high-speed transaction" achieving thousands of transactions per second, a program installed in a computer in advance, we will see a drastic change of financial investment.

For example, Virtu Financial, a leading American electronic trading firm, announced in March 2014 that it had a profit loss only for one day in super high-speed transactions during 1,238 days. That stunned the world market. However, such super high-speed transactions would be soon combined with prediction techniques by using AI and Big Data. Tremendous amounts of qualified data would be key to achieving progress in AI and whoever can access Big Data can control AI.

As is well known, there are other areas where the rapid progress of the evolution of AI would play a key role. In the area of medical science, by using AI, it is easier now to identify a cancer by image data. We have a project in progress to support medical doctors in their clinical judgements by pinpointing the cancer on the image. There are some cases today where AI has found cancer that was not apparent to a medical doctor's naked eye. In such cases, I would like to repeat that the data of images are the key to the success of the project.

Since we are now living in an age when IoT and its related-product markets are rapidly expanding, all kinds of data are being valued as new assets all over the world. AI, Big Data analysis, 3D printers, robots, and all such contemporary high technology products are based upon data sets. Their active application in a wide range of business and life purposes would mean "data" rule the world, and this is what we call the Data-based Industrial Revolution.

In this revolution, the growth speed of markets closely related to data is remarkable. According to Gartner Inc., an American IT research and consultant company, the markets of Big Data, IoT and AI are predicted to grow at 15% per annum, which is much higher than the stagnant developed countries' economic growth rate, the ROE of Japanese business firms (around 8-9%) or expected returns for Real Estate Investment Trusts (around 4-5%).
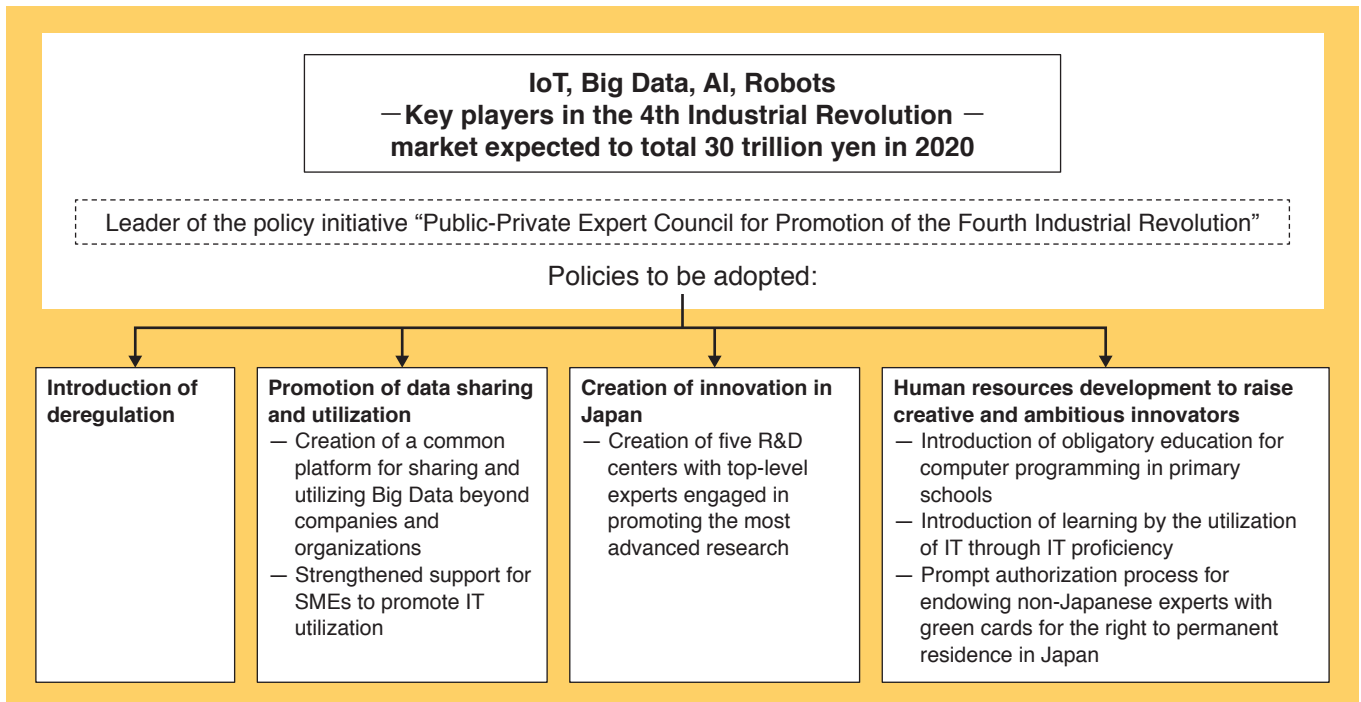
Among these markets, the application of Big Data is expected to have a positive impact upon a variety of business fields, as the White Paper on Telecommunications 2013 issued by Japan's Ministry of Internal Affairs and Communications described. For example, retail business could provide customers with optimal products by using data on customers' behaviors and point-of-sale data systems. Insurance companies could devise new insurance products based on data on natural disasters and geographical data on disaster-hit areas, and auto-insurance companies could set premium rates based on data on driving. Hospitals could provide the best medical service through data on medical consultations. Energy companies could provide customers with electricity in the most efficient way by using data on power consumption measured by smart meters. The infrastructure business could reduce maintenance costs by using data on the use of social capital or public facilities. The government could provide private businesses with their owned data on public policy to encourage them to use them for their own benefit.

To be more specific, NTT Docomo has now started a new business selling its own Big Data for practical use. Komatsu Inc. has also started to reduce production costs by 10% by an analysis of data on

CHART 1
Roadmap towards 4th Industrial Revolution
— For realizing an economy of 600 trillion yen nominal GDP —
Target: new markets to enhance growth potential

IoT, Big Data, AI, Robots
－**Key players in the 4th Industrial Revolution** －
market expected to total 30 trillion yen in 2020

Leader of the policy initiative "Public-Private Expert Council for Promotion of the Fourth Industrial Revolution"

Policies to be adopted:

Introduction of deregulation	Promotion of data sharing and utilization	Creation of innovation in Japan	Human resources development to raise creative and ambitious innovators
	— Creation of a common platform for sharing and utilizing Big Data beyond companies and organizations — Strengthened support for SMEs to promote IT utilization	— Creation of five R&D centers with top-level experts engaged in promoting the most advanced research	— Introduction of obligatory education for computer programming in primary schools — Introduction of learning by the utilization of IT through IT proficiency — Prompt authorization process for endowing non-Japanese experts with green cards for the right to permanent residence in Japan

Source: Council of Industrial Competitiveness of Japan

capacity utilization of mining production facilities all over the world in collaboration with GE.

On the questions of healthcare (including care for beauty) and longevity, if we can specify the factors determining longevity and health by analysis of Big Data concerning people's habits, eating habits (including vitamins), professions, and salaries, as well as hereditary information, the medical consultation business would gain enormous benefits by using the outcomes of this analysis and grow rapidly.

Recently in Japan, METI founded the "IoT Acceleration Consortium" for promotion of Big Data, IoT, AI, etc. in an alliance among industry, government and academia to achieve this goal. But they have a long way to go and Japanese business and industry in this high-technology area will need to be further consolidated to prepare for the severe competition against the winners of the "ICT revolution" — IT giants like Google and Amazon.

Integration of "Data" & "Finance" Beyond "FinTech" Necessary

On April 12, 2016, Japanese Prime Minister Shinzo Abe gave the opening speech at the Fifth Public-Private Dialogue towards Investment for the Future related to the Fourth Industrial Revolution, which included the following:

"Within this fiscal year, we will establish research and

development goals and a roadmap for the industrialization of artificial intelligence. To that end, we will gather the wisdom of industry, academia and the government, and create the non-vertically segmented Artificial Intelligence Technology Strategy Council.

We will link regional venture businesses with the global market. Within this fiscal year, we will create a private sector-led core organization, and mobilize the policies of each ministry and agency in a unified manner.

The first stage of the fourth industrial revolution was competition relating to online data. The second stage will be competition relating to real-world data, such as in manufacturing workplaces, where Japan's particular strengths lie. We will collect data that crosses the boundaries of companies and organizations, analyze it, and link it to business. We will transform the former principles of meeting in person or conducting transactions in writing, and instead use the new rule of the 'IT Principle'. We will create 'platforms' for the sharing and utilization of data in fields where Japan's strengths can be built upon.

By 2020, we will create advanced systems that share and utilize data, which go beyond the boundaries of separate factories or companies, collected by on-site sensors at 50 sites across Japan. By cooperating with Germany, which shares with Japan strengths in manufacturing bases, we will advance international standardization.

We will implement the practical application of automated driving maps, possibly as soon as 2018. Within this fiscal year, we will

CHART 2
Basic structure of Big Data fund
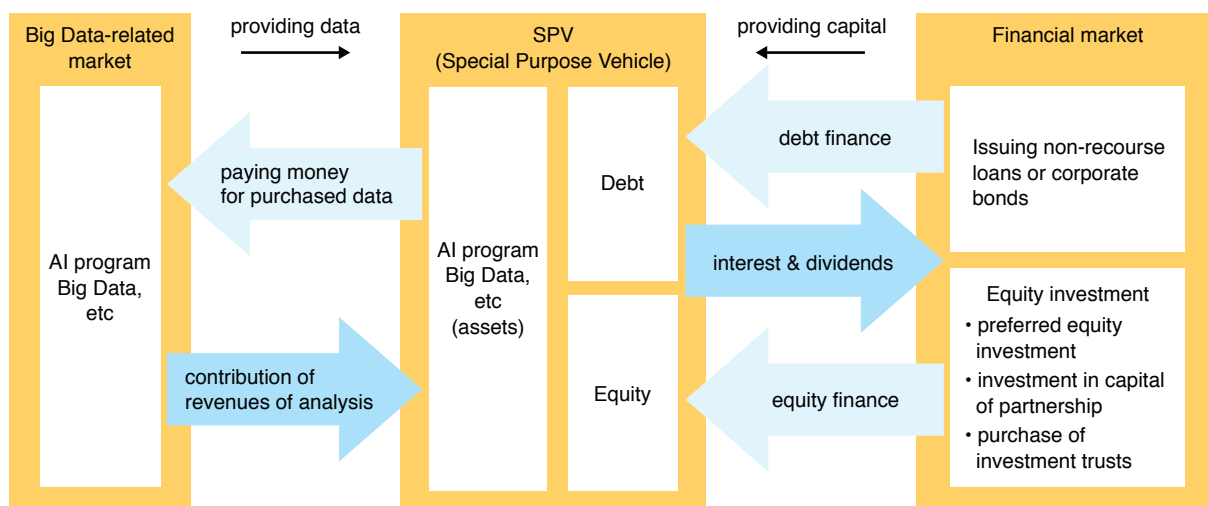
Source: Compiled by the author

gather car manufacturers and map companies, unify specifications that cross corporate boundaries, and conduct international standardization. Within this year, we will streamline legal systems for creating an organ that will efficiently collect large volumes of treatment and test data, manage it, and maintain anonymity, so the data can be used to further research on new drugs and treatments.

We will realize the provision of an 'individualized health service' that meets each individual's needs. To that end, within this fiscal year we will start verification operations to collect and analyze the data related to health insurance claims, medical examinations, and health that is currently held by medical institutions, companies, and insurance companies. We will introduce measures to strengthen initiatives by medical insurers that work to achieve preventative care and promote health, including the verification operations."

Abe also mentioned in his opening remarks at the 27th meeting of the Council of Industrial Competitiveness on May 19, 2016 that the key to the success of his growth strategy would be the Fourth Industrial Revolution. With the emergence of IoT and robots there would be new business opportunities and services to meet an individual's needs. The supply chain connected by IoT among shops and factories could make it possible to supply goods immediately in response to orders and thus make inventories unnecessary. This would overhaul the nation's industries. In order to take advantage of this big opportunity, we will need to engage in structural reforms as quickly as possible, otherwise this big opportunity will turn into a crisis for the Japanese economy, as Japanese firms could become subcontractors for the global companies successful in early reforms in responding to this drastic change of the business environment brought about by the Fourth Industrial Revolution.

Abe stressed the following three points as necessary structural reforms in his speech. First, as was mentioned above, promotion of a platform for sharing and using Big Data jointly among all companies nationwide; second, pioneering regulatory reforms to

encourage innovation; and third, human resources development to be a winner in the Fourth Industrial Revolution such as mandatory education in computer programming in primary schools or introducing proficiency in IT in such schools. With these reforms, Abe committed to achieving an economy of 600 trillion yen *(Chart 1)*.

In spite of this clear and strong message to take full advantage of the Fourth Industrial Revolution to achieve economic growth, I think more will need to be done to encourage the expansive growth of markets related to Big Data, IoT and AI.

My proposal is "integration of Big Data and Finance" going beyond so called "FinTech". "FinTech" is the utilization of IT in finance, such as services, to enable customers to send money to a specific bank account with only an ID used for social networks instead of the bank account number. The prevailing smartphones are expanding the utilization of such services. But what I would like to propose is not limited to such a function of IT in finance. There will be the question of legal data ownership arising from these expanding markets. We can define such ownership as assets and create a fund for securitization of those assets which would collect money from the mass of investors all over the world and distribute dividends among the investors. To realize this, we would need to accommodate a new legal institution that has never been devised before *(Chart 2)*.

We have such a collective investment scheme for real estate business, such as Real Estate Investment Trusts (REIT) or securitization of real estate, and it is well known that legislative reform to make it possible to achieve such a scheme was instrumental in stimulating real estate development. Likewise, we should provide a similar legal scheme to encourage collective investment in the ownership of the collected data for Big Data, IoT and AI. This could be called Big Data Investment Trust (BDIT). In this case, we can include not only raw data but also the outcomes of data analysis or predictions, a new data market to be created by AI, as well as the expected values for risk reduction represented by

algorisms, in "the Asset" — changed from "Data".

Why is this legal scheme so important for the Japanese economy? The primary reason would be that we can stimulate the growth of Big Data, IoT, AI and other related high-technology sectors without increasing significantly our government expenditures for promoting the Fourth Industrial Revolution. It is true that many of the government policy initiatives programmed into the current policy plan for Japanese growth are dependent on government budget expenditures. However, as is well known, the Japanese government is under strong pressure to observe budget constraints due to the permanent fiscal deficit and cumulatively increasing debt.

The actual plan of fiscal consolidation of the Japanese government, called "Basic Policy on Economic and Fiscal Management and Reform 2015", sets a goal for the primary balance of the central and regional governments of being in surplus by 2020, and also of curbing the deficit of the primary balance within 1% of total GDP in 2018. With this scheme, private funds would be used to stimulate the growth of those high-tech sectors to supplement or replace the public expenditures. This scheme could also result in vitalizing Japanese financial markets as well, since 1,700 trillion yen of Japanese individuals' financial assets as well as global assets could find their most effective use. I think it would therefore be the most effective growth stimulus for the new digitalized economy.

New Jobs & New Markets

Another reason why we would need this fund-raising scheme is that R&D investment for these high-technologies such as Big Data, IoT and AI would be enormous, since it would require large amounts of money to collect and accommodate high-level large-scale databases. So even though we can expect high profits from these projects in the future, venture capitals could hesitate to provide funds and in many cases they may not be able to earn sufficient returns for data accommodation. For example, Toyota has already announced the start of a study on AI in collaboration with Stanford University and the Massachusetts Institute of Technology, and its investment is estimated at around $50 million over five years.

The Japanese Ministry of Land, Infrastructure, Transport and Tourism published its "Grand Design of National Spatial Development towards 2050" in July 2014. This report made it clear that the locations across the whole country where the population in 2050 is predicted to be less than half that of 2010 would account for more than 60% of all residential areas.

Under such circumstances, it will be necessary to create a quantitative indicator to promote compact cities, an urban planning concept promoting relatively high residential density with mixed land use based on an efficient public transport system, and efficient maintenance of aged infrastructures. To achieve this, we would need a Geographic Information System (GIS) that includes the population diffusion by age or the utilization rates of various infrastructures in the database. It should be noted, too, that the potential need for Big Data to be applied to the cost-benefit analysis of this urban planning would be rather high. Among such data, there must be not only data

on public goods but also many other data that would impose very high costs for collection and accommodation on each business firm involved in this project. There is a risk of a rapid increase in liability in the balance sheet of a firm fund raising on its own. My proposal for a "collective investment scheme" would be very useful in enabling firms to earn funds without significantly increasing such liability, since the necessary capital is collected from the mass of investors.

In addition, I think this initiative could have a positive impact upon employment. With the markets of these high-technologies vitalized by this initiative, we could accelerate creation of new jobs such as "data scientists" or "marketing technologists". To be a winner in the Data-based Industrial Revolution, we need to create not only "a platform for sharing data" but also a platform for data specialists.

For example, "Deep Analytics" is a system that matches the needs of data analysis and data scientists providing such analysis. In the world today, crowdsourcing services for data analysis are increasingly common, such as Kaggle, CrowdAnalytix, TunedIT, Topcoder and InnoCentive. In particular, Kaggle, rapidly expanding in the US, is a platform on the modeling of forecasts and analytical methodologies where statisticians and data analysts from all over the world are competing for the optimal analytical model by submitting their ideas and findings to the site. The Japanese equivalent of Kaggle would be Deep Analytics.

On the question of the confidentiality of data, a sensitive issue today, we should take note that it will be necessary to do matching of data and promoting data sharing while maintaining confidentiality in the case of data not open to the public or that include personal information to be protected. The Japanese government is currently working on a policy to promote the use of anonymous data while protecting personal information. With the revised Personal Information Protection Law in Japan, partly put into practice since January 2016, it has been made possible to utilize data including personal information without the person's permission on the condition that firms make such information anonymous. The government is now working on a new guideline on the extent to which personal data must be concealed in order to make it possible to be provided to a third party. When this guideline is fixed, we would be able to accommodate an environment for mass data analysis in Japan.

The global competition in the Fourth Industrial Revolution will be highly intensive, as it will be competition to manage with the incomparably rapid progress of AI, IoT and Big Data. We must be more creative than ever in formulating growth strategies in such a rapidly growing digital market. We must think about how effectively our resources can be used for this purpose. The proposal I have introduced here shows, I believe, that Japanese excess savings in the business sector could be used efficiently for the appropriate goals. **JS**

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