A Global Data Infrastructure for Data Sharing Between Businesses

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1. Purpose of this document

This document introduces the current trends toward the implementation of digital management tools that support cross-border data sharing between businesses, which will be indispensable for future business transformations and pandemic responses. Today we find ourselves at the confluence of multiple evolving global trends. These include the emergence of new data-driven business models, the expansion of B2B platform business, the accelerating pace of digital transformation, the growing expectations for the fulfillment of Sustainable Development Goals (SDGs) and other social needs, the rise of New Glocalism, the growth of stakeholder capitalism, and the Great Reset. In this article, we discuss the challenges of establishing a global data infrastructure for data sharing between businesses as a key ICT infrastructure for the construction of a next-generation society, and the efforts that are being made to address these challenges.

The content of this document is based on studies performed by the Global Data Distribution Management Infrastructure Study Sub-Working Group (SWG8) of the Robot Revolution & Industrial IoT Initiative (RRI) / Manufacturing Business Revolution through IoT Working Group (WG1), of which the author is a member.

2. Global trends in data sharing between businesses

Due to recent trends such as the emergence of new business models such as Everything as a Service (XaaS) and the Sharing Economy, and the growing need for productivity improvements through the use of AI, there has been a growing demand for an ICT infrastructure equipped with mechanisms for safe and secure data sharing across international boundaries and between businesses that form supply chains and ecosystems.

For example, according to the World Economic Forum's "Share to Gain" White Paper, it is estimated that the potential value of data sharing could exceed \$100 billion even if we only consider its contribution to the optimization of production processes in the manufacturing sector. Data sharing can also create significant value in various other industries. Efforts are also being made to assist predictive maintenance by using IoT to collect and analyze the operating data of products exported and delivered overseas. Indeed, the COVID-19 pandemic has created a rapidly growing need for remote monitoring and control of the operating status of factories and plants around the world, and for the real-time acquisition of global supply chain information.

Although data sharing between businesses and between countries is expected to result in the development of industry and the creation of new businesses, if the confidentiality of this data is compromised, then it could have a serious impact on a company's management and survivability by, for example, leaking corporate secrets or information about the operational status of manufacturing facilities, or breaking confidentiality agreements between businesses. Nowadays, moves are being made to restrict the international flow of data, such as the monopolization of data by IT giants in the US, national rules on data censorship and foreign exports, and the diverse data protection rules that have been put in place in different countries and territories around the world. In the future, it is feared that these restrictions will erode the data infrastructures of each country and region. For example, if data from overseas factories and exported products can no longer be used freely, then this is liable to hinder the digital transformation of society as a whole, which will not only affect individual businesses, but will also impede the economic activities of entire nations and value chains.

To facilitate global data sharing, it is important to implement a mechanism for interconnecting the infrastructures of different countries/regions, and to manage it safely and fairly according to internationally accepted rules. The key is to protect the data sovereignty of data providers and the rights of stakeholders including data providers and users. In Europe, for example, the GAIA-X project is an organic collaborative effort of industry, government and academia that conducts specific and comprehensive studies of technical measures for protecting the data sovereignty of data providers, and to construct a system for the implementation of these measures.

Among these trends in data sharing, Japan has also taken steps to unify the direction of the efforts being made by individual businesses, organizations and government bodies. To ensure that Japan is not left behind in these global trends, we urgently need to establish an ICT infrastructure and develop operational rules by implementing strategies that involve industry, government and academia.

* Data sovereignty of data providers: The right of data providers to decide on matters such as how their data is stored and processed, and whether or not other parties should be granted access to this data.

3. Data sharing problems

In discussions at the Global Data Distribution Management Infrastructure Study Sub-Working Group (SWG8) of the Robot Revolution & Industrial IoT Initiative (RRI) / Manufacturing Business Revolution through IoT Working Group (WG1), the current and anticipated future issues relating to strengthening the competitiveness of businesses through data sharing have been broadly divided into issues that apply before data sharing, and issues that apply during data sharing. Issues that apply before data sharing include issues relating to business processes and awareness that must be addressed within each individual business and issues relating to the major trends of industry and society, while issues that apply during data sharing include issues relating to the mechanisms and rules for the external disclosure and sharing of data.

3.1. Issues that apply before data sharing

Issues that apply before data sharing include the following 6 major points that relate to business processes, rules, awareness, etc.:

- 1. Lack of systematic digital data (e.g., data managed on paper and in Excel spreadsheets, delayed system maintenance, etc.)
- 2. Rules prohibiting the sharing of data inside or outside the business (e.g., slow identification of cooperative or competitive areas)
- 3. Lack of management-level awareness of the significance of data sharing (e.g., data only regarded as a means of making improvements at the same location)
- 4. Lack of a risk-taking attitude to the promotion of digital transformation (e.g., many businesses wait until other businesses have succeeded)
- 5. Delayed preparations for responding to the changing structure of industry (Sharing Economy, XaaS, etc.)
- 6. Inadequate understanding of international standards/national regulations (e.g., cybersecurity, data protection, etc.)

Businesses that have problems of types 1 through 4 above tend to not be making effective use of their own data, and avoid disclosing data externally. In addition, businesses and industries that have problems of types 5 and 6 above tend to envisage negative future outcomes for themselves, such as reduced productivity and competitiveness, and being overtaken by the entry of players from other countries and other industries into the market.

3.2. Issues that apply during data sharing

Issues that apply during data sharing include the following 7 major points that relate to technical issues with information systems and IoT systems.

- 1. Lack of a business-wide (whole ecosystem) infrastructure to support the utilization of information
- 2. Lack of infrastructure for sharing data with business partners (no investing or operating entity)
- 3. Lack of unified communication procedures or data formats, with no compatibility or interoperability.
- 4. Lack of connection between OT and IT (making it impossible to utilize on-site data for business management decisions)
- 5. Procedures not established for converting human attributes and knowledge into digital data
- 6. Inadequate mechanisms for providing reliability and security assurances that are essential for IoT
- 7. Lack of system support for cross-border data sharing management and rights protection

As described above, many businesses and industries face various risks due to their failure to take adequate steps to convert information to digital data or implement data management/sharing systems. As a result, it can be seen that not much progress has been made in data sharing between businesses or across international borders, and even data sharing within businesses has made little progress.

3.3. Issues to be addressed in the future

To accelerate industrial development and the creation of new business by means of data sharing between businesses and across borders, it will be necessary to solve both classes of problem listed above (issues that apply before data sharing and issues that apply during data sharing). Issues that apply before data sharing include issues related to business processes, rules, and awareness. Overcoming these issues requires the formation of a common understanding of business transformations that are liable to take place in the future, the sharing of information and software necessary for complying with new international standards and regulations in each country that arise as a result of these transformations, and the promotion of management reforms and business process reforms in businesses and local governments based on this sharing. Issues that apply during data sharing are related to information systems and IoT systems and the like. These will have to be addressed by measures such as defining common rules, common interfaces, and common processes for exchanging data in diverse zones including within organizations, within businesses, between businesses, within countries, and between countries, and by working to establish an ICT infrastructure that facilitates the use of data sharing by businesses and local governments.

In particular, to solve issues that apply during data sharing, it is necessary to discuss a cross-industry approach that brings together knowledge from various perspectives while taking into consideration international studies aimed at solving the issues that apply before data sharing. In particular, with regard to issues 6 and 7 that apply when sharing data between businesses or across international borders ("Inadequate mechanisms for providing reliability and security assurances that are essential for IoT" and "Lack of system support for cross-border data sharing management and rights protection"), it is necessary to concentrate to discuss as an issue on establishing an ICT infrastructure due to the difficulty of achieving to solve the issues by individual businesses and industries.

4. Solving problems in data sharing

To implement a mechanism that guarantees the security and reliability of data, as mentioned among the issues that apply during data sharing, together with systems for ensuring the protection of rights and facilitating the management of cross-border data sharing, we require a new ICT infrastructure for business communication across international boundaries and between businesses.

Examples of ongoing studies on data sharing in Japan include the Global Data Distribution Management Infrastructure Study Sub-Working Group (SWG8) of the Robot Revolution & Industrial IoT Initiative (RRI) / Manufacturing Business Revolution through IoT Working Group (WG1), wherein studies are being performed with regard to data disclosure and access controls and the like based on laws and contracts/ownership rights for guaranteeing the data sovereignty of data providers. In addition, the Industrial Value Chain Initiative (IVI) has been developing the Connected Industries Open Framework (CIOF) as a mechanism that facilitates the collaborative use of data by making use of system and data settings within existing platforms, and the Data Trading Alliance (DTA) has been studying data trading rules and standards over a wide range including the personal data of consumers assuming data trading market.

Meanwhile, in Europe, technical specifications and legal systems are being drawn up based on the data strategy announced by the European Commission in February 2020. Using the International Data Spaces (IDS) communication interface — whose specifications were created by the Fraunhofer Society and the International Data Spaces Association (IDSA) — increased efforts are being made to use communication interfaces that can protect security and the data sovereignty of data providers. One example is the new GAIA-X data infrastructure, which the EU plans to build by 2021. This technology is expected to lay the foundations of ICT infrastructure that will accelerate the implementation of new business models.

* International Data Space (IDS): An initiative promoted by IDSA (established in late 2014 under the leadership of the Fraunhofer Society in Germany), which aims to build a virtual data space. By using a standard common information model, businesses, local governments and individuals can securely share data with each other while protecting the data sovereignty of data providers. It is reckoned that the data sharing mechanism using IDS connectors and the secure data storage mechanism promoted by GAIA-X will complement each other to guarantee the data sovereignty of businesses, local governments and individuals in the data value chain.

4.1. The importance of security and data sovereignty

Based on the needs and issues of businesses that build, operate, and manage on-site systems, and on the trends in data protection regulations by governments in each country and region, as conditions required for data sharing infrastructure between businesses and between countries, together with the basic function of data sharing in allowing data to be freely distributed in order to improve industrial productivity and production efficiency and stimulate economic growth, it is also important to implement security measures to guard against, detect, handle and recover from threats such as cyber-attacks, and to implement safeguards based on laws and other rules so as to protect the data sovereignty of data providers and the associated interests of countries and regions.



4.2. A global data infrastructure for data sharing between businesses

Based on cyber security measures in places such as Europe, the United States and China, the implementation of legal systems related to data protection, and the construction of regional data sharing infrastructures such as GAIA-X, it is also possible that different countries and regions could end up building their own data sharing infrastructures, each with their own individual architectures and data formats, based on the underlying economic, cultural, and policy attributes of each country and region. In this case, it will be necessary to establish mutual connection frameworks to link these different infrastructures in order to support data sharing by businesses across the borders between countries and regions, and to make effective use of this data. Therefore, when considering the requirements of a global data infrastructure for data sharing between businesses, it is important to consider the sort of functions it might require, and how they might be implemented. For example, this could involve a combination of separate data sharing infrastructures that can be constructed and operated on a per-country or per-region basis, and a global data sharing infrastructure whereby they can be interconnected fairly and securely based on fixed rules and their operating status can be monitored.



4.3. Current state of studies around the world

Various projects around the world are promoting the construction of systems and architectures where data can be shared legally and safely while maintaining the data sovereignty rights of businesses, local governments, and individuals involved in the sharing and use of data. Leading examples include the GAIA-X Project, IDSA, the EU's European data strategy, and various white papers published by the World Economic Forum ("Share to Gain", "Data Free Flow with Trust", "A Roadmap for Cross-Border Data Flows" and "APPA"). The GAIA-X project is particularly noteworthy in that it is working on the design and implementation of specific system functions such as the International Data Space (IDS) communication interface, and has already progressed to the prototype construction stage.

The GAIA-X project was announced by the German and French governments in October 2019. This is a technical mechanism that controls access to data based on authentication and contract procedures, and protects the data sovereignty of data providers while ensuring interoperability with various cloud services. A promotion organization was set up in 2020, and is scheduled to start operations in 2021. The aim of this project is to build a high performance, competitive, secure, reliable and open data infrastructure for European businesses, governments, institutions and citizens, but there have also been calls for the system to be opened up to non-European markets. A central organization at the European level will be set up to operate this infrastructure and make decisions

regarding the development of reference architecture, the definition of certification standards, and the issuance of product quality assurances.

The GAIA-X system specification is a distributed data management model that links data stored in multiple cloud and edge locations. It is also envisaged that the system will standardize and automate the creation of contracts and procedures related to user authentication, access control based on data type, and the provision/use of data. Specifically, the IDS connector, which is being standardized by IDSA, has a gateway-like function that controls whether or not data can be accessed based on predefined authentication methods and data classifications. When IDS connectors are installed on devices and cloud systems used by businesses or individuals and data is exchanged between these devices and cloud systems, it becomes possible to distribute data securely while maintaining the data sovereignty of the data providers. IDS connectors also ensure interoperability with various existing cloud services.

Since GAIA-X guarantees connectivity within the European region, it is expected to facilitate the sharing and use of data within the region, which will help to improve the quality of life and productivity of its citizens. On the other hand, there are also uncertainties regarding how this system will connect with systems in other regions, and it may conflict with the interests of other countries such as the United States and China. Furthermore, if IDS connectors become the European standard and then the international standard, it could become impossible to access industrial data in Europe (GAIA-X) without using a certified IDS connector. Therefore, alongside Europe, the United States and China, it is considered to be important for other countries, including Japan, to accelerate their efforts to ensure interoperability so as not to be left behind, and to work together on promoting preparations for the establishment of fair international data sharing rules.

4.4. Approach to problem-solving studies

"Data sharing" is a term that can be applied to an extremely diverse range of data types across different related industries, which makes it difficult to identify the requirements covering all possible patterns in a short period of time. Therefore, to make solid and speedy progress with the study of conditions that are needed for a data sharing infrastructure, it is useful to conduct studies based on specific use cases. As a concrete approach to this study, we assume a business model that can be established by performing secure data sharing among many businesses after they have entered into contracts and agreements in a short time. By selecting specific applications (use cases) for which the sharing of data across international boundaries is considered to have a large economic effect, we consider how to proceed with the investigation of requirement for data sharing from the viewpoint of the users of products and services in these use cases.

As mentioned at the beginning of this document, there has in recent years been a shift to new business models such as XaaS and the Sharing Economy. Examples of future use cases that are expected to emerge with the development of new XaaS business models include car sharing and the Circular Economy. Furthermore, through the centralized management of assets such as facilities and equipment at factories in multiple locations, it is possible to provide businesses that lack these facilities and equipment with a service for the production of components or products in the form of a Factory as a Service business model.

One example of a Factory as a Service use case is a Japanese machinery manufacturer that performs maintenance of machinery delivered to Thailand by relying on the services of a local Thai factories as a service provider. In this use case, the main activities that occur between the business operators are as follows: (1) the machinery manufacturer asks the Factory as a Service provider to manufacture components and perform maintenance on them, (2) the Factory as a Service provider selects a partner factory that can handle this request, and (3) the partner factory manufactures the parts and carries out machine maintenance work. When this activity was examined in detail, we uncovered problems that had occurred, such as difficulties in tracing the machinery manufacturer's drawings, which were passed through the Factory as a Service business operator to an unintended recipient. Thus, as a requirement of the data sharing infrastructure, we were able to identify requirements such as the need for a mechanism capable of modifying and controlling the scope of data disclosure depending on who it is supplied to.



This deeper examination of use cases made it possible to enumerate specific requirements for the functions provided by data sharing infrastructure, the data it distributes, and the rules that need to be followed. Furthermore, by considering multiple use cases rather than a single use case, we were able to envisage a common set of requirements to form the core of an infrastructure that is used in a wide range of applications by a wide range of users.

If we can study data sharing use cases in various industries together with people who are internationally active at the forefront of business and management in these industries, then it should be possible to promptly extract common conditions that are required of a global data infrastructure for data sharing between businesses, resulting in the prompt implementation of actual systems with the desired form and function.

5. NTT Group initiatives

As part of the NTT Group's "Your Value Partner" business initiative, we are leveraging our diverse corporate resources, including our R&D facilities, ICT platforms and human resources to promote a digital transformation while collaborating with our partners to solve society's issues. This section introduces some of the efforts being made by the NTT Group to address issues in data sharing.

5.1. Research and development of Intertrust technology for the construction of next-generation ICT infrastructure

Research and development within the NTT Group is carried out by NTT R&D, which is working on new technologies while engaging with people in various fields of industry, including other businesses in the NTT Group, with the aim of resolving social issues by overcoming problems related to issues such as safety, disaster prevention, and sustainable development.

In 2019, the NTT Group launched the Innovative Optical and Wireless Network (IOWN) concept, which aims to implement the communication infrastructure of the future by using the latest optical communication, optical computing and information processing technology to create a smart world. To accelerate the realization of this concept, NTT R&D unveiled a technology development roadmap in April 2020. This roadmap includes data-centric architecture that links various systems, centered on data exchange and sharing means that support various communication methods.

With the aim of implementing this data-centric architecture, NTT R&D is working on the construction of a global open information and communication infrastructure where it is possible for all types of businesses and organizations around the world to provide, share and use data securely, at low cost, and at high speed. Both the real world (real space) and its digital twin (cyberspace) are targeted in various industries and areas such as factories, mobility technology, and cities. This design philosophy is oriented towards a distributed architecture that connects across clouds and edge nodes, and emphasizes protection of the data sovereignty of participating players. We plan to implement this data sharing platform in partnership with telecommunications carriers in each country.

NTT Group is working at examining the requirements while carrying out proof of concept tests using prototypes with people in various industries, and is building a prototype system that supports data sharing between businesses while protecting the data sovereignty of data providers. Communication interfaces called Trust Gateways (Trust GWs) are installed in edge devices or cloud equipment used by data providers and users, and data is exchanged via these gateways. To protect the data sovereignty of businesses and local governments, agreements are made between data users and data providers.

regarding the provision and use of data, and the contents of these agreements are managed within the system. This results in a system where all the Trust Gateways are comprehensively controlled by the system, and data is only extracted and shared when certain criteria are met, such as the data sharing policy of the data provider/user, the data storage location, and the network environment.

As a core technology for the realization of these Trust Gateways, NTT R&D is researching and developing Intertrust technology, which interconnects the data areas (trusted areas) protected by each business or local government based on their own standards, so that data can be shared from one trusted area to another. In each trusted area, businesses and local governments can select data storage methods and locations based on their own business strategies, their contractual obligations to other parties, and on the local laws and regulations of the countries and regions in which they are located. Intertrust technology respects the trusted area of each business/local government while searching for data required by other business entities beyond the corporate/local government boundaries. Then, after proposing how this data could be used and agreeing to the data sharing conditions, the data can be shared and utilized while complying with the laws and regulations of each country/region and protecting the data sovereignty of the businesses and/or local governments that provided the data.



The Intertrust technology currently being researched and developed by NTT R&D can be broadly divided into three categories: (1) Intertrust protocol technology, (2) Intertrust computing technology, and (3) Intertrust intelligence technology.

(1) The purpose of Intertrust protocol technology is to enable the sharing and utilization of data while observing the local laws and regulations of each country/region and protecting the data sovereignty of each business/local government. This involves searching the data of each business/local government for the data requested by a business entity, proposing the use of this data, and obtaining an agreement on the sharing of this data. It primarily consists of techniques for purposes such as labeling data with metadata (information about its origin, type of data, etc.), cataloguing this metadata, proposing and obtaining agreement on data sharing policies, applying these data sharing policies based on metadata, controlling the use of data (usage control), and logging data usage history information.

- (2) The purpose of Intertrust computing technology is to provide mutual protection for the value of data provided by one business or local government and the value of the data analysis algorithm provided by another business or local government while implementing a basic mechanism that enables the sharing of just the results of processing the said data with the said algorithm. By protecting not only the value of data but also the value of algorithms, this makes it possible to promote the mutual sharing of data and algorithms that were previously difficult to distribute outside individual businesses and local governments.
- (3) The purpose of Intertrust intelligence technology is to implement basic mechanisms for the provision of intelligence by making full use of data sharing between businesses, including protecting the data sovereignty of data providers while sharing machine learning data with other businesses/local governments and sharing inference algorithms using machine learning data. This can be expected to create business of greater value than ever before by flexibly combining machine learning data that can be shared between businesses/local governments, allowing it to be used for data processing in the field by various industries.

Amid growing expectations for the digital transformation, practical efforts are being made all over the world in relation to industrial IoT. However, to determine the cost of designing and operating systems for the storage of data used in different ways, it has hitherto been necessary to design systems that handle data after performing demonstration tests or the like in order to first determine how the data will be used. But from now on, the implementation of a global data infrastructure for data sharing between businesses based on Intertrust technology, will make it possible to protect the data sovereignty of the data owned by various businesses/local governments while testing the necessary data combinations when needed, and creating new businesses with greater resourcefulness than ever before. Even if changes are constantly made to data protection laws and regulations and to international agreements on data sharing, this system will still be able to adapt flexibly and allow business to continue by complying with the latest rules. This will greatly accelerate the process of creating business based on the use of data.

5.2. A Smart Data Platform that contributes to corporate data sharing and the realization of a Smart World

On September 30, 2019, NTT Communications launched the Smart Data Platform in order to work on the implementation of a Smart World that promotes a data-driven digital transformation to address social issues. This platform reorganizes the collection of services supporting data utilization that had been under development since FY2018, provides a one-stop solution for all the functions necessary for data utilization, and implements cross-cutting data utilization among different organizations and processes both within businesses and between businesses.

Smart World		
DX Enabler		
Apps on SDPF SBS VDX AI Subscription Business Support DX Intelligence Sales Force Automation Management PDX HCA VM IT Service Pay DX Home Currency Vehicle operation Management Management		
Smart Data Platform	IRV ICT Resource Visibility	
Integration Analysis IoT Security DM Data Management	Orch	
DI Data Integration API-GW DAAI Data Analysis AI IoTP IoT Platform Desc Data Security	Orchestrator	
Storage PrC Private Cloud PuC Public Cloud ST Storage	MS Managed Services	
Collection FIC Flexible InterConnect	Sec Security	
IoTE IOT Edge LSG Local 5G oSIM eSIM SD-WAN		

Using this Smart Data Platform, NTT Communications aims to promote the implementation of corporate digital transformation in various different fields, including smart workstyles, smart education, smart cities, smart factories, and smart healthcare,

and will contribute to sustaintable growth of business and society, and the resolution of social issues. In particular, in the field of Smart Factories, we plan to provide industry collaborative digital platforms that utilize the Smart Data Platform with the aim of reducing the on-site labor requirements of the manufacturing industry and accelerating the collaboration and cooperation with partners inside and outside the industry.

The functions provided by the industry collaborative digital platform in the Smart Factory domain include a DATA Trust function that shares highly confidential data of each business safely by using Intertrust technology based on research at the NTT R&D, which is incorporated as one of the basic functions of the Smart Data Platform. Using this DATA Trust function, data owners can specify who is able to use their data, and under what conditions. This makes it possible to safely share and analyze highly confidential data, providing an ecosystem where data from various businesses can coexist, and helping to to support the competitiveness of the entire industry.

NTT Communications plans to continue expanding its Smart Data Platform functions, such as optimal allocation of data processing capabilities and implementing autonomous ICT resource control, and is also planning to expand its cooperative applications including the services of other businesses. Through these efforts, we will contribute to the digital transformation of businesses, broaden the scope of data utilization by building an ecosystem that includes cooperative application partners, and work on the implemention of a Smart World.

6. Conclusion

Across all industries, the importance of data will continue to grow due to environmental changes and the shift to new business models. Data owned by businesses and local governments will be actively and strategically shared not only within businesses/local governments but also in supply chains and ecosystems, and will be used in international communities based on mechanisms and rules that guarantee the data sovereignty of related parties.

To continue invigorating society and increasing the industrial power of each country/region, it is important to be able to accurately anticipate current world trends and introduce superior technology, systems and standards, while providing a global data sharing infrastructure that is improved and evolved according to the cultures and values of each country/region. To this end, various players such as businesses and local governments must be able to collaborate and cooperate in the division of roles and the promotion of initiatives. It is essential that this is achieved with appropriate involvement and cooperation of not only the businesses involved in each industry, but also the platform operators and system integrators who provide basic functions, national and local governments, and private citizens.

So how should each player contribute to the data sharing infrastructure of each country/region? To answer this question, we need to take a look at the discussions being held by the Global Data Distribution Management Infrastructure Study Sub-Working Group (SWG8) of the Robot Revolution & Industrial IoT Initiative (RRI) / Manufacturing Business Revolution through IoT Working Group (WG1).

For example, in the manufacturing industry, manufacturers and the operators of production equipment and machinery will not only effectively utilize data for their current business, but should also think about the creation of new businesses and services by taking the future of manufacturing into consideration, thereby creating social value through data. In terms of optimizing supply chains and entire ecosystems, it is even more important to promote collaboration and data sharing with other businesses in the same industry and different industries. For a business to become capable of creating new businesses in this way, it is essential to accelerate the digitalization of the business, and to provide investment and develop human resources for this purpose. Similar considerations should be applied to other industries besides manufacturing.

It is expected that platform operators and system integrators will rapidly bring out secure communication environments and data sharing infrastructures that are essential for data sharing, and will build an ICT infrastructure that allows businesses and local governments to operate without incurring a heavy burden. Furthermore, as another step forward, instead of just letting businesses in each industry (e.g., manufacturing

companies in the manufacturing industry) create new businesses based on digital technology, it is important to understand the issues faced by customers and to advise business clients on how to use the latest IT technology and standards, and to bring about changes by working together.

At the level of countries and governments, it is hoped that the direction of each country with regard to data sharing infrastructure will be firmly established, together with plans for its implementation, and that these efforts will be promoted by industry, government and academia. For example, Europe's GAIA-X project is being led by the German and French governments. It is also necessary to establish a new legal system that can protect the data sovereignty of data providers while promoting data sharing. For cross-border data sharing, it will be essential to establish international rules and standards, and to this end it will be necessary to promote discussions with each country.

The issues that need to be addressed in the construction of a global data infrastructure for data sharing between businesses are many and varied, and cannot all be solved by one country or by one business. We therefore hope to discuss these issues with various industries and businesses with whom we can work together in bringing this vision to reality.

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