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DIGITAL TRANSFORMATION IN JAPAN

Assessing business opportunities for EU SMEs

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About the EU-Japan Center for Industrial Cooperation

The EU-Japan Centre for Industrial Cooperation is a joint venture established in 1987 by the European Commission (DG GROW) and the Japanese Government (METI) for promoting all forms of industrial, trade and investment cooperation between the EU and Japan. It is jointly funded and managed by both sides, with offices in both Tokyo and Brussels.

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Acknowledgments

Executive summary

Digital transformation (DX) has been a key and a growing topic over the past years, where Japan is no exception.

This report aims to provide a holistic overview of the current state of the digital transition in Japan, with a focus on the initiatives undertaken by the private sector and assess the way it has transformed its business and operating models. On this basis, it aims to identify potential opportunities for European companies to enter the Japanese market in the digital domains.

Japan shows room for progress. The 2025 digital cliff, the COVID-19 pandemic as the momentum for change

The 2025 digital cliff, the ageing workforce and the COVID-19 pandemic have been the momentum for the private as well as the public sector to undertake actions and accelerate the transition toward digital.

Despite positive signals and the promotion of digital concepts such as artificial intelligence (AI), the Internet of Things (IoT) or the cloud, facts and figures reveal that Japan still shows great room for progress both in the digitalization of its public administration and services, as well as of its corporate landscape.

In response, the Government of Japan (GoJ) set up ambitious goals by envisioning the creation of Society 5.0, described as the convergence between the cyber space and the physical world. Over the past few years, it has accelerated initiatives through the review and the publication of multiple policies. Moreover, it established the Digital Agency to centralize decisions in relation to digital measures and drive the transformation of the country.

A slow transition of the private sector

Firms are still operating for a vast majority on old legacy systems, inhibiting the transition to cloud and its related benefits, while digital marketing practices, the digitalization of the supply chain and the implementation of advanced manufacturing are still far from becoming the corporate norm. This lack of corporate digital maturity is reflected in firms' next priorities for investment in digital, indicating the improvement of business process operations is the main focus area for the years to come. The situation is also fragmented when comparing SMEs and large corporations. Whereas the firsts are still catching up by starting the transition to cloud and adopting standard practices such as data analytics, the seconds are starting to look into more advanced solutions powered by AI or IoT.

On the other hand, Japanese firms struggle to leverage value creation from digital innovation in products and services in comparison to global peers, suggesting firms are not able to fully materialize digital solutions into revenues yet. Business model disruption in traditional industries such as the automotive, healthcare, retail and financial sectors is currently taking a turn and is led by long established industries' leaders, which are very often cooperating with startups to leverage their solutions and innovate.

An undeveloped startup ecosystem, hindering domestic innovation and disruption

Innovation in Japan relied for a long time on large established companies, which had the tendency to promote internal development and experiment targeting domestic market. The startup community, which is recognized to play a key role in bringing disruption in the digital domain, has finally started to grow, although it remains small when compared to other advanced countries. Similarly, venture capital markets, which are key for startups to strive, are

growing but still insufficient to compete internationally.

Promising opportunities for EU SMEs in Japan

In this context, what are the opportunities for European firms in the digital domains to expand their activities to Japan? The environment suggests opportunities are multiple and concern all industries, where particular needs are observed in BtoB markets, with a focus on software solutions. First, the digitalization and the need of Japanese firms to improve business process and operations increases the demand for trust services, secure data exchange platforms but also for SaaS solutions supporting back office operations. Then, disruption in traditional industries and the development of technology enabled products have raised the demand for industry specific solutions leveraging AI, IoT, network and sensor technologies, but also solutions to improve user interfaces and user experience.

The opportunities for EU companies are promising, as those have the potential to fill the domestic gaps resulting from the lack of local digital talents, as well as the lack of disruptive innovation, which is eventually the consequence of the small domestic startup ecosystem. Moreover, several European countries are recognized for their digital branding and expertise in specific domains, as well as in niche solutions, suggesting that the continent holds a competitive position in the international market that deserves to be further explored.

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Abbreviations and acronyms

AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
AWS	Amazon Web Services
BtoB	Business to Business
BtoC	Business to Consumer
CPS	Cyber Physical System
CX	Customer Experience
CtoC	Consumer to Consumer
CVC	Corporate Venture Capital
DA	Digital Agency
D&A	Data and Analytics
DX	Digital Transformation
ERP	Enterprise Resource Planning
EU	European Union
FA	Factory Automation
GoJ	Government of Japan
HR	Human Resources
IaaS	Infrastructure as a Service
IoT	Internet of Things
IT	Information Technology
L4 AD	Level 4 of automated driving
L4 AV	Level 4 of automated vehicle
MaaS	Mobility as a Service
METI	Ministry of Economy Trade and Industry
MES	Manufacturing Execution System
MIC	Ministry of Information and Communication
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MoU	Memorandum of Understanding
MtoM	Machine to Machine
OEM	Original Equipment Manufacturer
PaaS	Platform as a Service
PoC	Proof of Concept
PRISM	Public/Private R&D Investment Strategic Expansion Program
RFID	Radio-frequency Identification
RPA	Robotic Process Automation
R&D	Research and Development
SBIR	Small Business Innovation Research
SIP	Cross Ministerial Strategic Innovation Program
SME	Small and Medium Enterprise
SaaS	Software-as-a-Service
SEO	Search Engine Optimization
SNS	Simple Notification Services
STI	Secretariat for the Promotion of Science, Technology and Innovation
TPO	Trade Promotion Organization
UAV	Unmanned automated vehicle
UX	User Experience
VPN	Virtual Private Network
VC	Venture Capital
VR	Virtual Reality
XR	Extended Reality

INTRODUCTION

Highlights

1/ "DX" buzzword. Digital transformation (DX) has been a growing topic over the past years in Japan, whereas all indicators show the country still shows room for progress.

2/ 2025 digital cliff and the COVID-19 pandemic accelerating the digital transition. The 2025 digital cliff and the COVID-19 pandemic have shown the weaknesses resulting from the overall poor adoption of DX in the country, urging the need for the government and the private sector to undertake actions toward digital transition.

3/ Purpose of the report. This report aims to provide a holistic overview of the current state of digital transformation of Japanese firms, both from the perspective of business operating models and product/service offering, with the purpose of identifying business opportunities for EU SMEs.

Context and purpose of the report

Digital Transformation, alternatively referred to as "DX", has been a one of the many tech terms buzzword of the last decade, where Japan is no exception. It is described as the cultural, organizational and operational change of an organization, an industry or an ecosystem by leveraging digital technologies, processes and competencies across all function levels. Whereas companies around the world have been working on scaling DX, many Japanese firms have only started the process and are said to be lagging far behind their global peers.

2025 digital cliff, the COVID-19 and the government transition to digital as the momentum for change for Japanese firms

In 2018, the METI has pointed out the **"Digital Cliff"** as a key challenge that companies will need to overcome by 2025, which is described as a combination of human resource and technological risks foreseen to be an obstacle to the growth of Japanese firms. Fujitsu Research Institute estimates that shortage of human resources in IT will double to about 430 000, while more than 60% of core IT systems will have been in operation for more than 21 years[1]. If left unchecked, the impact is measured to lead to a loss in the economy of 12 trillion yen annually by 2030, urging the need for change.

Moreover, the **COVID-19** has been a tremendous catalyst for the business and the government to move forward to DX. The pandemic has dramatically exposed Japan's delay in digital transformation, starting from the government response in fighting the crisis. Japan's health ministry faced difficulties collecting accurate, reliable and real-time data, while local governments spent weeks for delivering grants to their citizens. On the corporate side, whereas companies around the world were rapidly adjusting their operations and services to respond to restriction measures and the need to offer remote alternatives, Japanese firms have comparatively struggled to swiftly adapt and deploy appropriate measures and changes by leveraging technological solutions[2].

In this context, the Japanese government has undertaken multiple initiatives to lead the path forward and encourage the corporate landscape toward its digital transition. Solutions for digitalization, high-tech and deep-tech have been at the center of concerns for the public sector to develop appropriate policies, infrastructure and e-government services. On the other hand, it is the momentum for the private sector to take actions, cross-industries and cross-company sizes, to maintain its competitiveness in a rapidly changing society.

Provide a holistic understanding of the current DX situation in Japanese firms and evaluate market opportunities for European SMEs

The purpose of this report is to **provide a holistic view and a snapshot of the current state of DX adoption in Japanese firms** and to assess the way it has transformed their business and operating models, including the impacts of the COVID-19. It further aims to measure disparities according to company sizes and industries, as well as identify the main trends when it comes to the type of digital technologies and high-tech/deep-tech solutions. On this basis, it aims to **outline market opportunities** for entrepreneurial innovation arising from digital transformation, evaluate the synergies and complementarities with Europe, and ultimately identify the opportunities for European SMEs to enter the Japanese market.

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[1] Ministry of Economy, Trade and Industry, *DX レポート IT システム 「2025 年の崖」の克服と DX の本格的な展開, [DX Report : Overcoming of « 2025 Digital Cliff Involving IT Systems and Full-fledged Development of Efforts for DX»],* published on 07/09/2018, Accessible at :

https://www.meti.go.jp/press/2018/09/20180907010/20180907010-3.pdf

[2] McKinsey Digital Japan, *デジタル革命の本質: 日本のリーダーへの メッセージ[The essence of the digital revolution: a message to Japanese leaders],* September 2020.

The approach of the report is on two folds. First, it analyses how the introduction of digital technologies has changed the way firms operate, evaluating the impact and the main trends considering back office activities, the supply chain, logistics as well as the impact on manufacturing practices. On the other side, it provides an overview of the emergence of new business models, evaluating how it has transformed traditional products aby introducing new value offering and revenue streams in leading industries.

Methodology and limitations of the report

The research was carried out through the provision of deskwork from secondary resources including qualitative information and quantitative data from existing literature available in English and Japanese. Resources include reports, surveys, press releases, public interventions, as well as websites. Complementary to the deskwork, short case studies of digitalization in business and operating models were included to illustrate practical examples. Last but not least, a set of interviews were conducted with European Trade Promotion Organizations (TPO) located in Japan to further collect information about recent trade activities and gather opinions on identified opportunities.

It is important to note the following limitations when it comes to the statements and statistical observations provided throughout the report.

First, the research includes multiple references to data regarding the adoption of technologies by the corporate landscape, usually measured through surveys conducted by domestic public or private organizations. Results slightly differ from different sources according to the sample size, industry grouping method as well as the definition of "technology adoption", which has the tendency to vary according to the respondents' interpretation and to the survey approach. As such it is important to refer to the surveys' methodology for an accurate interpretation of the results.

Figures originally available in Japanese have been translated into English by the author of this report. These constitute provisional and unofficial translations.

Definitions

Key definitions of terms used in this report are listed below.

- **Digital transformation** (hereinafter referred to as DX): according to the METI, it is the process by which companies respond to rapid changes in business, using data and digital technology to transform their products, services, and business models based on the needs of customers and society, as well as to transform the business itself, the organization, processes, and corporate culture to establish a competitive advantage.

- **Digitalization**: Digitalization refers to enabling or improving processes by leveraging digital technologies and digitized data.

- **Digitization**: Digitization refers to creating a digital representation of physical objects or attributes. In other words, it is about converting something non-digital into a digital representation or artifact.

- **Digital technology** is an umbrella term for computer-based products and solutions. Those include devices, methods, systems, which deal with the creation and the practical use of digital or computerization.

- **SMEs** in Japan are subject to a different definition from the European Commission, as highlighted in the tables below. It should be stressed that observations and statistics collected from Japanese

sources referred in this report are subject to different definitions of SMEs compared to European standards.

- o SME definition according to the European Commission[3]:

Company Category	Staff headcount	Turnover	Or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

- o SME definition according to the Japanese Ministry of Trade and Industries (METI)[4]:

Company Category	Staff headcount	Or	Total capital or invest. amount	Main industry
Medium-sized	≤ 300		≤ ¥ 300 m	Manufacturing, Construction, Transportation and other than (a),(b),(c).
	≤ 100		≤ ¥ 100 m	(a) Wholesale trade
	≤ 100		≤ ¥ 50 m	(b) Services
	≤ 50		≤ ¥ 50 m	(c) Retail trade
Small	≤ 20		Na	Other than Commerce and Service industries
	≤ 5		Na	Commerce, Services

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[3] European Commission (2012), *SME Definition*, Available at https://ec.europa.eu/growth/smes/sme-definition_en, Accessed 24/08/2021.

[4] Ministry of Trade and Industries Small and Medium Enterprise Agency, *Chapter 1 General Provisions Art.2*, Available at https://www.chusho.meti.go.jp/sme_english/outline/08/01_01.html, Accessed on 24/08/2021.

01 JAPAN DIGITAL POLICY BACKGROUND

The IT Basic Law enacted in 2000 has driven Japan's IT strategy over the past 20 years. It has helped the country building strong infrastructures supporting the use of the internet, however it has also shown weaknesses in the development of the "uses and applications". To address the stagnant situation, the Government of Japan (GoJ) enacted several reforms over the past years and has initiated the "Basic Act on Forming a Digital Society" in September 2021, implementing new policies and measures with the aim to unleash digitalization in the country.

Highlights

1/ Establishment of the Digital Agency. The GoJ inaugurated the Digital Agency in September 2021. The newly established entity centralizes the government's budget for IT and takes the lead on policies initiatives related to the strategy for the digitalization of the country.

2/ Society 5.0. Ambitious policies were published over the past 5 years to encourage the shift toward "Society 5.0", which draws a society that leverages technologies such as AI, the cloud and the IoT to support the convergence of the cyber and physical spaces, as the government envisions.

3/ Next priorities in smart cities, disaster prevention and data platform. Main priorities of the 5 years Science, Technology and Innovation plan (STI) include the development of a strong platform to support collaborative data, the creation of smart cities and the development of solutions for disaster prevention.

4/ Set of policy measures for the realization of digital transformation. Main policy measures include investments in disruptive R&D programs, the creation of digital talents and appropriate IT infrastructures, the development of the startup ecosystem, as well as the provision of support and guidelines to encourage the private sector to adopt cutting edge technologies. In parallel, measures to materialize the digitalization of government services are implemented to evolve toward a strong e-government.

1.1 Digital Policy Background

1.1.1 Society 5.0

"Society 5.0" conceptualizes the vision and the aspiration of the country to leverage continuous technological transformation along all levels of the society and evolve toward a super smart society. The concept was first introduced in 2016 as part of the 5th Science and Technology and Innovation (STI) Basic Plan.

The plan describes the ambition of the government to create a society with **a high degree of convergence between cyber space (virtual space) and physical space (real space).** This includes the integration of digital technologies such as artificial intelligence (AI), Internet of Things (IoT) and robotics, which are meant to be at the service of economic growth and the realization of a human-centric society addressing social problems.

The **6th STI plan (FY 2021 – 2025)** further elaborates on the upcoming priorities in line with the Japanese social and economic challenges, along with technology and innovation as major topics. Moreover, the plan recognizes that the pandemic brought to light the fact that Japan was unable to fully benefit from digitalization in key areas, precisely administration, education and medical care, and further stresses the importance to gain maturity in these domains.

In this context, the government urges the needs to develop key digital technology areas to support the materialization of Society 5.0. Main targets as stated in the plan include the development of (1) collaborative data; (2) disaster prevention fields and (3) smart cities.

Measures to realize the plan emphasizes the importance of investing in R&D for next generation infrastructure, the development of a resilient data governance, the creation of a trustworthy and secure data distribution environment and the increase in digital talents. Moreover it highlights the need to ensure continuous review and issue of digital policies, as well as the contribution and collaboration with the international community.
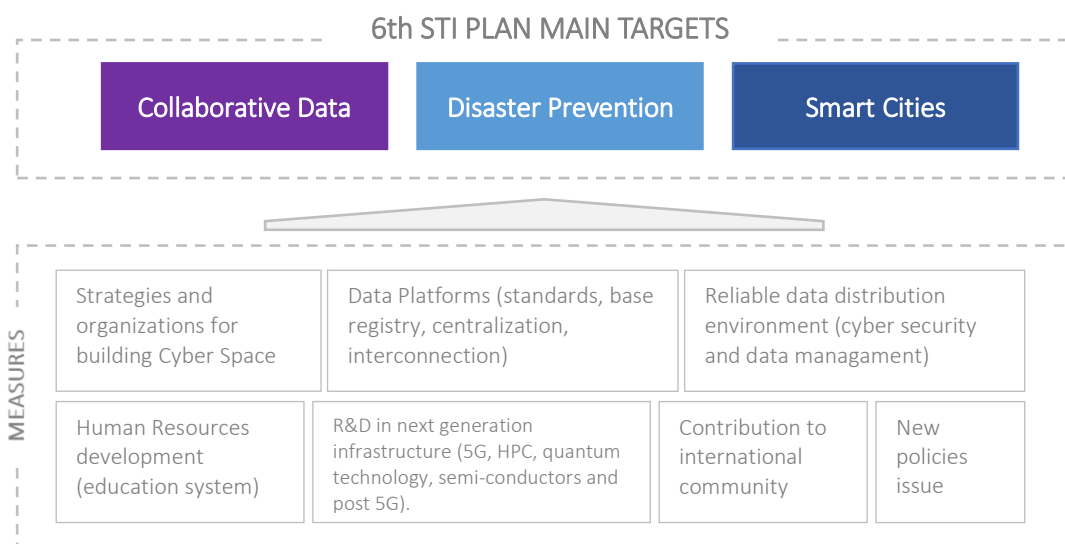
Figure 1 - 6th STI plan targets

1.1.2 Digital Strategies – Policies and measures

In the context of a rapidly changing society with the development of technologies constantly bringing disruptive challenges, the 6th STI plan aims to continuously **review and reevaluate measures** surrounding digitalization in order to support and build appropriate framework to create a safe space for the business and the society to strive and take initiatives to innovate. For this purpose, working groups and collection of experts' feedbacks are organized by ministries on a continuous basis to feed into political decisions, activate the vision of Society 5.0 and adapt policies, guidance and regulations accordingly.

Integrated innovation Strategy outlining next priorities in digital innovation

A notable policy that was compiled in June 2021 is the **Integrated Innovation Strategy,** drafted by the Cabinet Office, which outlines key measures for the coming year in the domain of digitization. The strategy incorporates new elements added to the 6th STI plan, including the promotion of the placement of next generation data centers, the development of manufacturing for advanced semiconductor technologies, R&D investment in quantum technology, the promotion of universities as regional cores and the review of the AI and biotechnology strategies to align with recent developments. Identified strategic sectors include safety and security (natural disaster, infectious diseases, and global outbreaks), environment and energy, health and medical care, space, oceans, as well as food and agriculture, leveraged by technologies such as robotics, AI, IoT or UAVs[5].

A human-centric approach to AI

In the key area of Artificial Intelligence, the **AI strategy**, initially drafted in 2017 and amended in 2021, outlines the upcoming initiatives and priorities when it comes to the domestic development of AI-based solutions. The strategy indicates measures to promote the education and the creation of digital talents, the support of the creation of AI R&D network and programs implementation to develop solutions for industries and the society. Key industry areas concern the development of AI solutions for healthcare, agriculture, national resilience for infrastructure and natural disasters, transport and infrastructure, regional revitalization through smart cities, as well as manufacturing. Moreover, the "Social principles for human-centric AI", published in 2021, establishes non-binding AI R&D and utilization principles to promote the development of human-centric solutions that are accepted and properly used by the society.

Toward the development of next generation ICT infrastructure

Another strategic domain is the development of appropriate **ICT infrastructures** that will support the digital transition. On top of the aforementioned STI plan and Integrated Innovation strategy, notable policies include the "**Beyond 5G Promotion Strategy—Roadmap towards 6G**" compiled in 2020 by the MIC, which outlines the strategy and the roadmap for the coming years. It establishes specific measures focusing on R&D, IP & standardization, as well as the deployment of faster communication infrastructures that will support the advanced synchronization of Cyber Physical Spaces. The strategy describes the objective to develop secure, accurate and energy efficient ICT infrastructure solutions that would rely on the deployment of optical networks and the cloud,

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[5] **UAVs**: Unmanned aerial vehicles, or commonly called drones.

on the development of terahertz waves and quantum technologies, as well as through the upgrade of 5Gs characteristics features including super eMBB, super URLLC and super mMTC[6].

Moreover, given the strategic role of quantum technologies and to pursue a leadership position in this domain, the **Quantum Technology Innovation strategy** was announced in 2020, initiating the creation of the national Quantum Security Hub, which conducts cutting edge R&D related to quantum networks and establishes a cooperation center for industries, academia and government entities.

Cybersecurity "for all", in response to an interconnected society

The security domain is also considered as a key component of the digital transition. The **Cyber Security Strategy,** issued in September 2021 by the NISC (National Center of Incident Readiness and Strategy for Cybersecurity), highlights the implementation policies and measures that will be undertaken in the coming three years. It aims to reinforce the overall literacy and awareness around cyber security, including governmental institutions, industries and SMEs. It further promotes efforts to strengthen the security of government agencies' IT systems and administrative areas, as well as ensures the safety of critical infrastructure operators. R&D in the security domain is also advocated to take measures against new threats emerging from the progress of AI, IoT and 5G, to conduct research on cryptography in relation to quantum computing solutions, as well as to develop sophisticated solutions that monitor and analyze cyberattacks. Moreover, international cooperation is also considered in order to share expertise, coordinate on policies and strengthen collaboration for incident response.

1.1.3 Government led R&D programs

R&D is highlighted as a key policy measure in the various strategies and plans promoting the digital transition of the government, the society and industries. The following lists the three main cross-ministerial and cross-sector strategic R&D programs, namely the SIP, the Moonshot Program and the PRISM, initiated under the supervision of the Government Office.

Cross Ministerial Strategic Innovation Program (SIP) to support industry innovation and early social implementation

SIP is a national project created by the Council for Science, Technology and Innovation of the Cabinet Office to realize science and technology innovation through the promotion of R&D around 12 key issues (for the 5 years term plan initiated in 2018), including a wide range of domains from cyber space infrastructure, security for IoT society, autonomous driving, quantum technologies, and many more [7]. It allocates its own budget beyond the boundaries of ministries and fields and promotes the industry, academia and government collaboration to conduct research with the ultimate goal to implement its practical application and commercialization.

Moonshot Research and Development Program to lead disruptive innovation

The Moonshot R&D Program aims to create disruptive innovation originating in Japan and

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[6] **Super eMBB** (Enhanced mobile broadband), **Super URLLC** (ultra-reliable and low latency communications) and **super mMTC,**(massive Machine Type

Communications), which are the 3 mains characteristics and main pillars of 5G.

[7] Refer to "Appendix 1 – SIP R&D themes (2018)" for the complete list of the covered domains.

promotes high-risk, high-impact R&D to solve issues facing future society such as super-aging populations and global warming. The objectives of the program are long term and aim for the realization of a society by 2040-2050, where AI, robots and technologies would coexist with human in harmony; medical and nursing would prevent diseases; resources and food supply would be sustainable and ensure global environment restauration; and where advanced IT infrastructures would ensure efficiency, security and reliability. Multiple ministries such as the MEXT, the METI, the MAFF, as well as government agencies, such as the JST or the AMED are participating to the development of the Moonshot program. Ongoing R&D projects include the development of intelligent human robots, cybernetic avatars or solutions for quantum computing[8].

Public/Private R&D Investment Strategic Expansion PrograM (PRISM) to guide ministries' investments in key strategic areas

Established in 2018, the PRISM's objective is to increase public-private R&D investment and improve the efficiency of fiscal expenditure by guiding the R&D policies of each government ministry and agency to areas where high private R&D investment inducement effects are expected. Target areas include R&D projects in relation to infrastructures management and innovative technologies for disaster prevention and mitigation, AI based solutions, biotechnology domain, as well as quantum technology areas.

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[8] Refer to "Appendix 2 – Moonshot R&D Program" for the complete list of ongoing projects.

1.2 Materializing Society 5.0 – Digital Agency, Smart cities and support of the private sector

1.2.1 Digital Agency

In response to the failure of building a digitally advanced public sector and in line with the objective of the 6th STI plan to setup an organization that would support the development of the cyber physical space, the government has inaugurated in September 2021 its new **Digital Agency (DA)**.

The DA benefits from enhanced authority and centralizes Japan's governmental decisions in relation to digitalization. It takes the role of overall coordinator of digital policies and has the power to advise heads of related agencies, while most of the governmental IT budget is now controlled by the agency, instead of individual ministries. The DA announced its plan FY2022 supported by a budget of ¥ 472 billion (€3.6 billion)[9], identifying the following priorities in line with the STI plan as described earlier.

[1] The development of centralized data platform through the standardization and unification of admin services by 2025. A centralized cloud platform will be in implemented to replace the current local and scattered digital landscape. Concrete initiatives include the centralization of the MyNumber system (citizens ID), as well as the development of data base registries standards by 2030.

[2] The digitalization of public services related to medical care, education and disaster prevention, with the aim to implement the "cloud by default" principle.

[3] The provision of support and infrastructure for the digital transition of all industries including 5G, optimal data center, improved administration for corporate services and the increase of digital talents.

Given its recent inauguration, the role and responsibilities of the DA are still being discussed and negotiated. It is certain that it has become a key national reference for international discussions and the window for future cooperation around digital domain.

1.2.2 Smart Cities

A key initiative undertaken by the GoJ toward the realization of Society 5.0 are Smart Cities. The 6th STI plan established the target of implementing **100 initiatives[10] by 2025**, with the contribution of 1 000 or more organizations involved from the local government, regional organizations and private enterprises.

In order to facilitate public-private partnerships and the development of regional projects, the "Smart city public-private partnership platform" was initiated in 2019, gathering members such as companies, research institutes, related ministries and agencies. This platform aims to create a common place for the public and private sectors to work together and promote initiatives across the country through the provision of business and matching support, as well as through dissemination promotion activities.

To further support implementation, the cabinet office published in 2021 the "Smart city

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[9] Digital Agency, デジタル社会の形成に関する重点計画・情報システム整備計画・官民データ活用推進基本計画について, [*Priority Plan for the Formation of a Digital Society, Information System Improvement, and Basic Plan for the*

Promotion of Public-Private Data Utilization], published on 24/12/2021.
[10] Number of local governments and regional organizations that implement technologies, link and connect data between fields.

guidebook" with the aim to provide examples and advices based on success and failures collected from use cases. Moreover, through the provision of the "Smart city reference architecture guidelines", it encourages the regions to promote local adoption of standard systems that have an interoperable function with other regions, in order to maintain national connectivity.

Currently ongoing and future projects in relation to smart cities give priority to implementation programs for mobility, healthcare and government administrative services.

1.2.3 Diffusion of digitalization across the private sector.

Guidelines and helpdesks to support corporate digital transition

The GoJ has started publishing **guidelines** over the past 3 years to promote the digital transition of the private sector and provide practical support, in particular to onboard SMEs. Examples include guidelines published under the initiative of the METI and the MIC to promote digital transformation within organizations, with guidance specifically targeting SMEs. Similarly guidelines for AI, cybersecurity and for secure cloud services implementation were published in 2021. Other examples include the publication of similar documentation by the MIC to facilitate the implementation of local 5G, as well as a set of guidelines for UAV applications in plants and in the domain of delivery of luggage.

On top of practical guidance, ministries and local prefectures launched various **helpdesks** contributing to the support for SMEs to take initiatives to digitalize:

[1] **Telework helpdesk**. The Ministry of Health, Labor and Welfare has introduced a telework helpdesk center, which provides support, guidance and consultations in relation to labor management issues when introducing and implementing telework.

[2] **The digitalization support initiative** from the METI provides financial support and network of IT professionals for SMEs looking into solutions to initiate their digital transition. Activities include support for creating EC website, advices for implementing online meetings, RPA or telework, as well as the provision of materials and guidebooks to leverage IT tools.

[3] In the manufacturing domain, **Public Industrial Technology Research Institutes** support SMEs with a range of services including technology guidance, technical assistance and trainings. The institutes are operated under the guidance of the METI and in general, funded and managed by local prefectures. Activities of the centers include R&D projects, provision of equipment for prototyping and industrial production trial incorporating advanced technologies (e.g. sensor- enabled devices, embedded intelligence, 3D printing, and many others).

Governmental initiatives for promoting innovation and the startup ecosystem

Multiple initiatives are undertaken at central government, ministries and regional levels to actively promote innovation in the startups and SMEs' ecosystems. The strategy "*Beyond Limits. Unlock Our Potential*" published by the METI in 2019 highlights the government's approach to expand the startup ecosystem, relying on 7 key pillars.

[1] the creation of a city startup ecosystem, by introducing cross-ministerial support through the provision of appropriate human resources, infrastructure, funding and community, as well as through the collaboration with global

startup bases and the organization of startup events.

[2] **the empowerment of universities,** through the enhancement of entrepreneurship education in schools, the development of capacities in universities and the enhancement of activities for innovation such as hackathons and boot camps.

[3] **the set-up of acceleration programs**, by initiating collaboration with global top accelerators and with the creation of domestic acceleration programs in specific fields such as AI, bio and space. Recent examples include the Intellectual Property Acceleration Program (IPAS2021) undertaken by the Japan Patent Office, aiming to support 20 startups in developing an IP strategy FY 2022. Other programs run by the NEDO include the Technology Commercialization Program (TCP) or the NEDO Entrepreneurs Program (NEP).

[4] **the gap funding for tech startup,** for example, through the Small Business Innovation Research (SBIR) system, supervised by the SME agency. The system aims to strengthen the management of SMEs through the promotion of new business activities by providing subsidies for R&D. Since 2020, in line with the new STI plan and the growing importance of digitalization, the purpose of the program is now focusing on R&D contributing to the creation of innovation by start-up and SMEs, accompanying them from early stage technology seeds to their commercialization.

[5] **the public procurement for startups**, with the organization of Open Innovation Challenges and through the activation of procurement programs at local government levels.

[6] **the enhancement of networks** through the promotion of open innovation among industries, universities, governments and startups. The NEDO, J-startup, JETRO, as well as the Japan Science and Technology Agency are among the key governmental organizations supporting the development of such network.

[7] **the increased mobility of human resources** with the mobilization of human resources for R&D.

02 CURRENT SCENE OF DX IN JAPAN

For both the public and the private sectors, DX implementation and the adoption of advanced technologies are expected to contribute to respond to structural challenges such as the ageing workforce and the comparatively low productivity, but also revitalizing the country's economy through entrepreneurial innovation.

Based on facts and figures, this chapter provides an overview of the current state of DX in the business landscape and trends in digital technologies adoption, with a focus on disparities according to company sizes and industries.

Highlights

1/ The private and public sectors show low maturity in DX. Although general awareness has been rising around DX, Japan lags behind its country peers – e-government and corporate digital transitions are showing comparatively low maturity. DX in Japan corporate landscape is led by large corporations, while SMEs show weaknesses in the adoption of most of technology solutions areas.

2/ Improvement of Business Process Operations as the main priority. When it comes to DX, main priorities for the business concern digital transformation to improve business process operations. Adoption of technologies to develop new products/services remains low among established companies.

3/ Fragmented adoption of technologies according to industries. Overall, the financial and social infrastructure sectors show the highest technology adoption, in particular for back office solutions, RPA and AI. Connected devices and IoT are striving in the manufacturing and construction sectors, while advanced solutions such as the blockchain, drones and robotics show low corporate adoption rate and strive in niche industries.

4/ Priorities for future investments differ according to company sizes. Large organizations with higher revenues indicate a priority for future investments in advanced technologies such as AI, big data and IoT, with an increased concern on cybersecurity and data visualization. In contrast, companies with lower revenues prioritize investments in back office supporting tools such as electronic approval and contracts, stamping systems or the implementation of public cloud solutions.

2.1 Snapshot of the digital scene in Japan

Ranking as **#28 in the IMD Digital Competitiveness** metric in 2021, it is no longer a choice for Japan to digitalize but rather an imperative to maintain its top 3 economy position in the near future. Moreover, Japan's index has not progressed in 5 years, while other Asian nations such as China, South Korea and Hong Kong have been working hard to effectively scale their digital learning curve[11].

Digital and Global Competitiveness #28	Digital Industry 6.76% ecommerce penetration (BtoC retail)	Digital Technology and leadership 3% Public cloud spent (% IT spent) 6% Global AI Conference papers
Digital Talent 1% of workforce as digital talent	5% Telemedecine Penetration	
Digital Government Infrastructure #84 (Tokyo) in IMD Smart City Ranking 7.5% Citizens using digital gov. apps	6.9% Mobile banking Penetration	Startup Economy 11 unicorn startups in 2021

Figure 2 - Japan Digital Score Card 2021

Japan is characterized by the stability of its business environment and society as well as by a general high quality of infrastructure and services, including ICT infrastructures, communication technologies, education and healthcare. This steady environment led to little urgency for change, including the need to shift to digital. The effects can be observed on the scorecard highlighting gaps in multiple key areas.

The low rate of **digital talents**, who master technologies and transformation expertise, is reflected in the poor adoption of **digital within industries** - where ecommerce, telemedicine, mobile banking and manufacturing indicate a single digit penetration level.

The limited digitalization is also reflected in the **digital maturity of the government**, where Tokyo

is ranked #84 in the IMD Smart city ranking in 2021, positioning last among the OECD countries for digital procedures, while digital government apps adoption rate is at a mere level of 7.5%.

Finally, Japan's **startup economy** is showing relatively poor results in comparison to its peers with 11 startups reaching the status of unicorns in 2020, where the US and China have respectively counted 400 and 150 the same year[12].

Japan has faced low and decreasing productivity over the past ten years

Japan has been facing a decrease in labor productivity over the past ten years, where the gaps with peer countries has grown significantly.

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[11] In 2017-2021 period, China climbed from 31st to 15th, South Korea from 29th to 23th and Hong Kong from 7th to 2nd.

[12] World bank (2021), *Tokyo Start-up Ecosystem*, published on September 2021

In the context of low birth rate and aging society, it is crucial for Japan to improve its productivity metrics, where digitalization is expected to play a key role and help restoring its competitiveness. A report from 2020 McKinsey Global institute analysis estimated that AI, and more precisely machine learning, will contribute to the automation of about 19 million jobs between 2018 and 2030, with a major impact on discrete repetitive tasks.

On the other hand, the demand for new occupations and functions in areas such as cloud engineering or machine learning is expected to grow to 15.6 million, urging the need for Japan to prepare and create digital talents with appropriate skills to respond to those positions and secure the country toward its digital transition.

Japanese companies are 2 years late in comparison to global average when it comes to DX.

From an industry point of view, Gartner Japan revealed through its annual CIO survey that Japanese companies are accelerating their digitization efforts. This is illustrated in figure 4 by an increased maturity in digital business transformation from 33% in 2018 to 48% in 2020. However, in comparison to global peers, Japan corporation landscape remains 2 years behind the global trend line, positioning 10 points behind on average.

Figure 3 - Comparison of global workforce productivity (2020)

Figure 4 - Gartner 2021: CIO Agenda on Digital Transformation
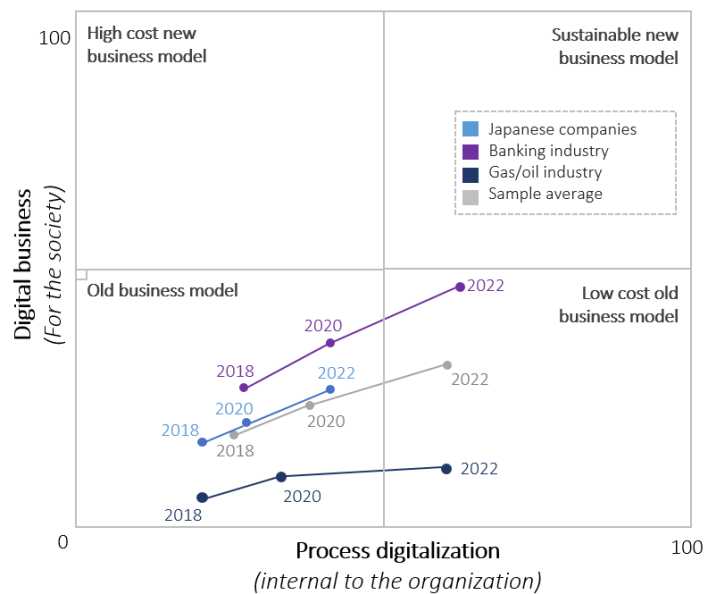
N= 1831, of which 146 Japanese corporations, 196 from banking industry, 33 from oil/gas.

Source : Cabinet Office, 企業活動のおけるデジタルトランスフォーメーションの現状と課題 (2021)

Source : Gartner Press release, ガートナー、日本企業のデジタル化は加速しているが、世界のトレンド・ラインより約 2 年の後れを取っている、との見解を発表

2.2 DX promotion and adoption

Since 2018, the private sector has shown an increasing recognition of DX and has demonstrated efforts to integrate the concept, cross sector and cross company size[13]. Surveys conducted by the METI[14] and FUJITSU[15] in 2020 indicated that almost half of the SMEs were actively promoting DX companywide, while large companies with more than 5.000 employees indicate an adoption rate close to 80%.

Although these results are rather positive at first glance, the IPA self-evaluation survey, launched under the initiative of the Japanese government, helps providing further nuance to the aforementioned adoption rates through an analysis of DX per maturity level. The survey collects cross-sector/cross-company size information about firms' initiative in DX, scaling their maturity from the absence of digitalization strategy (score equal to zero) to the level of globally competitive digital company (score equal to five). The governmental target is to encourage firms to reach **at least level 3**, which characterizes firms that have achieved cross-departmental DX. The results from end 2020 highlight that **only 5% of the surveyed firms** have achieved the target level (see. figure 5).

This demonstrates that although most of the companies have effectively undertaken initiatives toward DX, the maturity level of the implementation remains poor in most of the cases, characterized by **isolated implementations within organizations with a lack of companywide strategic vision.**

Figure 5 - IPA DX self-evaluation - 2020

DX Maturity Level	
Level 0	Not implemented
Level 1	Sporadic adoption in limited departments
Level 2	Strategic adoption in limited departments
Level 3	Promotion of cross-department strategic adoption
Level 4	Sustained cross department strategic adoption
Level 5	Globally competitive digitalized company

~95% did not or implemented DX partially within the organization

~5% reached DX cross – department implementation within the organization

Source: METI, *DX レポート 2, [DX report 2], December 2020*

[13] Ministry of Economy, Trade and Industry, *DX レポート IT システム「2025 年の崖」の克服と DX の本格的な展開, [DX Report : Overcoming of « 2025 Digital Cliff Involving IT Systems and Full-fledged Development of Efforts for DX»],* published on 07/09/2018, Accessible at : https://www.meti.go.jp/press/2018/09/20180907010/20180907010-3.pdf.

[14] Ministry of Economy, Trade and Industry, *令和 2 年度中小企業のデジタル化に関する調査に係る委託事業 報告書,*

[2020, Report on SMEs Digital transformation], published on 03/03/2021, Accessible at https://www.meti.go.jp/meti_lib/report/2020FY/000260.pdf.

[15] Fujitsu, *日本の DX は本当に遅れているのか？「DX サーベイ」から見る 900 社の実態, [Is Japan DX late ? Observed from 900 companies in the 'DX Survey'],* published on 17/04/2020, accessible at https://blog.global.fujitsu.com/jp/2020-04-17/01/ , accessed on 06/09/2021.

Improvement of business processes and cost reduction remains the priority on digital agendas

A survey conducted by Accenture[16] provides further insights about DX areas where digital initiatives were particularly undeveloped in Japanese established firms:

- **Lack of partnership with digital players and poor ecosystem**: Particular weaknesses are observed in the ability of organizations to collaborate and create partnership with digital players (such as ventures or digital vendors) to set up an effective digital ecosystem. This is also true for large organizations, which already benefit from a wide network, however struggle to find the best and most suitable partners.

- **A positive evolution is observed in the creation of new products and services leveraging DX, however is still at a premature stage**: As an illustration, only 13% of established SMEs consider the creation of new products and services as their number one priority when undertaking DX initiatives, although it is worth mentioning that those considerations evolved positively with the impact of the COVID-19[17], demonstrating the slow but growing interest of organizations in transforming their business model.

- **Digitalization of user experience remains immature:** Digitalization of user experience including - omni-channel approach, dynamic pricing practices, development of innovative and personalized products/services – remains in overall underdeveloped across all sectors.

- **Insufficient digitalization of operations:** When it comes to the digitalization of operations, important gaps are observed in the digitalization of R&D activities. Moreover, manufacturing and logistic processes also appear to show room for progress, while agile project management remains under promoted.

When it comes to organizations' next priorities for strategic digitalization, companies are considering the **improvement of business processes -** including the streamline of business processes, the improvement of production processes, as well as the transformation of companies' ways of working (ref. Appendix 3). Those areas were also the ones that were the most reconsidered in response to the COVID-19 pandemic.

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[16] Accenture, *業種別・企業規模別の DX の状況と課題が明らかに 〜DX サーベイの調査・分析結果から見る日本企業の現状, [DX survey, analysis of state of Japanese firms, Insight on DX adoption based on industry and company size]*, published on 22/06/2021, Accessible at: https://www.accenture.com/jp-ja/insights/local/dxsurvey, accessed on 06/09/2021.

[17] Ministry of Economy, Trade and Industry, *令和 2 年度中小企業のデジタル化に関する調査に係る委託事業 報告書, [2020, Report on SMEs Digital transformation]*, published on 03/03/2021, Accessible at https://www.meti.go.jp/meti_lib/report/2020FY/000260.pdf.

2.3 Measuring key technologies adoption trends

The previous section provided an overview of the general strategic positioning and vision of Japanese firms toward DX. This section aims to deep dive into **key technologies adoption metrics** to better understand upcoming trends and disparities according to company sizes and industries.

2.3.1 Overview of key technology metrics

Digital technology		Technology adoption rate - per industry							- per size	
		Construction	Material manufacture	Machinery manufacture	Retail and wholesales	Financial	Social infrastructure	Services	Large companies	SMEs
Data Analytics	Management Dashboard	9.5	12.6	18.1	12.4	14.6	10.6	10.9	39.6	4.3
	Master data Management	29.8	21.8	28.5	31.4	25	30.9	22.2	58.5	18.4
	Big Data	11.9	10.2	11.9	11.9	16.7	17	8.7	45.3	2.5
Cloud	Private cloud	35.7	39.3	40.4	35.7	56.3	52.1	34.8	84.9	23
	Public cloud (IaaS, PaaS)	45.2	46.6	52.2	44.8	58.3	58.5	56.1	90.6	33.3
	Public Cloud (SaaS)	59.5	60.7	65.2	58.6	60.4	69.1	61.7	94.3	47.9
Advanced solutions	IoT	20.2	21.4	26.3	13.8	6.3	23.4	8.7	58.5	6.7
	AI	16.7	14.6	15.9	9.5	33.3	19.1	15.2	66	5.7
	Blockchain	2.4	2.4	1.9	1	6.3	0	0.9	11.3	1.4
Intelligent devices	AR/VR	20.2	3.4	7.4	2.4	0	11.7	7.8	30.2	3.5
	Wearable Devices	14.3	4.4	8.5	3.3	4.2	12.8	5.2	26.4	1.8
	Robots	9.5	18	28.9	8.1	6.3	17	9.6	39.6	6.4
	Drones	38.1	7.8	6.7	2.4	4.2	16	7.4	34	3.9
Back Office	Business Chat	51.2	41.3	51.1	42.4	43.8	50	54.3	86.8	37.9
	Electronic approval, stamping, contract syst.	41.7	26.7	32.6	25.2	45.8	34	32.2	54.7	19.9
	RPA	47.6	44.2	50	40	77.1	56.4	40	92.5	20.6
IT infrastructure	Mobile Device Management	57.1	46.6	54.8	41.4	50	53.2	44.8	84.9	30.9
	Mobile Application	48.8	28.2	41.5	32.9	66.7	48.9	39.6	83	24.1
	Enterprise architecture	6	3.4	8.1	4.8	16.7	9.6	4.8	30.2	1.1
	VPN	78.6	78.6	87.4	71.9	72.9	76.6	70.9	96.2	67
	5G	0	0.5	0	0	0	2.1	0.9	3.8	0
	Zero Trust Security	2.4	4.9	4.4	1.9	12.5	2.1	3.9	9.4	3.9

Table 1 - Overview of key technology metrics (technology adoption rate in %)

Cross industry adoption rate

Lowest   *Highest*
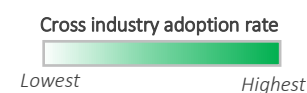
The financial, social infrastructure and manufacturing industries are leading in corporate digital technologies adoption

The *Table 1 - Overview of key technology metrics* [18] provides further information about technology adoption per industry, classified into seven categories. Results indicate the social infrastructure (incl. energy, ICT, distribution and communication sectors), financial industries and machinery manufacturing sectors show overall higher technology adoption rate in comparison to other industries. While the financial sector seems to have relatively more maturity in the digitalization of back office processes and data analytics, it also shows a strong adoption of AI. On the other hand, the social infrastructure industry also shows a relatively high adoption when looking at the technology categories as a whole. The construction sector shows higher adoption rate in connected devices, including AR/VR, wearable devices, as well as drones. Finally, the machinery manufacturing industry seems to lead in the adoption of IoT solutions and in robotics.

Those figures show the complexity of the DX ecosystem and demonstrate that there is a strong industry factor when it comes to measuring the impact of digital technologies on the business environment.

Large corporations show higher adoption rate in all technologies, while next priorities in technology adoption differ according to company sizes

When it comes to technology adoption according to company size, large companies' adoption rates are significantly higher than the ones of the SMEs for any type of technology (Refer to Table 1). Those differences in digital maturity are reflected by disparities in **next priorities for corporate technology investment.**

For SMEs, main technologies of interest for the years to come concern back office supporting tools such as electronic approval and contracts, stamping systems or the implementation of public cloud solutions such as SaaS[19], IaaS or PaaS. This highlights that **SMEs are still in the process of improving the digitalization of the systems and infrastructures to support their business operations.** It is also worth noting that interest in more advanced solutions such as IoT and AI solutions is also relatively high.

In contrast, the **next top priorities for large organizations** with higher revenues indicate a focus on

Figure 6 - Next priorities for corporate technology investment (%)

Firms with revenues under ¥ 10 billion

Digital contracts/ signature/ stamps	13.8
Public Cloud (SaaS)	8.5
RPA	7.4
IoT	7.1
AI	7.1
Public Cloud (IaaS, PaaS)	7.1
VPN	7.1

Firms with revenues above ¥ 1 trillion

AI	17
Big Data	17
Zero Trust Security	15.1
IoT	9.4
Public Cloud (SaaS)	7.5
Public Cloud (IaaS, PaaS)	5.7
Management Dashboard	5.7
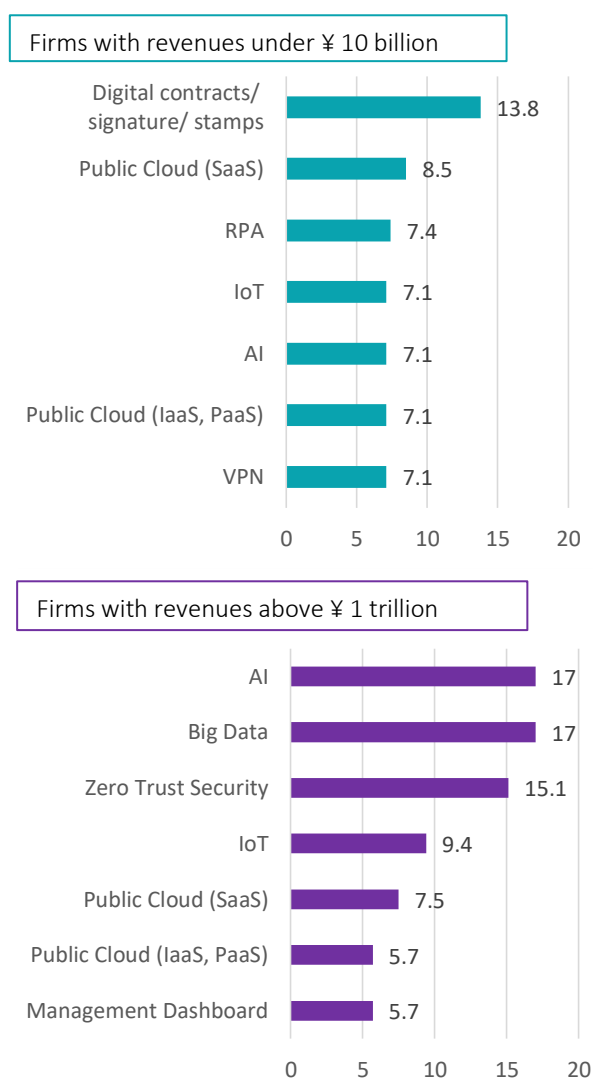
Source: JUAS, *企業 IT 動向調査報告書 2021*, *Corporate IT Trends Survey Report 2021*

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[18] Refer to Appendix 4 for more details about the survey methodology and composition of survey respondents.

[19] **Software-as-a-service (SaaS)** is a kind of cloud computing in which a third-party provider manages applications and makes them accessible to consumers over the internet. It removes the need for organizations to install and run applications on their computers or in their data centers, which eliminates the cost of hardware acquisition, provisioning and maintenance as well as software licensing, installation and support.

advanced technologies such as AI, big data and IoT, with an increased concern on cybersecurity and data visualization. This suggests large corporations are **moving toward the integration of more innovative technologies** into their business and operating models. Cloud adoption also remains among the top ranking of the next technologies to invest in.

These observations are in line with the earlier conclusion that digital transition of the established corporate landscape is led by large corporations, whereas smaller firms characterized by lower revenues are positioning as later adopters for any type of technology.

Trends suggest IoT and AI as high in importance degree for future corporate investments - cloud and RPA to be the future norm - while growing interest is observed in data analytics and zero trust security

The figure below helps to better understand the upcoming technology trends in the Japanese business ecosystem. Based on the survey conducted by JUAS[20], it takes into consideration the **current implementation rate,** as well as the **degree to which the technology is perceived as promising for investment** by the Japanese firms. The arrows indicate the comparison with the results from 2019.

Figure 7 - Key technology trend in Japanese corporate landscape (2020)
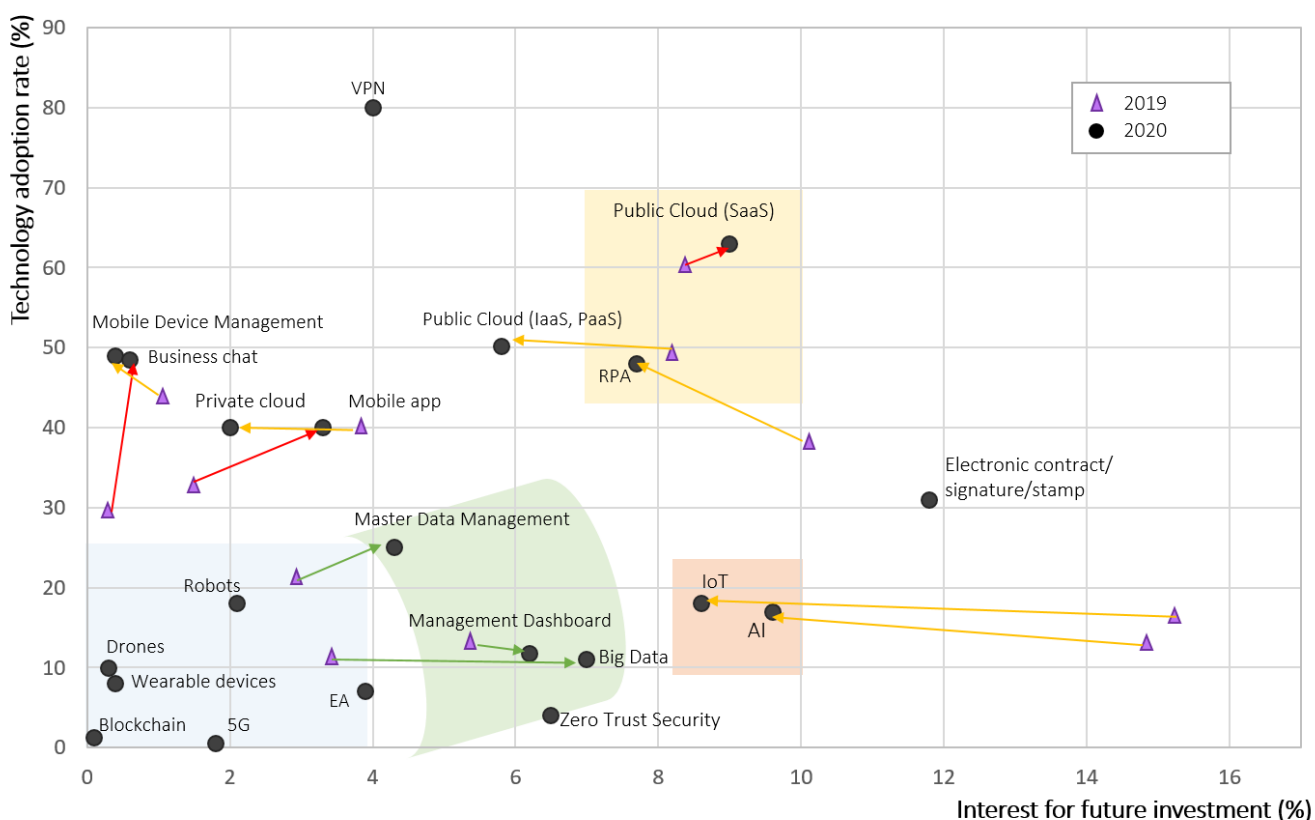
Source: JUAS - Corporate IT Trends Survey Report 2021
N=1146, based on an online survey conducted from 9/11/2020 to 27/10/2020. For more details about the methodology and the sample, refer to Appendix 4.

The graph highlights 5 trends that can be divided into the following groups:

COVID-19 effect: technologies which have benefited from growth in adoption in response to COVID-19.

Popular technology solutions: technologies that have comparatively higher adoption rate and which are also perceived as important for future investments.

Growing technology solutions: technologies which currently indicate a low adoption rate, however are perceived as highly important for future investments.

Promising technology solutions: technologies that have a low adoption rate, which have seen a growing interest in future investments over the past year.

Untapped technology solutions: technologies which show low adoption rate, as well as low interest for future corporate investments.

It is worth considering that the graph reflects the trends for the corporate ecosystem as a whole (cross-sector, cross company size) and **is very likely to vary based on the assessed industry**, as highlighted by the *Table 1- Overview of key technology metrics*. The following sections deep dive into each trend in order to capture the industry effect.

2.3.2 COVID-19 effect

The figure 7 showed that a set of digital solutions have benefited from an increase in adoption in 2020, very likely in response to the pandemic.

COVID-19 as a momentum to adopt business chat and back office solutions

Business chat, mobile device management, public cloud SaaS solutions and **digital signatures systems** have seen an important increase in adoption from the period 2019-2020, cross-sectors and cross-company sizes. Those are very likely linked to the effect of the COVID-19 and the need for firms to find solutions in response to the transition to remote working. The pandemic has pushed companies to implement telework, which requires supporting IT infrastructure such as cloud solutions and mobile applications, as well as communication tools such as software solutions for business chat.

On the other hand, the adoption of digital signature, electronic stamping and contract has shown growing interest to facilitate business exchange and contractual management, suggesting business operations and administration is increasingly relying on digital solutions. This represents an important change in Japan, which is particularly known for its paper based administration.

Figure 8 - COVID-19 effect on digital technology adoption
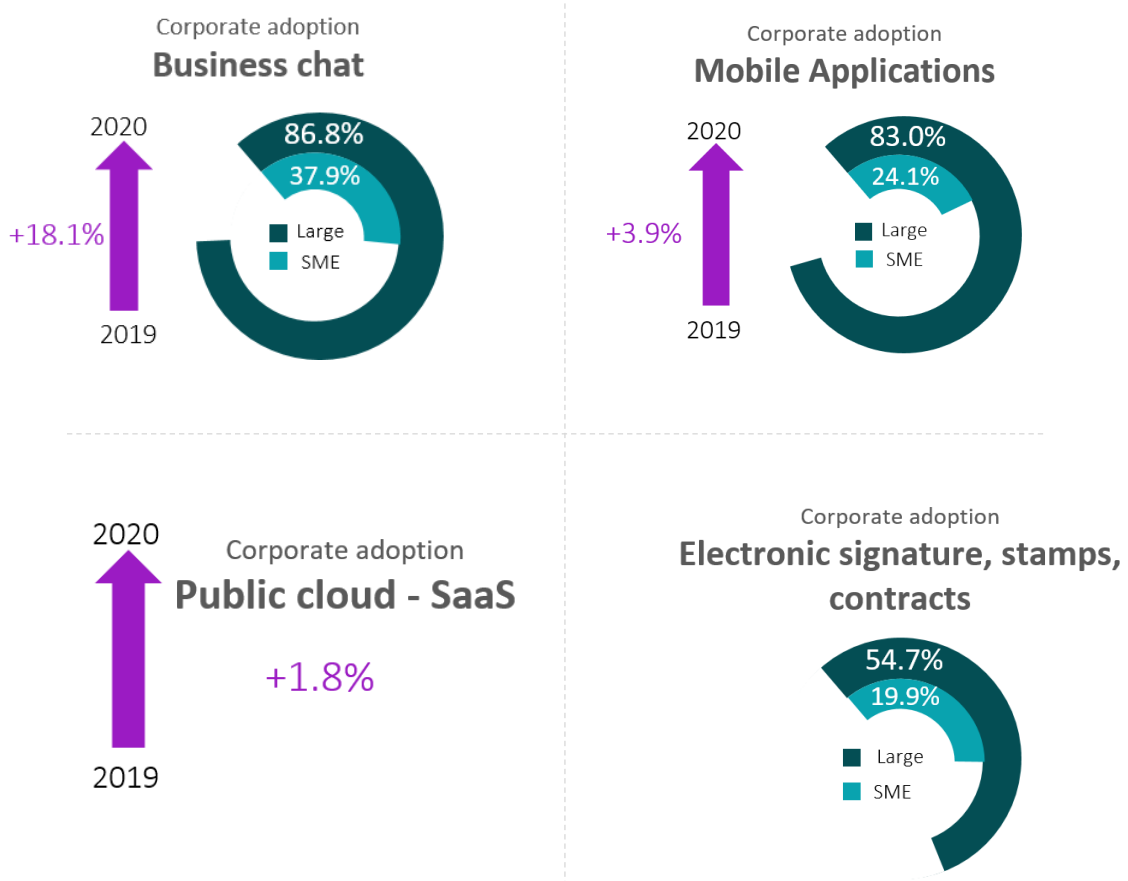
Source: JUAS, 企業 IT 動向調査報告書 2021, Corporate IT Trends Survey Report 2021
"Large" refers to companies with revenues greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

2.3.3 Popular technology solutions

Cloud solutions as well as **Robotic Process Automation (RPA)** are classified among technologies that are already normalized with a comparatively higher adoption rate and which degree of importance for future investments remains high.

Cloud Computing

Rapid increase in the adoption of cloud solution, however room for progress remains

Japan's public spending on cloud services is classified among the lowest, while Gartner estimated the country is lagging 7 or more years behind the US [21]. Despite comparatively low penetration, it appears that corporate adoption is progressing quickly, as the penetration rate raised by 16 points for SaaS and 14 points for IaaS and PaaS in 5 years, supported by a rapid growth in back office use. Unsurprisingly, cloud adoption rate has a positive relationship with the company size, where at least 9 large companies out of 10 have adopted it, whereas smaller companies indicate an adoption rate more than twice lower.

Among the type of available cloud computing services, firms have shown particular interest in SaaS solutions, largely benefiting from a rapid growth directly resulting from the effect of the COVID-19, as well as the increase in induction of web conference solutions[22].

Figure 9 - Corporate adoption of cloud solutions

Public cloud - SaaS

+16.2%
46.0% (2016) → 62.2% (2020)
2016 - 2020

94.3% Large
47.9% SME

Public cloud – IaaS & PaaS

+13.7%
37.2% (2016) → 50.9% (2020)
2016 - 2020

90.6% Large
33.3% SME

Source: JUAS, 企業 IT 動向調査報告書 2021, *Corporate IT Trends Survey Report 2021*
"Large" refers to companies with revenues greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

Robotic Process Automation

High adoption of RPA in large corporations, smaller organizations are catching up – financial industry is leading

RPA solutions have revolutionized back office repetitive tasks, automating and performing rapidly business process of yesteryear completed by humans using high performance cognitive technologies such as rule engine, AI and machine learning. In a context of low productivity and ageing population, the technology is very popular as indicated by the very rapid increase in corporate adoption, which rose by 43.1 points from the period 2017-2020.

While it has become the new norm for largest companies to have such technology in place, smaller organizations still indicate room for further adoption, as only 1 company out of 5 implemented such solution in 2020.

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[21] Gartner, *Cloud Adoption: Where does your country rank?*, Published on 19/08/2019, Accessible at:
https://www.gartner.com/smarterwithgartner/cloud-adoption-where-does-your-country-rank/ , Accessed on 08/09/2021.
[22] Gartner, 日本企業のクラウド・コンピューティングに関する調査結果を発表, [*Presentation of survey results on cloud computing adoption of Japanese firms*], published on 14/06/2021, Accessible at: https://www.gartner.co.jp/ja/newsroom/press-releases/pr-20210614 , Accessed on 07/09/2021.

RPA practices are particularly common in the **banking and financial industry**. Indeed, as the industry deals with a tremendous amount of data due to the nature of its activities (e.g. financial, market transactions), RPA solutions allow to automate a large amount of repetitive back-office tasks such as generating financial reporting or performing customer background screening, for example for loan processing or Know Your Customer (KYC) processes. Alternative use cases exist in fraud detection and more commonly in other sectors for automating tasks to manage accounts payable.
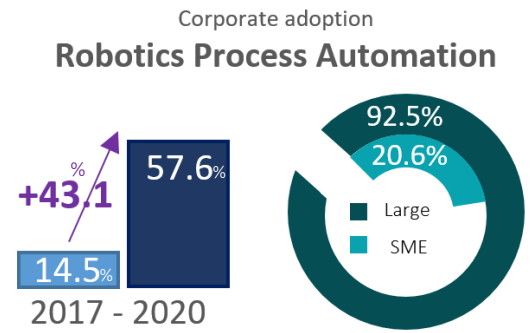
Corporate adoption
Robotics Process Automation

+43.1%

57.6%

14.5%

2017 - 2020

92.5%
20.6%

- Large
- SME

Source: JUAS, 企業 IT 動向調査報告書 2021, *Corporate IT Trends Survey Report 2021*
"Large" refers to companies with revenues greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

Interest for future investment in RPA remains high, in particular for SMEs which are expected to catchup

RPA is expected to continue growing in the near future as it shows particularly high interest from small organizations, which classified it as the third priority in technology investment, as shown earlier in figure 6. Expected benefits are particularly high as, if properly implemented, RPA solutions lower costs of workforce, free up time for skilled employees to focus on primary tasks and streamline enterprise operations, resulting in an overall increase in productivity.

2.3.4 Growing technology solutions

Among technologies growing and promising for the near future, Artificial Intelligence (AI) and the Internet-of-Things (IoT) attract attention from the business, as those indicate a relatively low adoption rate but a high interest for future investment.

Artificial Intelligence and the Internet-of-Things

Corporate adoption of AI and IoT remains low in Japan but is progressing positively

Cross sector and cross company size, AI and IoT indicated a respective average adoption rate of 15.2% and 18% in 2020, as measured by JUAS's survey[23].

The average adoption is evolving positively and fast for AI, as companies which were conducting proof of concept are progressively adopting the technology, while the interest of firms which have not induced it yet is growing. The trend is further encouraged by the fact that early implementers are starting to observe positive return on investment, in particular when it comes to increase in productivity, reduction of costs and innovation in products & services[24].

AI and IoT are mostly adopted for the purpose of improving business efficiency and cost reduction

Regardless of company sizes and industries, AI and IoT mostly find their usage for the purpose of improving business efficiency.

Figure 11 - Corporate adoption of AI and IoT

Source: JUAS, *企業 IT 動向調査報告書 2021, Corporate IT Trends Survey Report 2021*
"Large" refers to companies with revenues greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

Currently, AI integration is led by the **financial industry** showing implementation level twice larger than the other industries[25]. Financial and banking sectors are favorable for AI integration as they generate a large amount of information, such as payment or financial trade data. Use cases of AI integration include automated credit risk assessment, fraud detection, financial advisement to customers and analysis of trading trends. The use of AI for market expansion, raise of competitiveness or products & services upgrade remains rather limited in established firms and is not common in practice[26], despite growing positive returns on investment observed by early adopters.

On the other hand, IoT is led by the **manufacturing sector in machinery and equipment,** which represents the largest penetration rate with a quarter of the companies that have introduced the technology, followed by the manufacturing industry in raw material (21.4%) and the construction

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[23] JUAS, *企業 IT 動向調査報告書 2021, [Corporate IT Trends Survey Report 2021]*, 2021, Accessible at https://juas.or.jp/cms/media/2021/04/JUAS_IT2021.pdf.

[24] PWC, *2021 年 AI 予測調査 (日本), [2021, AI predictions]*, published on April 2021, Accessible at: https://www.pwc.com/jp/ja/knowledge/thoughtleadership/2021/assets/pdf/2021-ai-predictions.pdf.

[25] JUAS, *企業 IT 動向調査報告書 2021, [Corporate IT Trends Survey Report 2021]*, 2021, Accessible at https://juas.or.jp/cms/media/2021/04/JUAS_IT2021.pdf.

[26] Cabinet Office, *Information and Communication White Paper; Current Status and Issues of Digital Data Utilization (2020)*

industry (20.2%). Half the companies use IoT for business improvement (increase in productivity, reduction of costs), while almost 4 out of 10 are using it for the purpose of visualizing live situations. In contrast, the proportion of established firms using IoT for the creation of new business is rare and represents only 15% of the cases.

Forecasts predict AI and IoT will create tremendous value in the manufacturing and retail industry

According to a report published by the METI[27] analyzing the impact of AI on SMEs, it is foreseen that the technology will generate large value particularly for the manufacturing, retail, service and construction sectors in the coming years. This, through the development of predictive maintenance and demand forecasts, as well as through improved accounting operations and marketing practices.

Figure 12 - Forecast of the economic impact of AI on Japanese SMEs - By 2025
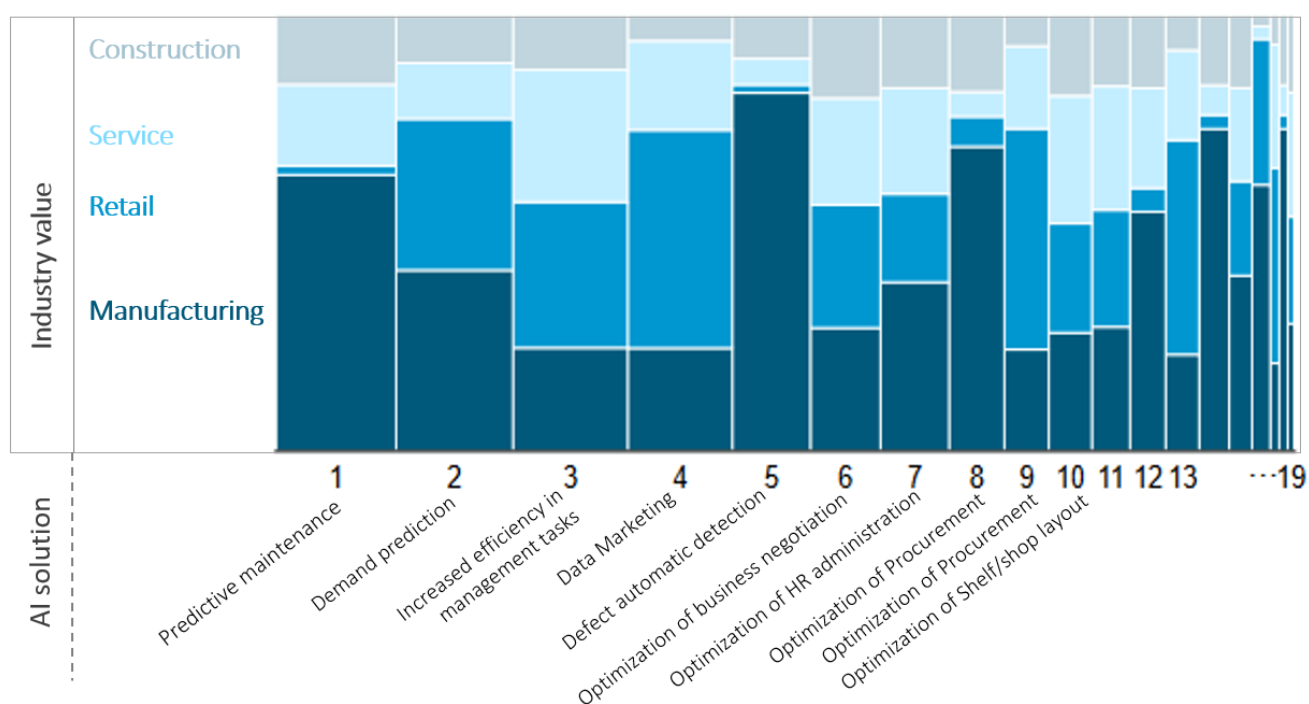
Source: METI, Strategic basic technology advancement / cooperation support project - Survey project on promotion of AI utilization by SMEs (2020)

Use cases which are expected to create high benefits include:

(1) Minimization of lost profits and maintenance costs through predictive maintenance by installing sensors on machines and facilities;
(2) Demand forecasting by analyzing internal data such as sales performance and external data such as climate,
(3) Improvement of operational efficiency through inventory optimization;
(4) Improvement of procurement efficiency through effective accounting related operations such as billing and payment;

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[27] Ministry of Economy, trade and industry, 戦略的基盤技術高度化・連携支援事業(中小企業の AI 活用促進に関する調査事業), [Strategic basic technology advancement / cooperation support project (Survey project on promotion of AI utilization by SMEs)], published on 27/03/2020, Accessible at: https://www.meti.go.jp/meti_lib/report/2019FY/000825.pdf

(5) Reduced marketing costs and increase in sales through data marketing.

The estimated impact on value creation reaches **11 trillion yen** led by the 4 main sectors by 2025.

Connected devices and IoT are expected to create value in construction, medical sectors and in logistics

Connected devices and IoT are expected to highly contribute to the construction sector, where important value creation is foreseen through increased labor safety with the installment of sensor points (e.g. temperatures, vibrations, voltages). RFID and location sensors data is also expected to contribute largely to warehousing and logistic improvement through asset tracking and real time inventory overlook. As indicated by the figure 13, analysis of data generated by such connected devices has been growing very fast over the past 5 years in the areas of Machine-to-Machine data, however it still shows room for progress as adoption rates remain lower than 10%.

Promising use cases are also discussed in the medical sector, with wearable connected devices allowing the tracking of patient's health data, or alternatively the real time tracking of medical equipment. However figures show that analytics of connected medical data has not

evolved as fast since 2015, suggesting this domain presents good opportunity for further development.
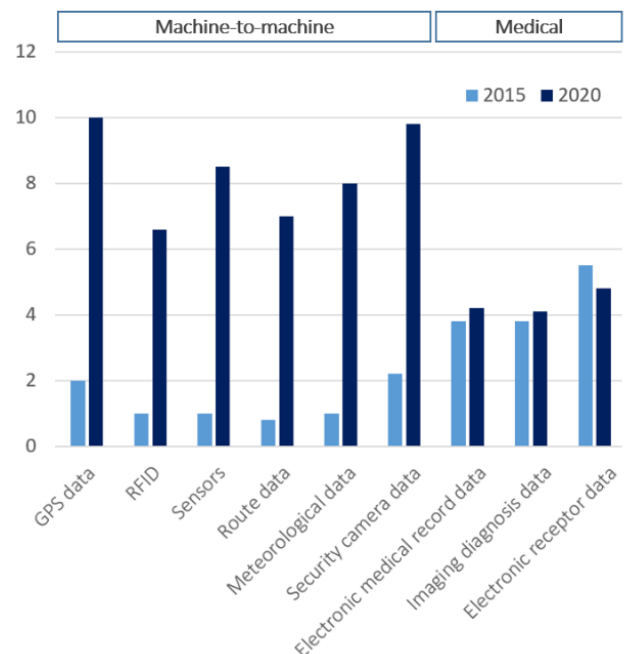
Source: Cabinet Office, *Information and Communication White Paper; Current Status and Issues of Digital Data Utilization (2020)*

The COVID-19 has a polarized effect on corporate adoption of IoT and AI

Although categorized as future promising investment areas, IoT and AI have faced important decline in perceived degree of importance when compared to 2019. Moreover, their overall adoption rate has not changed significantly from the period 2019 to 2020 (see figure 7). Those results demonstrate that firms' awareness about the technologies is high, however those seems to be less prioritized in times of the pandemic. As an illustration, a domestic survey conducted by PWC[28] indicated 32% of the respondents implemented AI in response to COVID-19, promoting new initiatives such as advanced analytics in marketing or human flows analysis. In contrast, 27% delayed the induction of AI, as well as digital initiatives as a whole, as organizations had to devote their management resources to measures compensating the effects of the pandemic.

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[28] PWC, *2021 年 AI 予測調査 (日本), [2021, AI predictions]*, published on April 2021, Accessible at: https://www.pwc.com/jp/ja/knowledge/thoughtleadership/2021/assets/pdf/2021-ai-predictions.pdf

2.3.5 Promising technology solutions

Data analytics domains such as master data management, big data and dashboard visualization, as well as zero trust cyber security show low adoption rate in the Japanese corporate landscape. However, those have attracted increased interest from the business over the past year as indicated by a growing intention for investment (ref. figure 7).

Data Management and Analytics

In an era where data is flowing from all over the places, data management and analytics sits at the center of companies' competitiveness. It provides insights about business operations and helps improving effectiveness and reduce costs, as well as helps to better understand customer behavior and preferences. When properly governed and managed, data offers tremendous business value, which is further leveraged if combined with other advanced technologies such as IoT or AI.

Japanese firms have not achieved full potential when it comes to data analytics yet, indicating low adoption rate in SMEs and overall low maturity in analytics capabilities

Data management and analytics are common practices within large companies, as 90 % of the companies specify data analytics is performed in at least one of their department. Master data management (MDM) [29] is the norm, while big data and data dashboards[30] are implemented in almost 1 company out of 2. In contrast, small companies' implementation of data analytics drops to 56%, whereas MDM, dashboard visualization and big data are still rarely used. However, it is worth noting that data analytics trend has been evolving positively over the past years, demonstrating increasing awareness around the benefits of managing properly data into insights.

The **financial sector** tends to have higher penetration rate than the other sectors when it comes to data management and analytics in overall, mainly explained by the nature of its activities generating tremendous amount of data, such as payment transactions.

The figure 15 further shows the **maturity level of data analytics** per industry size, starting from simple "data reading" approach to "predictive analytics using deep learning and AI". The table suggests the majority of the companies read available data, however few are the ones that perform advanced analytics or have

Figure 14 - Corporate adoption of data management practices

Master Data Management

+15.2 %
11.5% 26.7%
2016 - 2020

58.5%
18.4%
■ Large
■ SME

Management Dashboard

+2.2 %
11.0% 13.2%
2016 - 2020

39.6%
4.3%
■ Large
■ SME

Big Data

+2.4 %
9.2% 11.6%
2016 - 2020

45.3%
2.5%
■ Large
■ SME
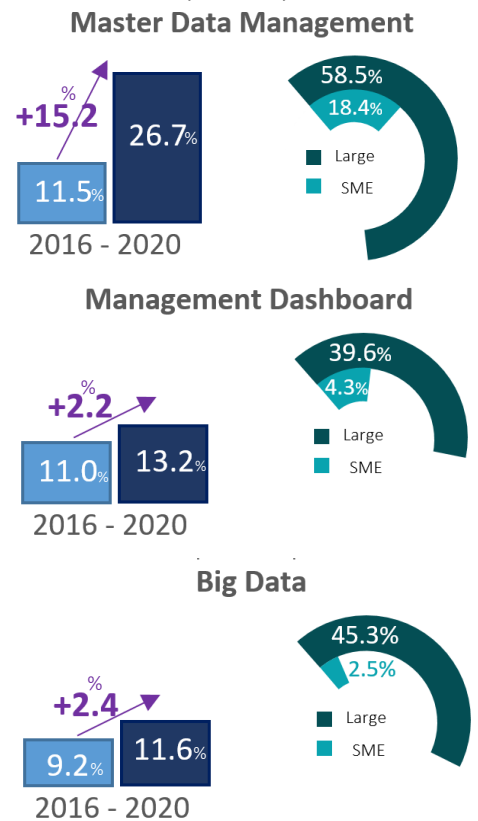
Source: JUAS, *企業 IT 動向調査報告書 2021,
Corporate IT Trends Survey Report 2021*
"Large" refers to firms with revenues greater than ¥1 trillion.
"SME" refers to firms with revenues below ¥10 billion.

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[29] **Master Data Management (MDM)** involves creating a single master record for each person, place, or element in a business, from across internal and external data sources and applications. It is key for companies to build a resilient baseline across organization and optimize the way generated data is used and interpreted.

[30] **Big Data** consists in deriving information and insights from the collection of huge amount of data.

Dashboarding consists in transforming data into visual information (such as graphs) to help track, analyze and display data. It helps gaining deeper insights about organizations' performances or status.

implemented deep learning and machine learning solutions. Moreover large disparities are observed between large and small companies.

Figure 15- Data Analytics Methodology (2020)
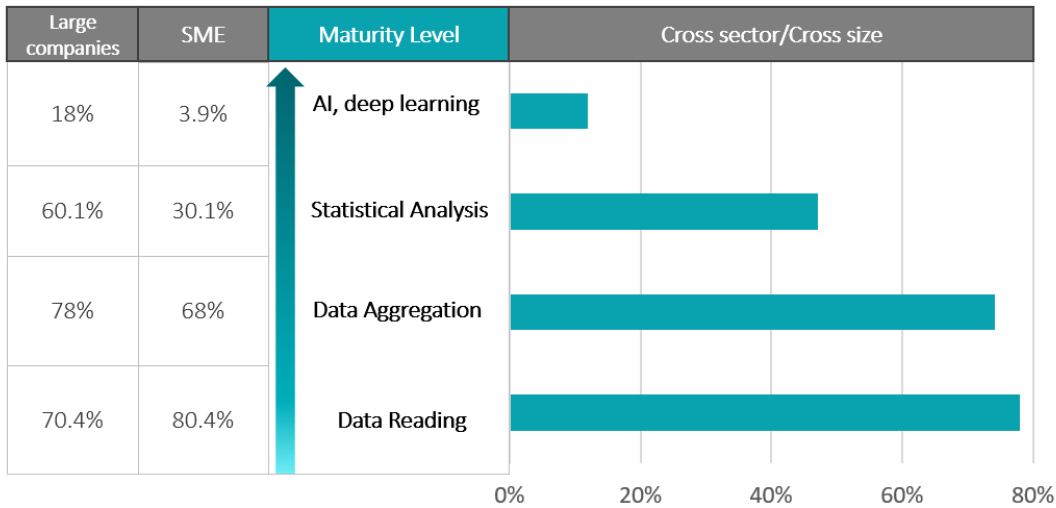
Large companies	SME	Maturity Level	Cross sector/Cross size
18%	3.9%	AI, deep learning	
60.1%	30.1%	Statistical Analysis	
78%	68%	Data Aggregation	
70.4%	80.4%	Data Reading	

Source: Cabinet Office, Information and Communication White Paper; Current Status and Issues of Digital Data Utilization (2020)

Japan is lagging behind in data analytics when compared to its American and European peers

While it is clear that Japanese corporations are progressing in data analytics, important gaps were highlighted when conducting similar survey with American and German companies. As shown in the figure below, Japan lags behind in all the covered domains including implementation of data analytics and analytics for product/service development when compared to its peers. It is worth mentioning that the gap is quite large, as observed implementation rates are twice lower than Germany in all the domains. Additional efforts are required to encourage firms towards digital transformation, in particular the SMEs, as data analytics is a key practice for business to improve their productivity and sales performances.

Figure 16 - Data Analytics implementation - per country (2020)
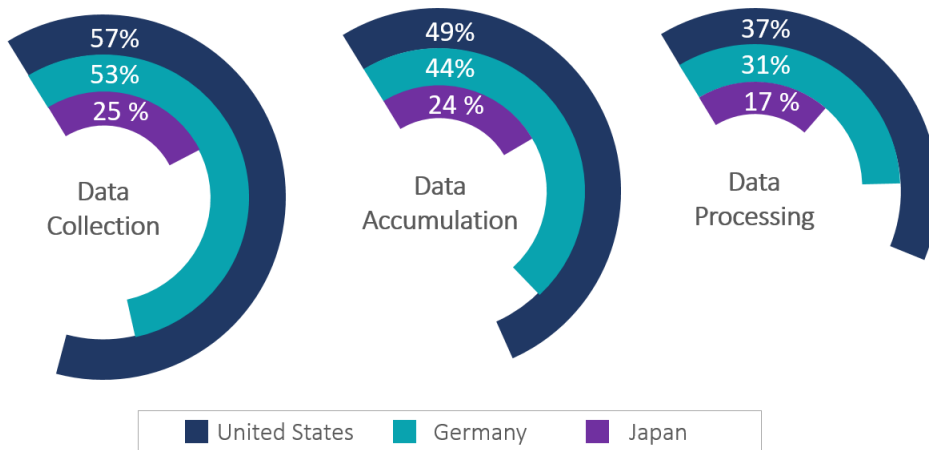
Source: Cabinet Office, Information and Communication White Paper; Current Status and Issues of Digital Data Utilization (2020)

Cyber Security

The digitalization journey has raised new challenges for firms as multiple cases of stolen data, ransomwares and unauthorized access were reported both by the government and the business. In this context, it has become a strategic decision for entities to secure citizens and clients' trust through the implementation of appropriate cyber security measures.

Perceived cyber threat has increased since COVID-19, while 4 companies out of 10 are not sure to have all necessary security measures in place

According to a domestic survey conducted by Sonpo in 2020[31], 4 companies out of 10 have mentioned that their perceived threat of cyberattacks has increased since the pandemic. Moreover, 15% of the respondents indicated they have implemented measures within 2020, suggesting an increased awareness around cyber risk, cross-company sizes and cross-sectors.

Overall, main reported attacks by the corporate sector consist in malwares, ransomwares, as well as fishing mails. In response, 90% of the companies have measures in place to counter cyberattacks, of which main initiatives are the traditional implementation of antivirus and vulnerability management software, as well as the setup of access logs.

Despite high implementation rate of security measures, 40% of the organizations are still not confident in having all the necessary measures in place, as risk is perceived as growing and becoming more sophisticated along with digitalization.

The future of cybersecurity - AI to automate security systems and moving toward "zero trust security" model

The current environment creates diversified exposures to cyber threats and opportunities to develop advanced security solutions. Indeed, digitalization involves the collection, processing and exchange of tremendous amount of data. Typical examples in the corporate environment include the remote connection through VPN, which allows access to information stored on the cloud or the adoption of numerous connected devices, which collect and share data through the online network. Those create vulnerabilities in many places for organizations. In response to increasing risk, sophisticated cybersecurity practices are emerging, as for example, with the development of AI solutions that automate security systems and help analyzing massive quantity of risk data.

Moreover, the necessity to increase security encourages corporations to move toward the "zero trust security" model. It is centered on the belief that organizations should not automatically trust anything inside or outside their perimeters and instead, must verify anything trying to connect to their systems before granting access. It requires firms to put in place governance model, authentication and robust technical cybersecurity solutions. Security is therefore to be considered in any digital component and is a key element of companies' DX journey.

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[31] SONPO, *国内企業のサイバーリスク意識・対策実態調査 2020, [Survey on Cyber Risk Awareness and Countermeasures among Japanese Companies 2020]*, December 2020, Accessible at: https://www.sonpo.or.jp/cyber-hoken/data/2020-01/pdf/cyber_report2020.pdf

While the maturity of SMEs is far from implementing such an advanced security model, JUAS survey[32] highlighted that large corporations are shifting toward this approach, indicating 6 companies out of 10 are investigating to adopt zero trust security in the near future.

For more information about Cyber Security in Japan, refer to the past Minerva reports:

Opportunities for venture firms, universities, and research institutes in the EU to conduct knowledge transfer with Japanese counterparts in nine digital technology areas (2018)
– by Toru Kodama

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[32] JUAS, 企業 IT 動向調査報告書 2021, [Corporate IT Trends Survey Report 2021], 2021, Accessible at https://juas.or.jp/cms/media/2021/04/JUAS_IT2021.pdf.

2.3.6 Untapped Technology Solutions

5G, enterprise architecture, intelligent and connected devices, as well as blockchain solutions seem to remain as untapped areas when compared to other technologies, as those indicate low adoption rate and low degree of importance for future corporate investments (refer to figure 7).

Intelligence Devices (Robotics, Drones)

Robotics mainly used for industrial manufacturing – COVID-19 as a momentum for the development of service robots

When looking at the area of robotics, Japan is positioned among the world's top leaders, with a density of 364 robots per 10.000 employees and representing 47% of the global robot production in 2020[33].

Unsurprisingly, the use of industrial robot is led by the **manufacturing sector**, representing 60% of the industry usage. Industrial manufacturing remains therefore the main purpose of robots usage, where fundamental functions consists in performing simple jobs such as assembling parts and physically dangerous tasks such as transporting heavy items.

On the other hand, robots adoption to serve **service industry accounted for 28.5%** of the cases in 2018. Those are for the majority used for client reception, guidance, customer service, but also for transport, information collection and research. As the COVID-19 emergency exploded into a full-blown pandemic, many robot-making companies saw a surge in orders, together with the need for "non-contact" solutions, contributing to the acceleration of the use of remote control and service robots. TIS, a Japanese firm offering services for service robot

development, has seen its demand for service robots multiplied by 5 during the first year of the pandemic.[34]

Although robotics for services still represents comparatively lower share in value and use when compared to industrial robotics, the pandemic has been a major accelerator to its development, strengthening knowledge and experience of robot making companies. According to the World Robotics report from 2020, main areas of development of service robots serve medical purposes, as well as logistic activities, which particularly grew in market demand in response to the COVID-19[35].

Figure 17 - Corporate adoption of robots
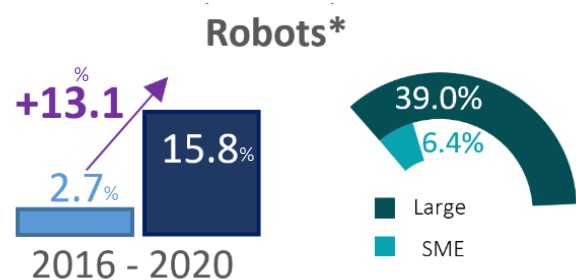
Source: JUAS, 企業 IT 動向調査報告書 2021, *Corporate IT Trends Survey Report 2021*
"Large" refers to companies with a revenue greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

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[33] IFR, *World Robotics 2021 report*, October 2021.
[34] Robotstart, コロナ禍でロボットの問合わせが 5 倍に!], *[Inquiries about robots are quintupled due to corona damage! "]*, published on 13/10/2020, accessible at: https://robotstart.info/2020/10/13/tis-strtgy2020.html , accessed on 25/01/2022.

[35] Japan Robot Association, サービスロボット調査結果：世界の業務用サービスロボットの売上高が 32 ％増加, *[Survey on service robot world business service robot sales increased by 32%]*, https://www.jara.jp/various/ifr/pressrelease/pr20201112/index .html

Progress in robotics have introduced advanced technologies and allowed conventional robots, which require human detailed instructions to function, to embrace intelligence and to independently make calculation to evaluate and make optimal movements and decisions. According to a survey conducted by NTT data in 2018[36], technologies that are the most deficient to support the development of next generation robotics are AI, data mining, big data and IoT. The survey further highlighted that the domain is particularly in shortage of human resources robotics engineers, software engineers but also of AI, data analyst/scientists experts. To maintain its competitive advantage in robotics, Japan needs to ensure the software layer, in other word the "intelligence component", is fulfilled.

> For more information about robotics in Japan, refer to the past Minerva reports:
> **Analysis of opportunities for EU SMEs in Japan's Data Economy and Artificial Intelligence in connection with Robotics** (2019)
> – by Agnieszka Kuczynska

Drones corporate adoption is led by large firms and is mainly used in the construction sector with opportunities in niche industries

The use of drones mainly takes place within the construction industry (38% of penetration rate) as well as in social infrastructure (16%) and is led by large companies' adoption. The technology has gained popularity relatively fast over the past 5 years. Drones indicate a high penetration rate in those sectors as they cover use cases in all phases of a building's/infrastructures lifecycle from surveying a new jobsite to assisting in ongoing maintenance of older buildings. Moreover, drones can enhance safety throughout a building's lifecycle. In niche industries, they are also used in military and space related solutions through outdoor and indoor inspection, surveillance, as well as aerial photography or videography.

Advanced innovation integrates AI to give the device the ability to function in situations where human cannot, contributing to the development of unmanned aircraft solutions. It also provides the possibility to analyze real time data and adjust upon obstacles and terrains. Forecasts suggest that industry and commercial use cases will further develop with technology advance in multiple areas including delivery, surveying, agriculture and many more. On the other hand, there is a strong need to build appropriate infrastructure and regulation to further encourage its dissemination.
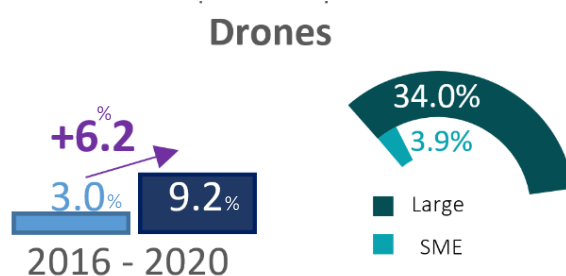
Drones

+6.2%

3.0% → 9.2%

2016 - 2020

34.0%
3.9%

■ Large
■ SME

Source: JUAS, 企業 *IT 動向調査報告書 2021, Corporate IT Trends Survey Report 2021*
"Large" refers to companies with a revenue greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

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[36] NTT data, 企業におけるロボットのビジネス活用動向調査, [*Survey on corporate business use of robotics*], published on 02/02/2018, Accessible at:

https://www.nttdata-strategy.com/archives/survey/goo/pdf/20180202.pdf.

Blockchain

Blockchain technology is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. Over the past years, it has been widely known for offering disruptive solutions such as cryptocurrencies and smart contracts, delivering multiple business benefits by improving traceability, transparency and tradability.

Blockchain indicates among the lowest corporate adoption rate in comparison to other key technologies, led by large industries in the financial sector

Although the technology has been very popular and much mediatized over the past years, business reality shows that only few companies have adopted the blockchain. Indeed, only 1.7% of firms had it implemented cross-sectors, while 13% were considering it or were in the process of adopting it in 2020[37]. Moreover its effective adoption and intended implementation ranked among the lowest when compared to other key technologies such as AI or IoT, suggesting it is not a priority for the majority of established companies. Despite these observations, it is worth noting the adoption trend accelerated over the past years, as implementation rate grew more than 7 times from 2017 to 2020.

Looking at industry trends, adopters are concentrated in a limited number of sectors, where, unsurprisingly, the **financial industry** indicates the highest adoption rate (6.3%), followed by the construction and material manufacturing sectors (2.4%). Main practical uses include the development of the popular cryptocurrencies, as multiple initiatives are undertaken by large banks, as well as with the emergence of fintech companies. However it is worth considering that the practical use of blockchain solutions is led by forerunners and is not widely used among industries yet.

Figure 19 - Corporate adoption of blockchain
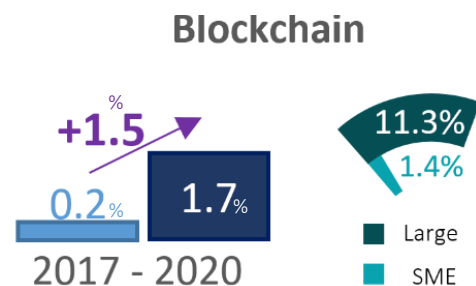
Source: JUAS, *企業 IT 動向調査報告書 2021, Corporate IT Trends Survey Report 2021*
"Large" refers to companies with a revenue greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

For more information about blockchain in Japan, refer to the past Minerva reports:

Blockchain in Japan (2019)
– by Marta Gonzàles

Advanced IT systems and infrastructure

While the cloud and VPN have seen great progression over the past years, companies that have adopted more advanced solutions to develop digitally mature IT systems and infrastructure are limited and led by large corporations. Indeed, looking into 5G or Enterprise Architecture (EA), implementation remains low and not considered as a main priority for future investment in comparison to other technologies.

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[37] JUAS, *企業IT 動向調査報告書 2021, [Corporate IT Trends Survey Report 2021]*, 2021, Accessible at
https://juas.or.jp/cms/media/2021/04/JUAS_IT2021.pdf.

Undeveloped Enterprise Architecture showing slow progression

Enterprise architecture is a discipline that defines, organizes and documents the architecture and key elements of an organization. It covers relevant domains such as business, digital, physical or organization and identify the interaction between those elements including processes, applications, data or technologies. It is a key approach to help businesses going through DX, since it focuses on bringing both legacy applications and processes together in an attempt to form a seamless environment.

JUAS's survey highlights that large companies are undertaking such process, also showing interest for future implementation, while smaller companies are lagging far behind. Industries showing the highest penetration of such practices are the financial and banking sectors.

Figure 20 - Corporate adoption of enterprise architecture
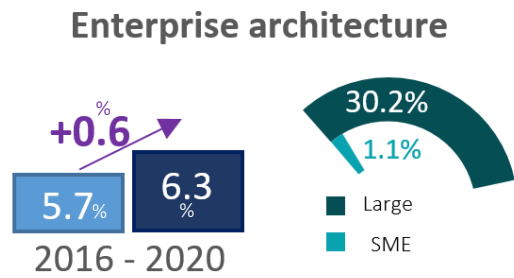
Enterprise architecture

+0.6%

5.7% → 6.3%

2016 - 2020

30.2% Large

1.1% SME

Source: JUAS, 企業 *IT* 動向調査報告書 *2021, Corporate IT Trends Survey Report 2021*
"Large" refers to companies with revenues greater than ¥1 trillion.
"SME" refers to companies with revenues below ¥10 billion.

5G adoption remains in early stage adoption, led by large corporations, which stand a high consideration for future implementation

5G is expected to support critical services of next generation of wireless technologies including connected devices, big data, as well as AI, requiring networks that provide high speed connectivity.

Despite its important media exposure, the effective corporate adoption is in fact particularly low and only in early stage, as only 3.8% of large organizations had it in place in 2020, while none of the surveyed SMEs had implemented 5G infrastructure. It is however worth mentioning that forerunners have started their path towards 5G, while consideration for future implementation among large corporations is relatively high.

Industries leading the trend are the manufacturing sector as well as the social infrastructure sectors, which is very likely to be linked with the development of IoT and machine-to-machine (MtoM) solutions.
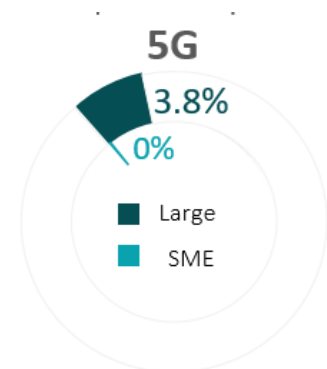
5G

3.8%

0%

Large

SME

Source: JUAS, 企業 *IT* 動向調査報告書 *2021, Corporate IT Trends Survey Report 2021*
"Large" refers to companies with revenues greater than ¥1 trillion and "SME" refers to companies with revenues below ¥10 billion.

03 DX IN BUSINESS OPERATIONS AND PROCESSES

Digital solutions bring a variety of opportunities for organizations to increase productivity and reduce costs by streamlining processes, by properly using and managing data or by automating redundant tasks.

This section brings to light the way main business functions and operations are disrupted by technologies, evaluates the extent to which Japanese firms enabled them to gain efficiency and assesses industries' specifics.

Highlights

1/ Back office and digital tools characterized by old legacy systems. A large proportion of IT systems running in Japanese established firms are so old that they prevent them to benefit from the cloud computing and its related services SaaS, PaaS and IaaS. The COVID-19 and the need to implement telework have accelerated the trend toward cloud adoption.

2/ Digital marketing led by large industry players. SMEs are mainly focusing on the maintenance of their homepages, whereas rare are the ones that exploit the benefits of online marketing. In contrast, digital marketing is a common practice among large organizations, where forerunners start looking into more advanced technologies using biometrics.

3/ Supply chain and logistics showing low progress in digital transition. The COVID-19 had an important impact on the supply chain, increasing awareness around the need to digitalize related processes. In particular, industry voices indicate the need for real time data visualization across the network. However in practice, facts and figures reveal that the digital transition of the supply chain and logistics remains an area which is particularly immature and shows room for progress.

4/ Connected Industries is seen as valuable, however practical implementation remains limited. Industrial manufacturing highly recognizes the benefits of implementing advanced technologies such as AI and IoT or augmented reality into the engineering chain. However in practice, the implementation of such solutions is led by large corporations while small manufacturers lag behind.

3.1 Back office and digital tools

One of the key elements that have revolutionized the way companies operate are **IT business systems and digital tools**. To define it simply, those are programs, software, website, or online resources that make tasks easier to complete. While conventional approach was to have customized in-house systems hosted on local IT infrastructures, hereinafter referred as "**legacy systems**", modern IT tools are nowadays running on the cloud and offer standardized high performance solutions by incorporating advanced technologies such as big data or AI.

Figure 22 - Legacy System vs Cloud
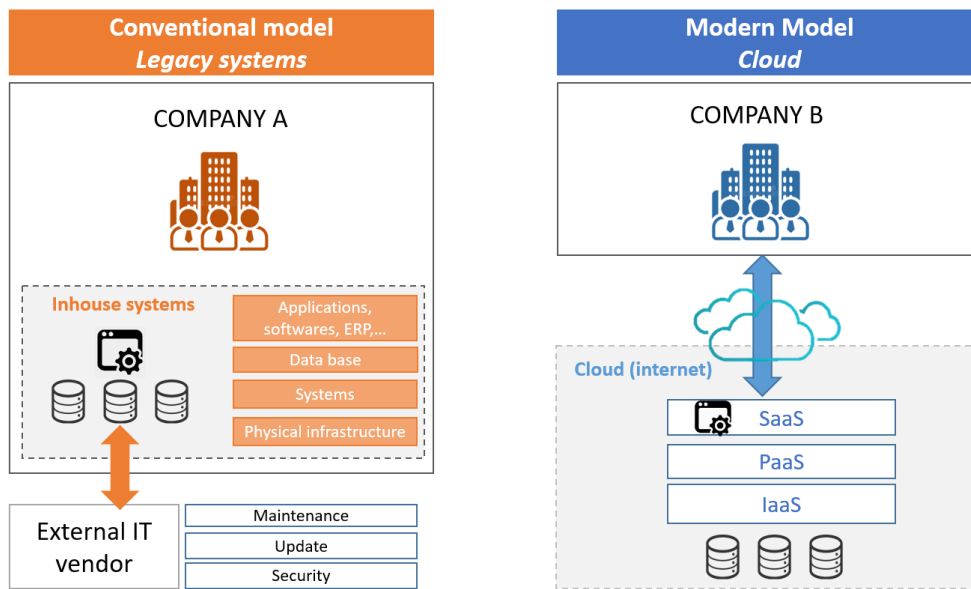
System legacy and vendor lock-in prevent Japanese firms to fully benefit from opportunities offered by cloud computing

Japan is characterized by a **high level of legacy systems**, where mission critical IT systems older than 20 years are expected to represent 60% of the systems by 2025 [38]. The accumulation of limited IT investments over the past decades has led to large maintenance costs of those customized and locally hosted old infrastructures, very often provided and maintained by external vendors. This creates a "vendor lock" situation, which makes it difficult for companies to update or replace their software in a short period of time, in contrast with modern software solutions running on the cloud, which tend to promote standardization incorporating best practices and regular maintenance.

Moreover, this hinders companies' abilities to commit to digital transition, as many of them allocate resources and budget for costly systems' maintenance preventing them to invest in other advanced and modern technological solutions. The figure 23 highlights the phenomenon, where it is shown that a large proportion of the digital tools currently running in Japanese companies does not rely on the cloud, nor use the SaaS type of solutions.

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[38] Ministry of Economy, Trade and Industry, *Overcoming the IT system "2025 cliff" and full-scale deployment of DX*, March 2019.

Figure 23 - IT tools in use and cloud penetration in SMEs

	Implemented	Implemented since COVID-19	Implementation evaluation ongoing	Not implemented
Communication	39.2	23.9	10	27
Human Resource	60.6	1.6	14.7	23.1
Accountance	53.4	1.3	16.6	28.6
Groupwear	47.1	2.6	11	39.2
Sales Promotion, Procurement	44.8	1.4	14.4	39.4
Production Management	42.7	0.4	11.8	45.1
ERP	39.3	0.4	11	49.5
Information Management	28.4	1	20.2	50.4
Management Analysis	24.2	0.5	16.3	59.1
Automation administrative tasks	10.5	0.4	24.2	64.5

Source: Ministry of Economy, Trade and Industry, 2020, Report on SMEs Digital transformation (2021)

By shifting to cloud, enterprises would benefit from online data storage and applications to support remote work, as well as to a wide range of SaaS solutions that support back office tasks and streamline processes. Those remove the need for organizations to install and run applications on their devices or in their data centers and give the benefit of eliminating the cost of hardware acquisition, provisioning, maintenance, as well as software licensing, installation and support. Those also offer very often more affordable solutions for SMEs.

Communication, HR and accounting tools among the most popular solutions

When it comes to the IT tools in use, with no surprise, communication tools are the most adopted among all the others since the pandemic (see figure 23). Disregarding the effect of the COVID-19, most commonly implemented tools are serving **horizontal back office purposes** including HR management, accounting business, as well as sales and procurement supporting activities.

On top of horizontal solutions, **vertical SaaS** solutions are also a growing segment. These consist in a set of software that create solutions catered to niche industries. They support specific needs of industries from end-to-end for example, with the provision of contract, invoice, and electronic signature supporting systems in compliance with the industry standards. The global vertical SaaS market is forecasted to register a 9% CAGR these next years to worth $60 billion by 2023, although the market seems to be relatively small in Japan and is yet to mature. Key industries which have shown interest in investing in vertical SaaS solutions are the medical, wholesales and construction sectors.

Telework as a new working norm and rising needs for digital tools

With no surprise, the pandemic has been a major accelerator of teleworking in Japan. According to a survey conducted by the Tokyo Chamber of Commerce[39], nearly 4 SMEs out of 10 in Tokyo had implemented remote work by May 2021.

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[39] Tokyo Chamber of Commerce (2021), 中小企業のテレワーク実施状況に関する調査, [Report on telework adoption in

SMEs], published on 16/06/2021, Accessible at https://www.tokyo-cci.or.jp/file.jsp?id=1025070 , Accessed on 30/08/2021.

Results are positively related to company sizes, as firms with more than 300 employees adopted teleworking twice more than the ones counting less than 50, while the effect is more or less the same when it comes to disparities according to industries.

More than half of the organizations that have introduced telework in response to COVID-19 have seen positive effect on productivity by the intermediary of digital tools adoption. Although most of the current initiatives to implement telework were first undertaken in response to the pandemic, the purposes of implementing remote work have been slightly shifting from "a response to COVID-19" to "a consideration of the transformation of the way of working". This suggests companies are starting to observe the benefits of such practices and are reevaluating their approach for the long term.

This further leads to new priorities and challenges, in particular regarding information security, as well as the need to consider the integration of other digital tools running on the cloud. [40]

COVID-19 and the government moving to cloud as a momentum for Japanese firms

Japan's private sector needs to overcome the legacy systems that are currently widely in function across the country to benefit from cloud advantages and to properly leverage and capitalize on advanced technologies. Those can significantly improve productivity, quality and efficiency in back office operations. Positive progress is expected as the government announcement to move to the cloud made a strong statement and signal for the future. Moreover, plans to build public online applications to digitize administrative processes should encourage the private sector toward this path. Combined with the consequences of the pandemic and the need to introduce teleworking, the current environment creates a favorable baseline for more extensive adoption of cloud computing based software solutions.

BOX 1 - Use Case: Cloud and Digital Tools

Cloud and SaaS solution to manage remote work

Work Smile labo is a Japanese SME employing 35 workers selling office supplies, furniture and office automation equipment.

Challenge
The company was looking for a solution to provide more flexibility to employees raising young children, as there were times when there was no choice but to take a leave due to unforeseen circumstances.

Measures
In response, Work Smile labo considered remote work as a solution. Undertaken measures to support the transition include the centralization of activities on shared server, enhanced security and the provision of remote access. Systems to support labor management and employees clock in and out were implemented and attendance data was moved to the cloud.

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[40] Digital Shift, 「テレワークとデジタルツールに関する調査」が実施　約４割が今後も「テレワークの継続を検討」, [Survey on Digital work and Digital tools. *About 4 out of 10 consider the continuation of telework]*, published on 20/07/2020, accessible at: https://digital-shift.jp/flash_news/FN200720_6, accessed on 02/09/2021.

Moreover, the company set up tools for web conferencing and introduced new approach and rules for employee evaluation systems.

Outcome
The introduction of remote work supported by the transition to cloud and the adoption of supporting IT tools helped reducing overtime by 40% and increased profit and productivity.

Source: Worker's resort

Vertical SaaS – App solution to support operations in construction industry

Okada Construction is engaged in the housing and general construction business since its establishment in 1957. The company handles in-house the whole process from planning to construction and sales of condominiums.

Challenge
As a general construction company, Okada construction had already introduced advanced technologies such as 3D design data creation, drones and ICT construction, and the management was looking for a solution to digitalize processes for its housing business. The site supervisor in charge of multiple sites spent a long time moving across the various construction sites, while the provision of instructions, documentation and paper based reporting process were time consuming. At that point, improving work efficiency was an issue.

Measures
Okada construction looked for a solution that would respond to the need to digitalize operations, compared various options and ended up selecting Andpad's application. It is a cloud-based project management solution focusing on construction industry, which supports the centralization of management activities from site efficiency to operations improvement.

Outcome
The Andpad app has facilitated the housing processes by centralizing and smoothing reporting, instructions and documentation processes. Among the key benefits, sites pictures are now taken with workers' mobile phone and directly stored on the app, reducing the time to manage construction sites photos. On-site carpenters can directly draw on pictures stored in the cloud and provide quickly instructions, instead of sending it via email or fax. Quality control also improved thanks to real-time check relying on information centralized on the app and through chat communication, increasing the overall transparency and replacing the previously implemented daily reporting system.

Source: Andpad

3.2 Digital Marketing

Digitalization has brought disruptive changes in marketing practices in multiple ways. The introduction of ecommerce, new channels and touchpoints, combined with advanced analytics generate new insights and help companies on two folds: it reduces costs as well as provide opportunities to increase sales through more precise, aware and effective Business-to-Consumer (BtoC) and Business-to-Business (BtoB) customer targeting.

Enhanced online marketing with the rise of online touchpoint and customer data

Online activities have created new customer touchpoints through the introduction of online home pages, SNS presence, content publications of articles, videos or podcasts, as well as through direct communication via emails.

Those touchpoints are enhancing marketing practices as they generate tremendous amount of data about BtoC and BtoB customers' behavior (e.g. number of clicks, user profiles, conversion rate, etc.). The collected data is further leveraged by combining digital capabilities such as advanced analytics, data visualization or AI, often supported by digital tools and software, helping companies to gain insights and conduct more precise marketing.

Enhanced customer targeting allows companies to generate advertisement through the various digital touchpoints to relevant targets only, reducing advertisement costs and increasing engagement and conversion rate. It uses technologies such as SEO, advanced analytics, AI as well as data visualization.

Marketing automation is based on pieces of software that automatically perform repetitive tasks such as email marketing, ad campaigns or profiling to identify leads and maintain customer loyalty. An example of a functionality is to send email based on user's web activity, for instance, by automatically reminding the visitor via email in case of abandoned shopping cart.

With the increase of internet traffic and data generated from it, analytics and marketing automation tools have been growing at a rapid pace and are expected to further evolve in the coming years.

Important gaps in digital marketing adoption between large corporations and SMEs

When it comes to the adoption of digital marketing by Japanese firms, multiple surveys conducted by RICOH, the METI[41] and Fujitsu[42] suggest that there are important disparities when comparing SMEs and large firms. When it comes to SMEs with less than 500 employees, results indicate that the COVID-19 had a positive impact on the use of SNS and digital marketing for promoting sales, however the proportion of firms that have adopted such practices remains very low.

Indeed, statistics indicate that approximately 60% of SMEs have a web portal, while only 1 company out of 5 is doing promotion on social media or performing online advertisement. On the other hand, adoption of marketing automation tools concerns only 15% of the cases.

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[41] RICOH, 中小企業のデジタルマーケティング実態調査資料, [Survey on SMEs digital marketing implementation], March 2018, Accessed on 21/10/2021.

Ministry of Economy, Trade and Industry, 令和2年度中小企業のデジタル化に関する調査に係る委託事業 報告書, [2020, Report on SMEs Digital transformation], published on 03/03/2021, on 03/09/2021.

[42] Fujitsu, 大企業のデジタルマーケティング取り組み実態調査, [Survey on marketing initiatives in large enterprises], October 2019, Accessible at: https://www.fujitsu.com/jp/solutions/industry/manufacturing/contents/fi2019-5gad/fujitsu_theme04_report01.pdf , Accessed on 21/10/2021.

This suggests low maturity of Japanese SMEs when it comes to performing online advertisement and prospection, while the main practice of going online consists in maintaining the brand's homepage. Overall, the general poor adoption across SMEs is mainly due to the lack of available resources and knowledge, the low budget allocation to marketing, as well as the difficulty to recognize and measure the benefit of implementing digital marketing.

In contrast, large corporations (characterized by annual sales greater than ¥ 1 billion) seem to reach higher maturity. Indeed, almost 70% of them have implemented internet advertisement, website SEO/SEM, SNS communications and content marketing.

Main benefits indicated by the market leaders are increased competitiveness and successful approach to customers who were previously unreached.

Forerunners investing in next generation of advanced marketing using biometric data.

On top of digital marketing emerging from online data, recent technologies have opened opportunities to further leverage marketing using biometric data combined with AI, as highlighted by the report published by the EU-Japan center on "*Opportunities for venture firms, universities, and research institutes in the EU to conduct knowledge transfer with Japanese counterparts in nine digital technology areas*".

The report elaborates on the development of emotion analysis, as well as eye tracking technologies by large Japanese advertisement companies such as Dentsu and Hakuhodo, which collaborate with universities and martech start-ups to acquire those capabilities. While those practices sounds very promising, it is worth mentioning that effective adoption remains limited and solely used by industries' forerunners.

BOX 2 - Use Case: Marketing Automation
Source : Boxil (2021)

Maxhills (マックスヒルズ) provides services for the planning, production, implementation and sales promotion for advertising services.

Pardot is a cloud based BtoB business MA tool provided as part of Salesforce portfolio. It offers automated solutions for e-mail newsletter creation/ distribution as well as behavior data tracking. It provides visualization as well as reporting functions to maximize cost-effectiveness of marketing activities.

Challenge
Maxhills was struggling to manage the leads acquired in seminars and e-mail magazines to attract customers to sports facilities, which were ultimately not tied into contracts.

Measures and outcome
Maxhills implemented Pardot to do lead management and lead generation in real time. Customized email delivery and the flow of handing over to sales at the optimal timing have tripled the number of inquiries and contributed to increasing the accuracy of contracts.

3.3 Next generation of supply chain and logistic

Awareness around DX implementation is rising in response to COVID-19 to ensure supply chain resilience

Hit by the impact of the COVID-19, industries were confronted with extreme supply chain conditions and were forced into exceptional measures to protect their people and maintain their operations. Some struggled to keep their operations running facing shortage of raw materials, supply and workers, while others were challenged with drastic spike in demand. The crisis has put in light the **need to increase agility and flexibility of operations**.

Technologies enabling remote working, collaboration and visibility across the end-to-end supply chain are referred as strategic priorities, highlighting the call for more effective management of volatile and disrupted supply network. This is not limited to the company level, as the need to cooperate and comprehensively grasp business partners along the supply chain is also expected to increase in the near future.

Moreover, on top of the "defensive" approach of digitalization, which consists in strengthening existing business processes, it has become increasingly important to engage in more "offensive" approach to provide a variety of products that meet the needs of individual consumers and to build a supply chain that can respond to shortened product cycles.

In this context, the digital transition has become an indispensable technology for the realization and the support of complex production, inventory and distribution management.

The METI describes and categorizes the **digitalization of the supply chain in multiple stages**:

[1] The first stage requires organizations to grasp the manufacturing process in real time. This relies on technologies such as cloud computing or ERP/MES [43] to access data instantly and visualize accurate status of ordering or inventories.

[2] The second stage consists in pushing further visualization and transparency by including business partners and linking data bases. Data collected using wireless communication technology, such as IoT, is shared between organizations based on, for example, blockchain technologies and used as big data to grasp real time situation through the supply chain, supporting end-to-end optimization.

[3] Finally, **the last stage** envisions predictive analysis of supply chain risk and planning based on AI and digital twins technologies. According to a cross-industry survey conducted by Keidanren in 2020[44], 6 companies out of 10 have reviewed or planned to review their supply chain resilience in response to the pandemic. As part of the undertaken initiatives to strengthen their business continuity, the diversification of suppliers is positioned first, followed by the review of business processes and the implementation of digital transformation, which is considered by almost one company out of two. When it comes to concrete actions and initiatives, the survey highlighted DX implementation was mostly related to better visualization of real time data, as well as

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[43] **ERP** (Enterprise resource planning) refers to a type of software that organizations use to manage day-to-day business activities such as accounting, procurement, project management, risk management and compliance, and supply chain operations.

 MES (Manufacturing Execution System : Manufacturing execution systems are computerized systems used in

manufacturing to track and document the transformation of raw materials to finished goods.

[44] Keidanren, 第2回 企業行動憲章 に関するアンケート調査 結果, [Results of the 2nd survey on the Charter of Corporate Behavior], Accessible at: https://www.keidanren.or.jp/policy/2020/098_honbun.pdf.

information gathering and sharing with business partners using IoT and digital tags, suggesting there is a strong incentives for companies to evolve toward stage 1 and stage 2.

Figure 24 - Digital transformation of the Supply Chain
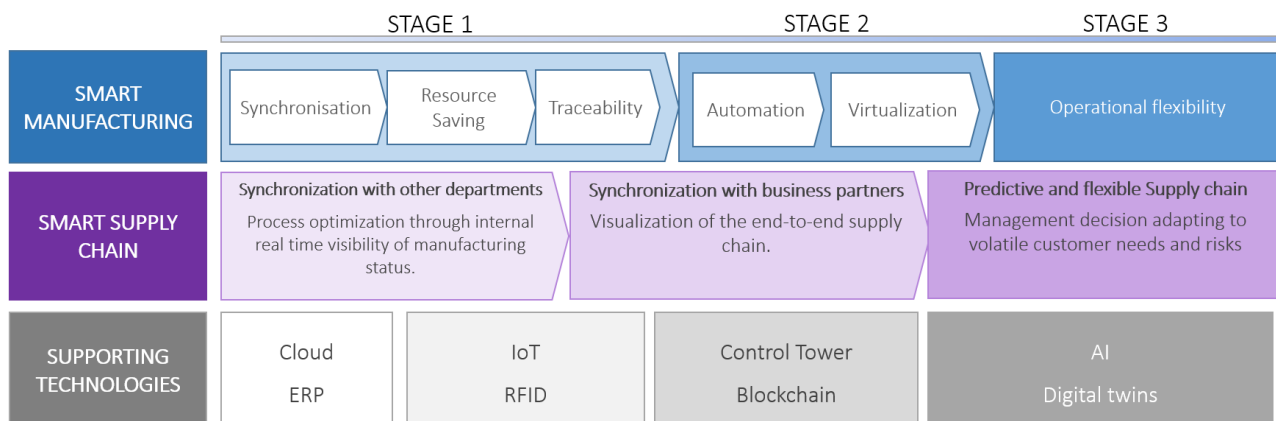
Smart warehousing and logistics are in need for real-time data and predictive analytics

Despite the benefits of integrating data between internal departments and with business partners, in practice, industries face great barriers to achieve information sharing across the supply chain. Stage 1 requires to set in place sufficient technology that helps capturing real time information, however facts indicate there is still room for Japanese firms to gain maturity in this domain.

Smart warehouses are inventory systems where all of the inventory processes are automated, interconnected with technologies such as robotics, IoT or AI, allowing more efficient inventory management and product location. Using similar technologies, **smart and connected logistics** offers near real-time tracking of movement and delivery of goods and services.

According to a cross-industries survey conducted by NEC solution in 2021[45], main issue when it comes to warehouse/inventory management system is the need to have access to inventory real time data, as well as access to detailed information about products, quantities and lots, as indicated by half of the survey respondents.

One of the growing technology solution commonly used to collect real time data in warehousing and logistics is **Radio Frequency Identification (RFID) tagging**, which is a type of tracking system that uses radio frequency to search, identify, track and communicate with items and people. RFID readers can be placed at entrances and exits of facilities, allowing real-time tracking of inventory as it moves in and out of the warehouse. It helps optimizing warehouse floor layout, as opposite to bar codes, which need to be scanned and are limited to the provision of inventory status for a specific given time.

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[45] NEC Solution Innovator, 物流や配送、物流システム（TMS/WMS）に関するリサーチ結果 2021, ［Research results on logistics, delivery, and logistics systems (TMS/WMS) 2021], 2021, Accessible at: https://www.nec-solutioninnovators.co.jp/ss/logistics/pdf/research2021.pdf.

In practice, warehouse and logistics managements are still **heavily relying on visual checks, as well as barcodes** (see figure 25) where RFID is characterized by low implementation rates. While the technology is well known in the logistic industry, awareness about benefits and functions remains particularly low in the manufacturing, wholesale and retail industries. Moreover, when it comes to the main barrier for adopting RFID, reports indicate costs of implementation is the main issue for all industries.

Advanced robotics and automated systems for logistics and warehousing are still in development

Other technologies that are expected to create high value and increase efficiency along the supply chain with advanced logistics and warehousing are intelligent robotics, providing potential solutions to fill the gaps in labor shortage and assist human in warehouses.

Currently, the introduction of advanced robots is beginning to spread mainly in large distribution warehouses for storage, packing, and sorting work. Future development is expected for

Figure 25 - Warehouse inspection method (2020)
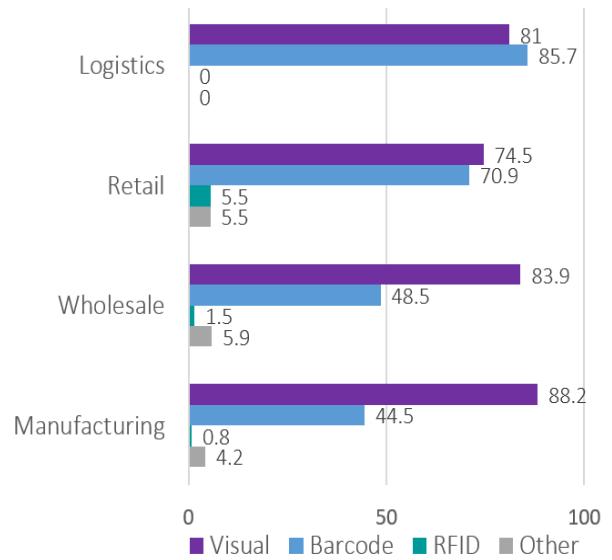
Source: MUFG, *令和２年度流通・物流の効率化・付加価値創出に係る基盤構築事業,* 2020

picking, loading, delivery and further automated solutions. As indicated by the figure below, the introduction of advanced and intelligent solutions in logistics and inventory management are not a market norm yet. Innovative solutions are arising from the R&D initiatives undertaken by large companies active in the logistic industry, such as Amazon, as well as by venture companies specialized in robotics and IT.

Figure 26 - Development stage of advanced robotics in warehousing
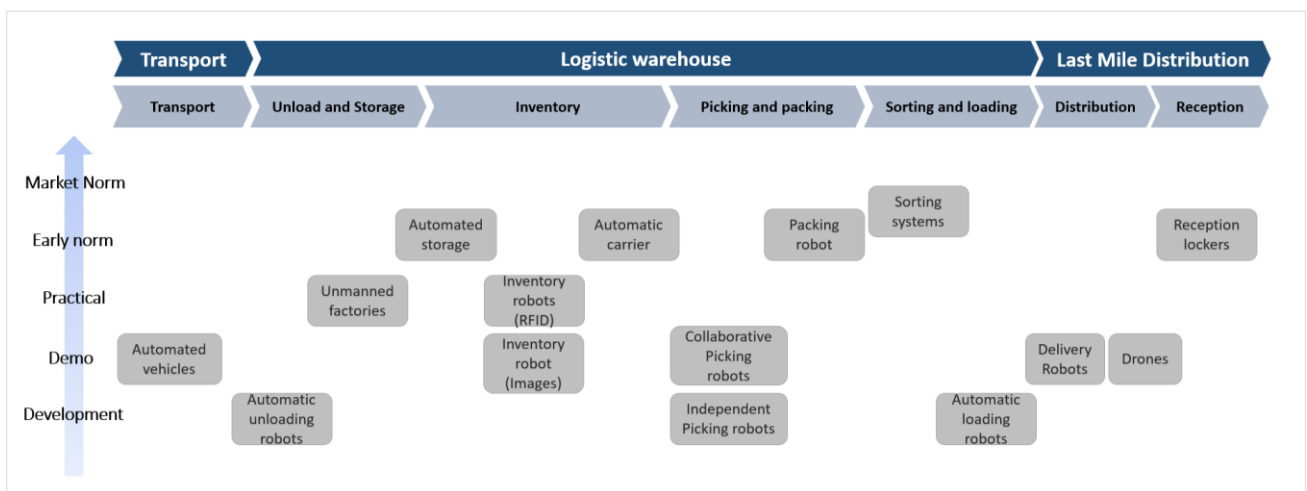
Source: Mitsubishi research Institute (2021)

Supply chain visibility and EPCIS – Japan remains analog when it comes to data sharing and system integrations between business partners.

As described earlier, a key element when looking at the digitalization of the supply chain is the procurement process and the information sharing with business partners, classified as "stage 2" of the digitalization of the supply chain (refer to figure 24). While it seems that scope for progress remains to make "stage 1" as a new norm, the next stage also shows important challenges to be successfully implemented.

When it comes to sharing information with business partners, the strong sense of resistance to the disclosure of trade secrets appears to be a major barrier, in particular from SMEs. In the context where information such as the cost of products to be traded, the place of origin, and the overall picture of business partners including other suppliers represents the competitiveness of a company, unnecessary disclosure may directly lead to changes in the power balance in transactions. On top of reluctance to share trade data, there is a lack of common understanding as to which data should be shared with which department or business partner, suggesting a gap in available standards when it comes to this topic.

From a technical point of view, the multiple stakeholders participating to the supply chain need to integrate and connect their individual systems to share and see data along the value chain. For this purpose, a common language needs to be set up to allow the systems to communicate together, whereas typical global standard technical framework is the **Electronic Product Code Information Services (EPCIS)**. According to a report published by the NEDO[46],

Japan is lagging behind global peers when it comes to the adoption of EPCIS by the corporate ecosystem. Although industry voice indicate a clear need for data sharing and data linkage, this has not been materialized yet.

In order to cover uncertainties and support players toward their supply chain integration, it is necessary to build an information sharing system based on a common standards. As it is assumed that it will be difficult for subcontractors or SMEs to request large companies to introduce the scholarship, large organizations or the government are expected to play major role in **setting technical standards, as well as frameworks** to facilitate data sharing and encourage the business ecosystem to move toward a more integrated supply chain.

Use cases of blockchain based supply chain traceability are rare and undertaken by forerunners.

A technology that has attracted a lot of attention over the past years in the area of supply chain is the **blockchain**, which manages encrypted data on multiple distributers and has the tamper resistance to improve product traceability and ensure reliability of information sharing between companies. Blockchain based solutions like smart contract, crypto assets and trade are alternative solutions which are expected to contribute to various needs in the supply chain, such as improving supply chain efficiency through facilitation of procedures.

As an example, Nutrisafe initiative, originating from Germany and Austria, is an effort to improve food traceability by the government, universities and companies. The initiative fulfill the purpose of improving information disclosure to consumers, the perspective of resilience such

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[46]Ministry of Economy Trade and Industry, *令和２年度産業標準化推進事業委託費, [Industrial Standardization Promotion*

Project Consignment Expenses], published on 3/12/2021, accessible at:
https://www.meti.go.jp/meti_lib/report/2020FY/000231.pdf

as the safe supply of food in the face of risks such as disasters and food poisoning.

Similarly in the pharmaceutical industry, blockchain is used for the purpose of realizing drug traceability. As an example of domestic use case, Nippon Express from Japan has announced in 2020 that it would invest 100 billion yen in blockchain technology to build a transport network for pharmaceuticals by the end of 2021,

with the purpose of introducing quality control to prevent the contamination of counterfeit drugs.

Although the technology has attracted a lot of attention and is widely shared on media, it is worth mentioning the solution is rarely implemented in practice for traceability purpose and if so, it is led by large corporations, often supported by governmental initiatives.

BOX 3 - Use Case: Smart inventory and warehousing management

RFID and real time data in automotive manufacturing   *Source : Toyota Tsusho (2019)*

Toyota Tsusho established in 1948, is a trading company part of the Toyota Group. It has grown mainly in the automobile-related business and has a presence in multiple countries overseas.

Challenge
The logistic industry presents major issues in labor shortages and is facing aging workforce. Also, from the perspective of Business Continuity Plan in the event of a disaster, visualization of luggage and global supply chain management are a key element. In the context of Toyota Tsusho, which is expanding its business in 28 countries around the world, building an optimal supply chain for parts and conducting stable supply and inventory management operations was a strategic decision.

Measure
RFID tags were implemented to replace the previous bar codes system. The tags were attached to each packing box when parts were brought into the warehouse, while the reading results of the RFID tags were collated with the warehousing schedule list, inventory list and shipping schedule list for each work process in order to improve work efficiency and accuracy.

Outcome
An example of a key benefit include the process of inventory inspection of products stored in high positions on the warehouse shelves, which had to be taken down to the floor with a fork lift and then returned to the shelves. The newly implemented "AGV system for inventory" can automatically read tags on the warehouse shelf with a height of 6m, so inventory work can be completed without dropping the inventory on the floor, saving a consequent amount of time.

Moreover, given the global activity of Toyota Tsusho, it requires connecting domestic and overseas logistics bases. The RFID solution allows the visualization of the number of automobile parts real time in stock in the supply chain, contributing to the sophistication of ordering and inventory management, as well as logistics functions. By visualizing the logistics on the supply chain in real time, the organization is encouraged to leverage other logistics services to further improve efficiency in the future.

3.4 Smart factories, Connected Industries and Industry 4.0

Industrial manufacturing is the largest sector in Japan's economy, valued at ¥ 114 trillion in 2019[47] and it goes without saying that the digitalization of its value chain plays a key role in the digital transformation of the country.

Industry 4.0 and Connected Enterprises

The concept of **Industry 4.0** was first introduced in Germany, where the term finds its origin from the "fourth industrial revolution" and involves technical introduction of advanced technologies for industrial production. Other similar initiatives are undertaken by European countries, such as "Industrie du future" in France and "Industria 4.0" in Italy. AI, the cloud, big data, cyber physical systems and IoT form the main technologies of the concept.

The vision suggests that, as a result of fast and connected technologies, large amount of data is collected from various sources like the internet, social media, production systems, and so forth. The gathered data is raw and its processing through AI allows its accurate manipulation. This ultimately takes form in efficiency increase for example, through better insights in production errors, customer behaviors and accurate demand forecasts. Cloud computing is required in order to store big data and conduct instant analysis, which connection to the data is ensured by the IoT, providing internet connection perceiving the real world, allowing devices to communicate with each other.

In 2017, the METI shared the concept of **Connected Industries** to realize its vision of Society 5.0. While industry 4.0 advocates an increase in efficiency and optimization of all processes in manufacturing industry - from design, manufacture to maintenance - the Japanese concept goes one step beyond and aims to connect manufacturing industries with each other.

The vision is ambitious and promises tremendous benefits both for companies and the society. However when it comes to facts, the Japanese manufacturing industry has not quite achieved digital maturity yet and rare are the firms that have adopted the aforementioned technologies.

DX in manufacturing is owned by large companies, while IT investment remains poor in transformative digital areas

As already observed multiple times in this report, the manufacturing industry makes no exception when it comes to the **digital maturity gap between large and small companies**. Disparities are observed in all areas, from the adoption of wireless network, extended reality, as well as data collection/analytics through the manufacturing process.

It is very unlikely to change in the short term as IT investments are giving priority to increase in business efficiency and in reduction of costs, as well as to the maintenance and improvement of existing systems. Facts and figures highlight the lack of investment in transformative areas, indicating poor vision and adoption of DX across the sector.

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[47] Statista, *Value added to the gross domestic product (GDP) at current prices in Japan in 2019, by industry*, June 2021, accessible at: https://www.statista.com/statistics/1244047/japan-nominal-gdp-value-by-industry/, accessed on 26/01/2022.

Engineering chain stands analog, nevertheless awareness on benefits of digitalization is growing

The **engineering chain** is a key concept specific to the manufacturing sector and refers to the series of business processes from planning to product design, process & equipment design, manufacturing production preparation and after sales services.

According to a survey conducted by Mitsubushi UFJ, current digitalization rate is very low for all processes, where product design is the most advanced and maintenance indicates the lowest adoption rate (refer to figure 27).

It is however worth noting that firms have shared their intentions to increase efforts for digital transition, where digitalization of the manufacturing production, maintenance, industrial process design and procurement is under consideration by more than half of the surveyed respondents, demonstrating an increased awareness of the benefits of incorporating advanced technologies as part of the end-to-end manufacturing journey.

Moreover, it is worth mentioning that data transmission and integration across the various processes is still immature, where data collection and outputs remain in silos for each process. Plants are still far from integrating and connecting data across the whole engineering chain, suggesting there is still a long way to go to reach the vision of connected industries as envisioned by the GoJ.

Main incentives toward DX of the manufacturing processes lie in cost reduction, shortened lead time to delivery and transmission of technical skills. Despite strong incentives to move forward, the main barrier to the digital transition is the lack of human resources with the appropriate capabilities or the difficulty to allocate a person in charge. On the other hand, unavailability of financial resources is concerning one third of the industry.

Figure 27 – Digitalization of the Engineering Chain
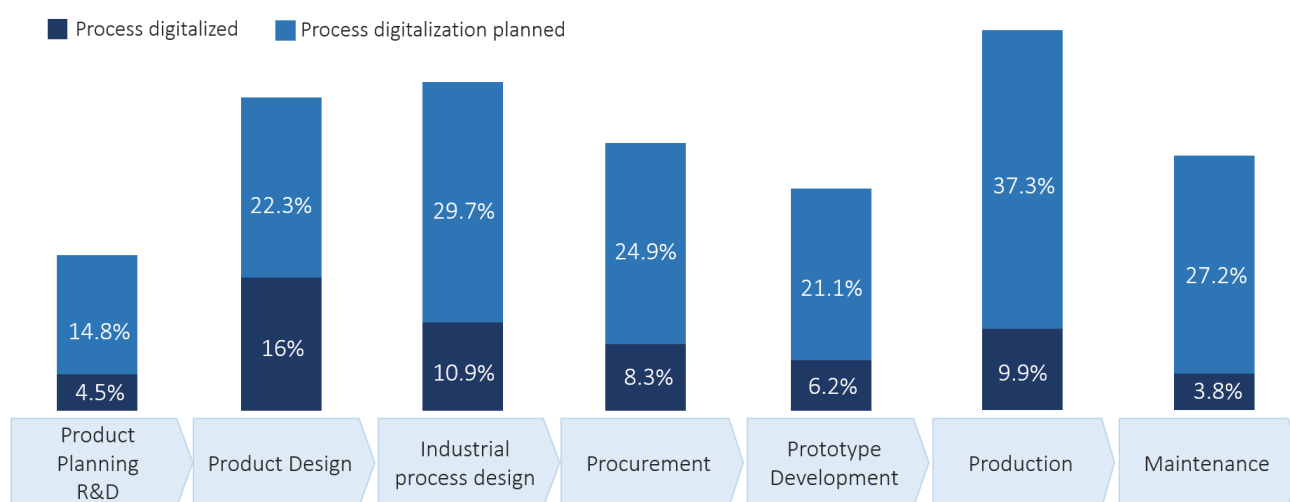
Source: METI – Mitsubishi UFJ consulting report on manufacturing sector March 2021

Half of the manufacturers collect data along the production line, nevertheless data usage is not optimized and leaves huge opportunity gaps

As regard to integrating data collection and analytics, **1 company out of 2 is collecting data along the manufacturing production line**. When it comes to large organizations (>300 employees), it concerns 75% of them. However, it appears that firms still struggle to fully leverage value from data collection, as almost half of them have not seen any progression by introducing the practice. Moreover only 4 out of 10 specified that the data is effectively used by the departments or the manufacturing plants.[48]

50%
Collect Data
along the production chain

4/10
Effectively use
it in offices or plants

Few manufacturers have implemented IoT with IT sensors and visualization along the production line despite high recognition of the added value.

A popular technology related to smart manufacturing are sensors dispatched along the manufacturing line. Those are used to monitor the performances of process and aspects of machine operations, collect data to assess benchmark level of operations while also detecting small fluctuation of performances. Combined with AI, this allows for example the prediction of equipment failures and triggering of maintenance, the monitoring of production quality. Those ultimately ensure more transparency and better quality through visualization and support more efficient decisions and operations. In reality, few plants

16%
Manufacturers use **sensors**
to control their production
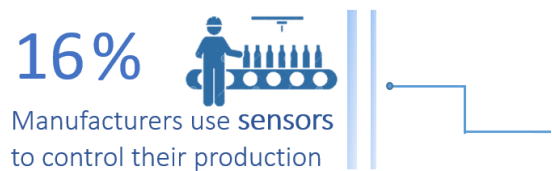
have the technology in place, **as less than 16% implemented instant visualization** [49] of production line, machinery and personnel operation status. Moreover, fewer are the ones that use that data for automation and process digitalization purposes. Despite very low adoption rate, it is worth mentioning that 1 organization out of 2 would be favorable of implementing such practices if it were possible, suggesting growing interest and awareness toward those technologies.

Wireless communications, human/machine-to-machine communications remain exceptions

Industrial wireless networking allows operational convenience by connecting machines to machines and machines to humans. For example, wearable wireless devices fitted with smart sensors connected through the internet can give instructions and improve worker safety and productivity. Plant managers can track workers exposure to toxic gases or radiations, or similarly avoid human collision with machines or robots. When it comes to machines, wireless controlled robots can be guided with limited human intervention and perform automatic assembly lines, packing and labeling or inspect products.

While it appears that more than half of the organizations have a great interest in wireless communication systems (including 5G), **only 1.8% of the companies have it implemented**.[50]

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[48] Mitsubishi UFJ Research and Consulting, *我が国ものづくり産業の課題と対応の方向性に関する調査, [Domestic survey on challenges and initiatives undertaken by the manufacturing industry]*, March 2021, Accessible at
https://www.meti.go.jp/meti_lib/report/2020FY/000066.pdf.

[49] Ibid
[50] Mitsubishi UFJ Research and Consulting, *我が国ものづくり産業の課題と対応の方向性に関する調査, [Domestic survey on challenges and initiatives undertaken by the manufacturing industry]*, March 2021.

Currently, main implemented use cases of wireless communication systems in production line are to reduce the programing time of the machines, ensure their maintenance and implement prediction of malfunctions.

Use of Extended Reality (XR) is close to inexistent in manufacturing processes

When it comes to XR, which encapsulates Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR), **the adoption rate is at a mere level of 1.4%**[51], while 1 organization out of 10 is considering its implementation. Similarly to the other observations, large companies (>300 employees) are leading the practice, while the technology is almost inexistent in companies counting less than 50 employees. For existing use cases, those technologies are mostly used for the following purposes illustrated by examples:

[1] Increase in production efficiency and quality: for example engineers wearing AR glasses benefit from displayed instructions during assembly process, resulting in increases accuracy and speed.

[2] Product design: creation of interactive virtual models for prototyping, reducing development time and allowing more 3D representations in the evaluation stages.

[3] Training: use of gamification and storytelling to navigate the trainee through various modules as s/he walks through rooms, identify problems and make repairs.

1.4%
Adopted
Extended reality
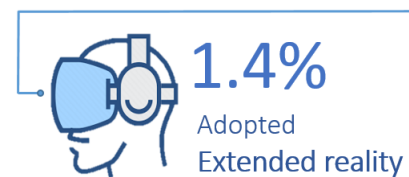
BOX 4 - Use Case: Sensors monitoring temperature

Ohno Seisakusho manufactures industrial valves with complex shapes and prototype parts related to automobiles. Taking advantage of the small turnaround of 10 employees, the manufacturer has achieved short delivery times, high quality, and low prices.

Challenge
For metal cutting, "cutting oil" is used to suppress friction and cool, but it is essential to control the temperature and concentration of oil in order to improve processing accuracy and prevent wear and tear of the equipment. Until now, measurements were taken manually, but the company's issues were labor saving and prevention of rough hands by employees due to oil.

Outcome
Utilizing the subsidy for the introduction of IT / IoT in Yokohama City, the system and concentration sensors were introduced and combined with the existing machine tools. As a result, the oil condition could be automatically monitored at all times, and the data could be confirmed on the monitor without human intervention.

Source : IToP Yokohama (2021)

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[51] Mitsubishi UFJ Research and Consulting, *我が国ものづくり産業の 課題と対応の方向性に関する調査*, *[Domestic survey on challenges and initiatives undertaken by the manufacturing industry]*, March 2021.

04 DX IN BUSINESS PRODUCTS AND SERVICES

The age of digital has changed in many ways traditional products and services. It has not only introduced new channels to sell, but it also encourages companies to innovate to launch digitally enabled products and evaluate the best ways of enhancing customer experience.

This chapter assesses the way digitalization and new technologies have changed value propositions in established industries and analyses the emergence of disruptive business models generating new revenue streams. Moreover, it investigates the source of innovation in Japan and measures the contribution of the startup ecosystem.

Highlights

1/ Japanese established firms struggle to optimize sales revenues generated from DX. Figures show that Japanese firms that have introduced digital technologies to innovate on products or services have not generated as much revenue as their global peers.

2/ Low risk R&D and intrapreneurship hindering disruptive innovation. R&D investment in Japan is high in volume, however is still focusing on low risk investments for market development of existing products and technologies, hindering Japan's capabilities to generate disruption. Moreover, innovation relies on large established companies that promote internal development and experiment targeting domestic market, which tends to limit innovations to be scaled at industry or global level.

3/ Undeveloped startup and VC ecosystems. The startup ecosystem and VC markets are growing but remain relatively small when compared to peer countries. Looking at the VC markets in volume, growth and investments are targeting startups delivering SaaS, AI and IoT solutions.

4/ Startups driving innovation in established industries. The transformation of products and services in key industries is driven by the startup ecosystem. Large established companies and system integrators collaborate and invest in domestic and foreign startups to drive innovation and change.

The section 2.2 highlighted that efforts of established firms to embed digitalization for market expansion, product improvement or new product creation remain comparatively low when considering organizations' priorities. This represents an important loss in value, as multiple reports have demonstrated that companies characterized by a higher maturity in DX and embedding digital solutions into their value propositions (product or service) have shown better results in sales and generated growth in revenues[52].

Japanese firms' ability to generate revenues from DX lags behind global peers

When it comes to the creation of new products or services by incorporating digital solutions, it appears that Japanese firms struggle to fully benefit from sales increase when compared to global peers. The phenomenon is illustrated on the figure 28, showing the **effects of DX on sales revenues**, categorized by maturity levels (1 to 3). Important disparities are observed between Japan, Germany and the US. It suggests that DX generates negative effect in sales for an important proportion of Japanese firms, regardless of their transition maturity level, while the US and Germany indicate more optimistic results. This demonstrates that Japanese firms still have scope for improvement to optimize their digital transition and to ensure it is properly materialized into revenues.

The GoJ further conducted a simulation evaluating the revenue effect of Japanese firms reaching the DX maturity level of the United-States for the manufacturing and the non-manufacturing industry. The estimated impacts were respectively an **increase in sales revenues of 5.7% and 4.2%**, equivalent to 23 and 45 trillion yen [53] . This quantifies the potential revenue growth that Japan could expect if its corporate ecosystem succeeds to better manage its digital transition.

Figure 28 - Product/Service innovation and impact on sales revenues
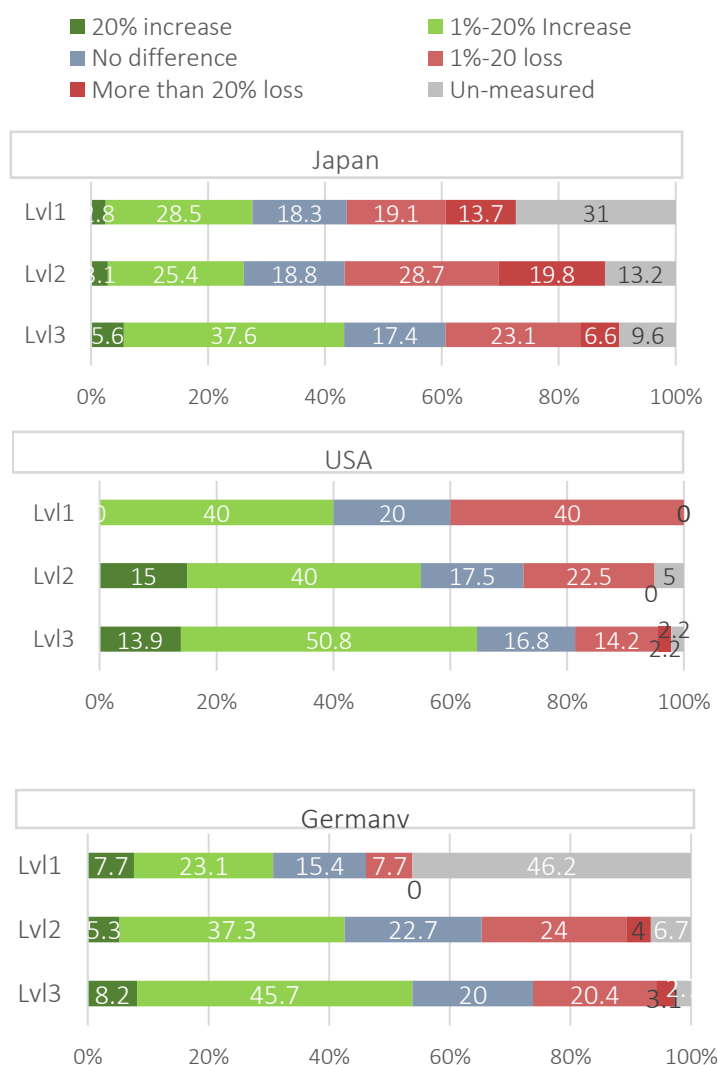
Source: Government of Japan, 令和 3 年版 情報通信白

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[52] Valoir, *The state of digital transformation*, September 2021, Accessible at:
https://static1.squarespace.com/static/5db8a4995630c6238cbb4c26/t/6140cb8c9f2e0c5aa9ea1c86/1631636365566/Valoir+Report+-+State+of+digital+transfomation.pdf
[53] Government of Japan, *企業活動におけるデジタル・トランスフォーメーションの現状と課題, [Current state and challenges of corporate initiatives towards digital transformation]*, 2021, Accessible at : https://www.soumu.go.jp/johotsusintokei/whitepaper/ja/r03/pdf/n1200000.pdf

Corporate innovation is led by large corporations, characterized by inward R&D promoting 'intrapreneurship'

Japan is characterized by an economic environment largely influenced by large companies. Indeed, while those represent 0.3% of the firms in numbers, they produced 51% of the total value added in 2013[54]. In this context, Japan's innovation has mainly been led by big conglomerates, while the firm entry rate has stayed low over the past two decades.

Looking at corporate investments in R&D innovation, Japan positions relatively high (see figure 29). However, the nature of investment tends towards **low risk R&D mostly covering existing technologies and market development**, indicating a low percentage of efforts to create new innovative products and services when compared to other countries[55].

This phenomenon can be explained by the Japanese business culture. Group harmony, communications and consensus are favored over making rapid decisions and changes, which are source of disruption in the working environment. Moreover, trust is a concept put at the center of decisions-making, which creates an inherent resistance in taking risks. These elements do not contribute to create a system encouraging digitalization, requiring risk taking, test mindset and fails approach.

Moreover **Japanese companies have on average a longer lifespan** than their global peers. Companies with longevity tend to prioritize increased profitability and global competitiveness at the expense of growth. In this context, digital transformation agendas are often considered to go against the status quo, although it has shown over the past years that it

can significantly reduce costs and increase competitiveness. These circumstances do not facilitate putting digitalization on priority agendas.

As such, the Japanese culture startup style venture **relies on large established companies that promote internal development and experiment targeting domestic market**, alternatively referred as "intrapreneurship". This tends to limit innovations to be scaled at industry or global level, curbing the opportunity to fully explore value creation and growth. This is also reflected by the fact that open innovation is not commonly implemented in Japanese firms in comparison to western practices, while acquisitions of startups are not a standard practice either[56].

Furthermore, a report published by McKinsey[57] stressed the importance of the role of the government in order to help the corporate environment toward its DX transition. Based on conversations with executives across industries,

Figure 29 - SMEs/Large companies' investments in new products and services (%)

50% Perform R&D for improvement of existing business

34% Perform R&D for market expansion

16% Perform R&D for innovative solutions
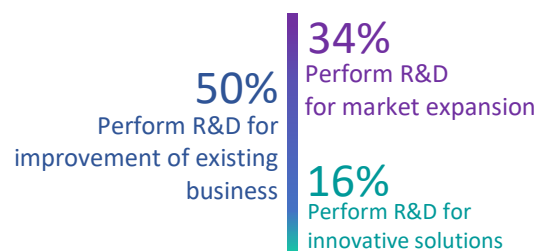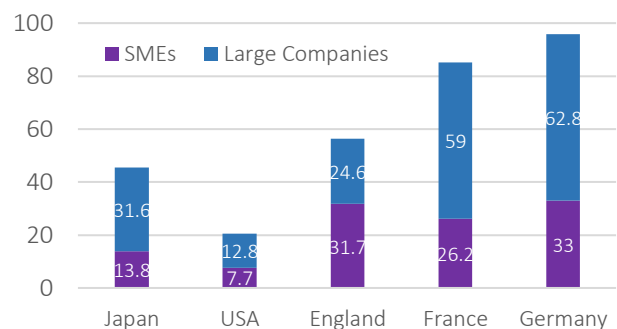
Source: Nedo, オープンイノベーション白書 第三版日本における
イノベーション創出の現状と未来への提言

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[54] Ministry of Economy, Trade and Industry (2013), 通商白書, [White paper on Trade].

[55] Joic, Nedo, オープンイノベーション白書 第三版日本におけるイノベーション創出の現状と未来への提言, accessible at : https://www.nedo.go.jp/content/100918465.pdf.

[56] Ibid

[57] McKinsey & Company and ACCJ, Japan Digital Agenda 2030, February 2021, Available at https://ceaa17af-1e95-46ee-9cbf-fff62ee679ca.filesusr.com/ugd/c01657_e32b2f3f71974adcb0d0aba480 59b852.pdf.

the report revealed that companies tend to wait for **the government to endorse digitalization** to align and foster DX within their organizations. It further noted that the private sector expects the government to trace the path, to showcase successful cases, as well as to put systems in place to ease adoption.

Figure 31 - Top 3 Japanese startups in funding received (H1 2021)
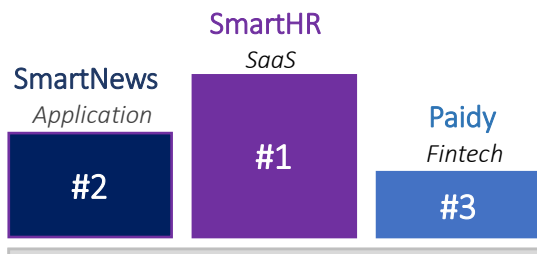
Source: INITIAL*, Japan Startup Funding 2021*

Figure 30 - Startup landscape in Japan (2020)
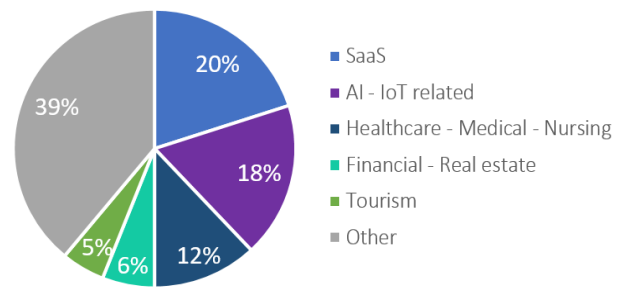
Source : Deloitte - *Online survey on domestic startups (Oct2020)*
N = 308

Startup ecosystem has gained maturity over the past years. However, the VC market remains low in comparison to global peers

Therefore, expectations are particularly high for startups as they play a vital role in creating innovative technologies and generate growth. A paper published by Washimi K.[58] highlighted the role of startups when it comes to innovation using the number of patent applications as a proxy, suggesting startups have a substantial role in innovation process in Japan as their patent rate is far higher than existing firms.

Looking at current industry trends in the startup ecosystem, **top 20 funded Japanese startups**[59] (see appendix 6) indicate that online tools boosting business efficiency continue to strive prominently, with the example of "SmartHR" ranking consistently in the top ranking. Unsurprisingly, firms providing solutions leveraging digital technologies are striving, with the examples of Fintech and AI-powered solutions also classified as top ranked firms. Looking at the startup ecosystem in overall, high proportion of startups are active in SaaS, AI or IoT related activities, as indicated by a domestic survey conducted by Deloitte in 2020 (see figure 31).

In order to evaluate the size and importance of the startup ecosystem, **Venture Capital (VC)** is often used as a reference, as funds play a key role in financing startups along their growth journey from early stage to the support of their expansion. The paper published by Washimi K. reveals that positive relationship exists with patent applications from startups and the level of VC investments, suggesting the significance of the VC market to support domestic innovation.

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[58] WASHIMI K. , *Venture capital and startup innovation – big data analysis of patent data*, Financial markets department, Bank of Japan, March 2021, accessible at:
https://www.boj.or.jp/en/research/brp/ron_2021/data/ron210312a.pdf

[59] INITIAL, Japan Startup Funding 2021: Mid-Term Summary, published on 20/08/2021, accessible at: https://initial.inc/articles/japan-startup-funding-2021-H1-en , accessed on 31/01/2022.

From 2010 to 2019, the investment volume in Japanese startups raised five folds from a total commitment volume rising from $ 800 million to $ 4 billion, supported by a slow emergence of independent VC firms[60].

Despite those positive trends, the country still has a relatively small VC market size in comparison to OECD members and partner countries, as indicated per figure 32.

Moreover, looking into the number of **Unicorns** in 2020, the Japanese startup ecosystem recorded 11 of them, positioning far behind the US counting more than 400, whereas China recorded 150 the same year[61]. Looking at the intensity of unicorns per GDP ù(see figure 33), it appears that Japan has the lowest number of all countries that have created such companies.

Figure 32 - Comparison of global VC markets evolution (2005-2018)
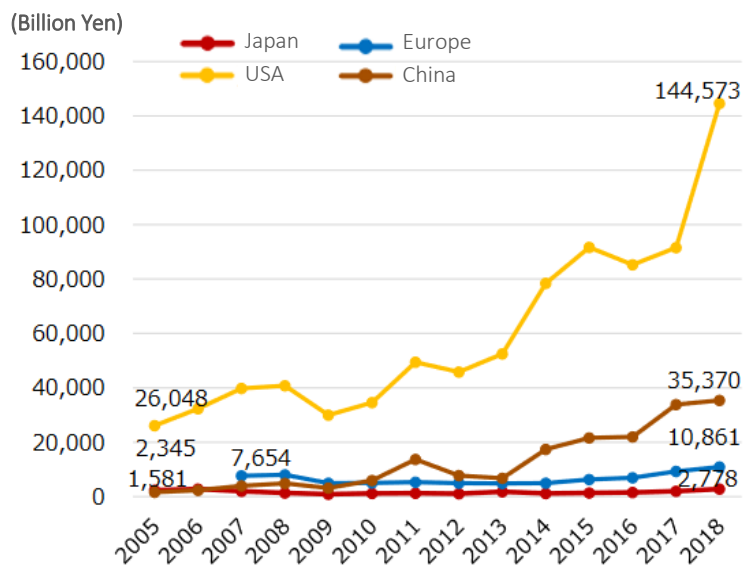
Source: *Mitsubishi Research Institute – White paper on Venture (2019)*

Figure 33 - Intensity of Unicorns by GDP, Across Select Countries
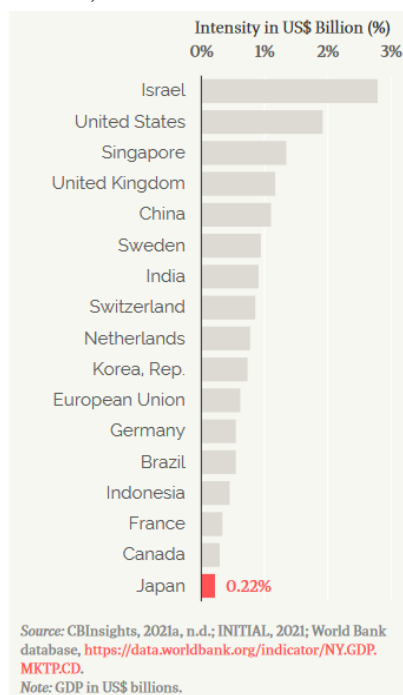
Role of Academia and R&D institute has been increasing over the past years

Another important source of innovation are academics and public research institutes. The country counts numerous research laboratories, which are expected to be important starting points for technological innovation discovery. Universities are now expanding the scope of their involvement to focus on engineering technological breakthroughs and commercialization together with the involvement of VC firms. Those provide R&D commercialization programs including talent matching for founders and the acceleration of connections for VC funds. These efforts greatly contribute to the rise of the startup ecosystem, particularly in the area of deep-tech, where startups tend to find their root in advanced academic research[62].

As an illustration, the number of university-launched startups has been increasing in recent years, and according to a report published

[60] INITIAL, Japan Startup Funding 2021: Mid-Term Summary, published on 20/08/2021, accessible at: https://initial.inc/articles/japan-startup-funding-2021-H1-en , accessed on 31/01/2022.
[61] Mulas, Victor; Astudillo, Pablo; Riku, Takashi; Wyne, Jamil; Zhang, Xin. 2021. *Tokyo Start-Up Ecosystem*. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/36462 License: CC BY 3.0 IGO
[62] Ibid.

by the METI[63], it has been increasing continuously since 2014, with 2.278 companies announced in 2018.

Figure 34- Number of university affiliated startups (2017)
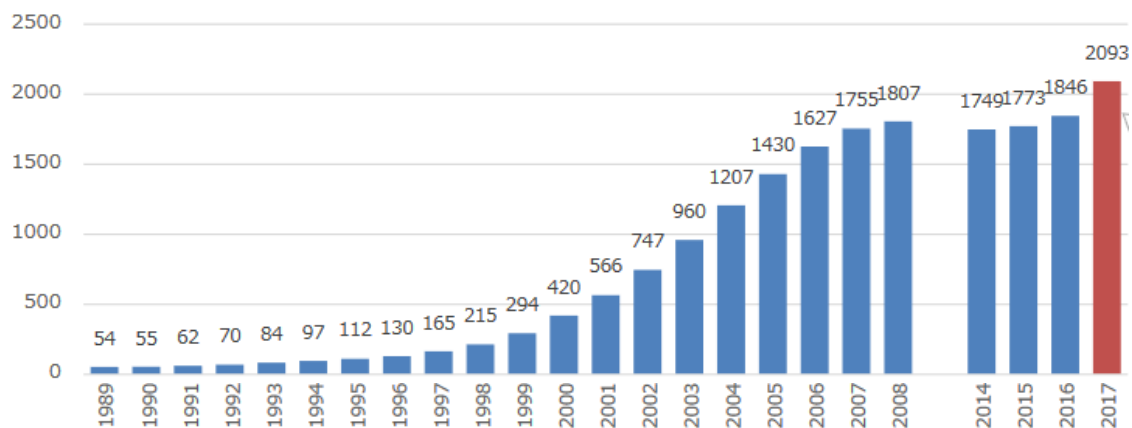
Source: *METI, 2017 年度大学発ベンチャー調査, [2017 Survey of University-Based Ventures], March 2017*

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[63] Ministry of Economy, Trade and Industry, *2018 Industrial Technology Survey*, March 2019.

4.2 Digitally enhanced products and new revenue streams

Digital transformation and advanced technologies provide tremendous possibilities to disrupt existing business models, develop innovative value propositions and create new revenue streams. The following list categorizes the key trends in new business models which emerged with the introduction of advanced digital technologies.

Ecommerce and marketplace model
Bring opportunities for firms to exploit new sales channels through the internet and online sales platforms. These practices generate tremendous amount of data, which processed and analyzed offer new opportunities for marketing and product innovation.

Digitally enhanced products
Leverage value by incorporating advanced technologies as a feature to traditional products. Typical technology is to connect existing devices to the internet (IoT), which create business opportunities and revenue streams through newly collected and processed data, for example through advanced analytics or AI.

Platform economy
- **Free model** provides service for free, while the user becomes the product that is being sold. The best examples are Google and Facebook, where every user who is using the services is giving valuable behavioral or preference information while using the platforms, which is then translated into revenues through ads services.
- **Freemium, subscription and on-demand models** are virtual products or services provided through a monthly/yearly subscription to a platform, or through on-demand purchase via online stores. Those can potentially offer free limited services, which require subscription to unblock additional features.
- **Sharing model** which allows the customer to use a service or a products for a given amount of time without owning it.
- **Ecosystem model** offers a unified and easy to use system through a variety of services and products. This allows platforms to grow exponentially by understanding the customer better, leveraging insights and valuable data collected through the multiple channels.

The following sections analyze how new business models and technology enabled products have disrupted the Japanese corporate ecosystem and what the opportunities are for future development, with a focus on the following industries:
- Automotive
- Healthcare
- Retail
- Financial
- Platform economy for services

4.2.1 Next generation automobile – E-car autonomous driving and smart mobility

The automotive sector is a major pillar of Japan's economy, as the country represents the third biggest market in the world, counting 78 factories employing over 5.5 million people in 2017[64]. Technological advancement has driven important disruption in the industry, bringing additional opportunities to enhance traditional cars. While the automotive manufacturing process and supply chain are heavily transformed by the Industry 4.0, on the product side, evolving digital ecosystems and the emergence of smart mobility is pushing the automotive industry to incorporate connectivity features and solutions for autonomous driving, opening the door for the development of innovative products and new business models.

AI, IoT as key technologies to support the development of next generation vehicles

Technologies such as electric, autonomous driving and connected cars require a massive restructuring of the existing product range. Modern vehicles are software-driven, collect and process massive amount of data and create opportunities to offer new features. Key trends in automotive product innovation involve technologies such as AI, IoT, which require the development of supporting infrastructures and hardware such as cloud, 5G and next generation of semi-conductors.

[1] **Connected cars and services** require connectivity embedded in the car to support end-to-end software platforms, linking all the systems in the car. This is supported by Wi-Fi hotspot placed in the vehicle offering features such as integrated routing, infotainment, but also more advanced solutions such as in-vehicle e-commerce services, predictive car maintenance or real-time emergency response. Connecting cars to the network open further opportunities for creating new revenue streams, for example, by enabling subscription models or by monetizing data generated by the car.

[2] **Autonomous driving** relies on technologies such as camera sensors, deep learning algorithms and models that help recognizing objects and location, as well as edge processing performing prediction to take avoiding actions. Moreover it requires high performing hardware that is embedded into the vehicle to enable on-board edge processing[65].

[3] The needs for **vehicle safety** are evolving together with the integration of advanced technologies, as cars process large amount of data that need to be protected, while autonomous driving must ensure the safety of passengers. Cybersecurity, geo fencing solutions and predictive models are key areas of development to ensure the safety of the car.

Major automotive companies teaming up with domestic and foreign startups

To achieve and maintain those competencies, the automotive industry needs to forge new alliance and invest in digital solutions. As an illustration, Toyota established Woven Planet in January 2021 to invest and develop mobility with AI. It acquired within the same year Renovo, a silicon valley based startup operating systems that integrate all the software needed to run

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[64] Japan Automobile Manufacturing Industry, *The motor industry of Japan 2017*, 2017, accessible at: http://www.jama-english.jp/publications/MIJ2017.pdf

[65] **Edge computing**: Edge computing works by capturing and processing information as close to the source of the data or desired event as possible. It relies on sensors, computing devices and machinery to collect data and feed it to edge servers or the cloud.

fleets of autonomous vehicles. Camera was also acquired and supplies real-time, high definition maps and data for driverless vehicles. Toyota is also in partnership with Apex.AI, a California based company which develops software for mobility systems, as well as with AWS to collaborate on its mobility service platform supporting cloud-connected fleet services.

Government initiatives toward MaaS and Level 4 of autonomous driving

The current Japanese regulation covers Level 3 of automated driving (L3AD)[66]. The Ministry of Land, Infrastructure and Transport (MLIT) amended in 2020 the Road to Vehicle Act to include equipment part of L3AD in the list of motor vehicle equipment subject to safety standards.

Further progress are observed since 2021, as the MLIT announced its plans for the development of Level 4 Autonomous Driving (L4AD). [67] This is materialized through the "RoAD to the L4Project", which was initiated by the METI the same year. The purpose is to develop necessary standardization rules, as well as to construct business models and industrial ecosystems on top of technical aspects. The project plans to perform multiple tests with the ambition to demonstrate L4AD cars in mixed spaces by 2025, including multiple vehicles, infrastructure and pedestrians. Similar initiatives are taken at global level, where Tesla, Waymo and European OEMs such as Mercedes are moving toward L4 and L5 development.

Moreover, the L4AD project goes hand in hand with the development of MaaS solutions as part of the government support for smart cities projects, which are undertaken at municipality level. Projects selected for government subvention for year 2021 include a great proportion of MaaS solutions, highlighting the importance of the topic for the public sector agenda and suggesting great progress in this domain in the near future.

For more information about opportunities in automated driving, refer to the past Minerva report:

Opportunities for venture firms, universities, and research institutes in the EU to conduct knowledge transfer with Japanese counterparts in nine digital technology areas (2018)
— by Toru Kodama

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[66] **Level 3 autonomous driving** can be described as a conditional automation, where the car is in full control in some situations and inform the driver when he or she must take the control, ensuring limited self-driving.

[67] **Level 4 autonomous driving** can be described as high autonomous driving, where the car can handle the majority of the driving situation independently, ensuring full self-driving under certain conditions.

4.2.2 Digital healthcare - Personalized and remote solutions

The medical sector offers numerous opportunities in incorporating technologies to improve patients' experience and provide safer, as well as more accurate results. Particularly in the context of Japan's aging population, digitalization is expected to reduce the burden of the domestic healthcare system and improve health services outcomes. When it comes to current digital penetration in the industry, only 5% of the Japanese population was using telemedicine services in 2018[68], suggesting important opportunities for further development in this area.

AI and IoT as key technologies to disrupt the healthcare sector

The promising trends for product innovation in healthcare include the development of wearable devices, telemedicine, as well as innovation in diagnosis and surgery practices through the incorporation of technologies such as AI and IoT.

[1] **Drug development and discovery** are areas from the healthcare sector which largely benefit from AI technologies through the application of machine learning. It allows the analysis of multiple data sources in a reduced time and can help predicting biomarkers in therapeutic response. An example of domestic success in Japan is the development of the drug DSP-1181 treating obsessive compulsive disorders, which managed to reduce the exploratory research phase to less than a year by leveraging AI.

[2] **Telemedicine** can be described as remote medical care provided to a patient who is not in physical contact with the doctor. Successful cases require connectivity and supporting technologies such as 5G enabling smooth interaction and efficient data sharing between the doctor and the patient. Near real-time data transfer and syncing also makes possible the use of AR and VR to carry out physical therapy. A key example is the case of the telemedicine project undertaken in Nagasaki in 2016, using real-time transmission of imaging and diagnosis data between Nagasaki University Hospital and the remote island of Kamigoto.

[3] **Internet of Medical Things (IoMT)** consists in wearable devices and other connected devices which can provide reminders, tracking and patient support when combined with apps. Use cases include smart pillboxes, equipped with sensors targeting medication adherence, helping patient to organize their medication with reminders and feedback. Another good example is the disease tracking app installed on mobile phones, which emerged in response to the COVID-19 pandemic.

[4] Advanced technologies can further help doctors to **perform disease diagnosis and assist surgeries**. For example deep learning can provide support in interpreting X-ray results or photographs faster and more precisely than human. On the other hand, robots can provide surgical assistance, as several use cases demonstrated they can complete operations successfully. Robotic-assisted surgery market is expected to grow further in the future domestically as well as globally, where Japan could potentially position itself as a leader considering its strength in robotics.

Major tech companies and startup ecosystem as main accelerators

Currently, AI and telemedicine solutions in the healthcare industry are developed by startup companies, as well as by major technology companies such as NEC and Fujitsu. R&D is also taking place in universities and public research institutes, while collaboration with the private

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[68] IPSOS, *Global views on healthcare 2018*, Accessible at: https://www.ipsos.com/sites/default/files/ct/news/documents/2018-07/Global%20Views%20on%20Healthcare%202018%20Graphic%20Report.pdf

sector is growing, as indicated by the report published by the EU-Japan Center on "*Artificial intelligence in the Japanese medical sector*".

For more information about opportunities in digital healthcare, refer to the publication of the EU Japan Center:
E-Health and Telemedicine in Japan (2021) – by Sven Eriksson
Artificial Intelligence in the Japanese Medical Sector (2020) – by Maths Lundin

4.2.3 Fintech and techinsurance – Cashless and automated decisions

Well-known industries for their transformation due to digitalization are the financial and insurance sectors. As highlighted in section 2.3.3, the financial industry has largely benefited from digital technologies to reduce cost by reducing paper work and human efforts in various processes, with an important contribution of AI. On the other hand, the sector offers tremendous opportunities in developing new revenue streams and business models through the development of mobile platforms or through the integration of technologies such as the blokchain, IoT and AI. The transition is key as Japanese banks have entered an era where maintaining the status quo is not a viable option. Indeed, the sector has been struggling over the past years as it has shown an annual decrease in profitability of 4.4% between 2014 and 2018[69].

Online platforms, mobile apps and cryptocurrency to support establishment of digital wallets and cashless payment systems

[1] In Japan, the cost of maintaining current cash-based infrastructure was estimated to ¥1.6 trillion yen annually, mostly supported by banks ensuring cash transport and ATM operations. Domestically, various well-established **digital wallets systems** such as PayPay, LINEPay or card-less online payment solutions like Paidy have gained popularity over the past years. Their solutions consists in zero-fee, peer-to-peer and consumer-to-business payments, easily adopted by merchants and users. Recent surveys highlight that the preference to cashless payment is growing since the pandemic, as nearly one third of respondents reported reduced usage of cash[70]. Although the transition toward cashless society seems to be progressing, the market and service landscapes remain fragmented with multiple platforms available, where no clear winner can be pointed out.

[2] Emerging **cryptocurrencies** are also providing an alternative to cashless payments. Relying on the blockchain technology, those do not require any institutional intermediaries allowing lower costs than traditional networks and remove the burden of approval processes and business cut-off times. In 2021, the Japanese crypto market is ranked as one of the largest in the world, counting 3.5 million users as of 2018, as reported by the FSA[71]. The availability of sales offices that enable users to easily trade crypto assets using the internet or smartphone apps for low fee has boosted the increase in the number of crypto asset exchanges in recent years. Multiple startups have emerged, offering platforms with a variety of services leveraging cryptocurrencies. Examples of main cryptocurrency exchange platforms include bitFlyer from Tokyo, but also foreign players such as Kraken originating from the United-Kingdom, or Binance from China.

[3] **Internet based lending** is offering alternatives to traditional lending practices. Based on analytics of transaction histories, it can automatically calculates interest rates and other terms using AI to suggest loans to client. Alternatively, it creates a place for peer-to-peer (P2P) lending. These offer substitute options for SMEs to apply for small loans in a more flexible and convenient manner. Successful examples include Credit Engine, which was launched in Japan 2017 as an online financing platform targeting SMEs. It assesses maximum loan amount eligibility by using data engine collating

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[69] McKinsey & Company and ACCJ, *Japan Digital Agenda 2030*, February 2021, Available at https://ceaa17af-1e95-46ee-9cbf-fff62ee679ca.filesusr.com/ugd/c01657_e32b2f3f71974adcb0d0aba48059b852.pdf

[70] Eunjo Chon, John Euart, David Hutchinson, and Sameer Kumar, *Financial decision-maker sentiment: Japan*, July 2020.

[71] Japan Virtual and Crypto assets Exchange Association, *Status report on cryptocurrency trading*, April 2018, fsa.go.jp.

data from multiple sources. Various P2P lending platforms have also emerged in recent years including Maneo, SmartLend and Funds.

[4] Investment advices: The emergence of fintech startups in investment services have increased competition toward retail banks traditional investment advice practices. AI has revolutionized the market, with the emergence of robo-advisors providing services through algorithmic trading or by managing customers' finance using machine learning. Those new services make trading available to a wider set of users with various levels in experience, who can easily access the market characterized by lower fees and providing intuitive dashboards. The number of startups in this domain has constantly grown over the past years with major players such as WealthNavi, while the majority of large banks have started introducing similar services, such as SMBC Robo Advisor or MUFG's PortStar.

Insurance services leveraged by AI and IoT solutions

Based on IoT solutions, insurance companies have started developing "**usage based insurances**", which consists in setting premiums and discounts according the customer's behavior. Typical examples are automotive insurances based on users' driving habits, which data is collected from connected car. Domestic examples include the recent partnerships of Aioi Nissay Insurance with US-based Cambridge Mobile Telematics. Their solution offers a telematics automobile user based insurance program relying on a small sensor device, which collects driving behavior and transmits data to the drivers' smartphone. Other use cases can be found in the healthcare sector. For example, SBI Life insurance has developed insurance premiums based on clients' lifestyle. The service offers health-promotion type insurance relying on a healthcare app delivered by FiNC Technologies, which collects data on users' health checkups, lifestyle habits, as well as genetic tests and calculates personalized insurance premium accordingly.

Innovation arising from startup ecosystem while large corporations are keen for partnerships and investments

It is undeniable that the startup ecosystem plays a key role in developing fintech solutions, providing disruptive and alternative solutions to traditional practices of the financial sector. From the development of digital wallets and wealth management solutions, to alternative lending solutions including P2P exchanges, it is deeply changing the landscape of the industry. On the other hand, large corporations are catching up by developing their in-house solutions through partnerships and investments. For example, large financial groups such as the SMBC or MUFG are more and more involved in hackathons, Open Innovation meet-ups, but also in creating ties with companies and institutions outside Japan[72] [73].

For more information about opportunities in fintech, refer to the past report from the EU-Japan Center:
The Evolving Fintech Landscape in Japan (2018) – by Max Berre
The Japanese Fintech Sector (2018) – By Nathalie Meyer
Blockchain in Japan (2019) – By Marta Gonzales

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[72] Sumitomo Mitsui Financial Group, *Fintech-promoting innovation with IT*, accessible at:
https://www.smfg.co.jp/english/company/initiatives/fintech.html ,
accessed on 31/01/2022.

[73] MUFG, 三菱UFJ イノベーション・パートナーズ2 号投資事業組合の設立について, [*Establishment of Mitsubishi UFJ Innovation Partners No.2 Investment Partnership*],
https://www.ip.mufg.jp/ja/news/__trashed/, published on 27/07/2021,
accessed on 31/01/2022.

4.2.4 Retail and e-commerce - Upgrading online and offline experience

The retail industry has faced a disruptive change of traditional sales channel with the introduction of online commerce. The impact was further amplified over the past years with the introduction of advanced customer data analytics, which contributes to more efficient targeting approach and leverages the power of e-commerce. On the other hand, offline shopping is also disrupted by technologies such as AI, VR and AR, which have created new opportunities to innovate customer experience.

Japan e-commerce led by Amazon and Rakuten, while SMEs' market transition remains challenging

Business to Consumer (BtoC) e-commerce market in Japan is positioned as the third largest market by revenue, behind China and the U.S, with sales counting for 3.5% of the GDP in 2019[74]. The domestic market is growing fast, as it indicated a growth in sales value of 7.65% from 2018 to 2019[75]. Although Japan positions very well when it comes to e-commerce in total sales value, the conversion rate of BtoC e-commerce in sales of good reached 6.76%[76] in 2019, lower than its neighbor countries such as China and South-Korea, which are both indicating e-commerce penetration of 24%. Forecasts suggest the market will continue growing at a rapid pace, accelerated by the impact of the COVID-19. As indicated by a survey conducted by McKinsey in 2020, Japanese consumers expressed an intent to purchase up to 20% more online even after the pandemic ended.

On the corporate side, a survey conducted by Jetro [77] provides insights about the importance of the e-commerce as part of established companies' strategies toward digitalization, indicating a growth in priority from 31% in 2017 to 39% in 2020. For SMEs, it is the technological solution they consider as the most important to implement as part of their digital transition journey.

When it comes to the market players, the growth in the domestic e-commerce industry is spearheaded by the two large-scale online retailers, namely Amazon and Rakuten, which generated sales exceeding one trillion Japanese yen and owned respectively 25.7% and 12.6% of e-commerce sales in 2020[78]. On the other hand, small retailers have now access to pre-built platforms to create their homepage to start online sales without the need to have hard coding skills. However, digitizing services, going online and offering delivery options still requires technical aptitudes (e.g. website design) as well as manpower (e.g. for delivery), which are not always equally available to all stores.

Advanced technologies such as AI, VR and AR disrupting online and offline shopping experience

Omni channel is the coordination of the different online and offline channels through which a customer can discover, experience, consume and purchase a product or services. Companies

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[74] UNCTAD, *Estimates of global e-commerce 2019, preliminary assessment of COVID-19 impact on online retail 2020*, Published in 2019, Accessible at https://unctad.org/system/files/official-document/tn_unctad_ict4d18_en.pdf.

[75] Ministry of Economy, Trade and Industry, 内外一体の経済成長戦略構築にかかる国際経済調査事業 *[Domestic market research on building an integrated economic growth strategy inside and outside the country]*, published on 02/07/2020, accessible at https://www.meti.go.jp/press/2020/07/20200722003/20200722003-1.pdf.

[76] Ibid.

[77] JETRO, 日本企業の海外事業展開に関するアンケート調査, *[Questionnaire survey on overseas business development by Japanese companies]*, February 2020, accessible at: https://www.jetro.go.jp/ext_images/_Reports/01/3f6c5dc298a628be/20200024.pdf

[78] Statista, *Most popular e-commerce sites in Japan as of November 2020,* published on 16/05/2021, accessible at: https://www.statista.com/statistics/1165994/japan-leading-e-commerce-sites/ , accessed on 06/10/2021.

that have the ability to coordinate seamlessly their digital and physical assets through the customers' journey stand to gain their loyalty.

Online shopping is optimized through the availability of integration of e-commerce platform and mobile application using APIs, while brands are also spreading information to the customer through their SNS platforms, as well as through targeted advertisement. Using data analytics powered by AI, personalized recommendations are made based on customer data collected through the various online and offline touchpoints.

Offline shopping is also benefiting from a change through the introduction of advanced technologies:

[1] The emergence of **augmented and virtual reality (AR and VR)**, combined with technologies such as 3D scanning or mobile applications offers the possibility for the customer to try virtually a product before buying it. Domestic use cases include Shiseido, which developed a makeup simulator app that allows the user to test makeup on their mobile screen as it was a mirror.

[2] **Unmanned stores** are starting to pop-up at several locations in Japan. Those require on-shelf sensors and AI equipped cameras to perform spatial analytics and detect when a customer takes or replace a product, while the cart is interfaced with a mobile application. For example the convenience store FamilyMart announced it prepares 1.000 unmanned stores in the country by 2024, after the completion of successful pilots[79]. This model offers multiple advantages of reduced costs (e.g. reduced staff and errors) but also collects a tremendous amount of data (e.g. instore customer

behavior), which can further be leveraged and monetized.

Major retailers collaborating with domestic and foreign startups

Retailers collaborate with various technology companies to incorporate digital solutions into their traditional model. Examples of partnerships include Imagr, a New Zealand-based startup, which developed a solution for connected trolleys, currently available in Japan's H2O retail stores [80]. Daiei, part of Aeon, has similarly teamed up with the Chinese startup Cloudpick, developing AI technology-based smart store solution, while Kinokuniya and Familymart have collaborated with Touch-To-Go, an affiliate startup of East Japan Railway supplying unmanned shops solutions.

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[79] Nikkei Asia, *FamilyMart preps 1,000 unmanned stores in Japan by 2024*, published on 10/09/2021, accessible at: https://asia.nikkei.com/Business/Retail/FamilyMart-preps-1-000-unmanned-stores-in-Japan-by-2024, accessed on 19/10/2021.

[80] Techcrunch, Bellan R., *New Zealand-based Imagr thinks camera-based AI is the future of shopping trolleys*, published on 27/08/2021, accessible at: https://techcrunch.com/2021/08/27/new-zealand-based-imagr-thinks-camera-based-ai-is-the-future-of-shopping-trolleys/, accessed on 29/10/2021.

4.2.5 Platform economy for consumer services

Platform economy can be described as businesses that create online networks facilitating digital interaction between people. High internet penetration rate and increasing use of mobile devices connected to the network have increased opportunities for the industry over the past decade, with the emergence of new business models characterized by alternative revenue streams, as described earlier in this chapter. There is a large variety when it comes to the type of digital platforms available today, ranging from the ones providing products (e.g. Amazon, Rakuten), to solutions for cashless payments (e.g. Paidy, LinePay) or online services. While all sectors and industries show room for endless opportunities for disruption, the service sector has shown multiple disruptive use cases across industries over the past years.

Entertainment industry leveraging subscription and on-demand model

The entertainment and leisure industry has leveraged new revenue streams through the introduction of subscription and on-demand models. These consist in offering virtual products or services provided through a monthly/yearly subscription to a platform, or through on-demand purchases via online stores.

Typical examples include the **SVOD[81] market**, which is expanding in the Japanese market, where main players are US-based Amazon and Netflix, counting respectively 15 million and 6 million subscribers. In comparison, local players such as Hulu Japan, DoComo Anime store and U-Next approximated each: 2.5 million subscribers by 2021[82], suggesting a strong position of US-based first movers in this domain.

Similarly in the **music industry**, Amazon music and Spotify are both used by 21.4% of smartphone users who have a music streaming app installed, followed by Apple (15.7%) and Line Music (13.9%)[83], indicating a leading presence of foreign players.

When it comes to an example of domestic success, **Smartnews**, recently crowned Japan's latest tech unicorn, runs a wildly successful news service that is powered by machine learning. It has expanded its business abroad to the US as well as in China and counts about 50 million readers globally by year end 2021.

Product as a service, Uberization and sharing economy transforming established industries

Sharing model allows the customer to use a service or a product for a given amount of time without owning it. Multiple industries and sectors were disrupted by this model from the hotel industry to restauration. Similarly to entertainment, US-based companies have a very strong advantage in offering these type of solutions, whereas examples of domestic companies taking the lead have been growing over the past years.

An annual survey conducted by PwC [84] on domestic sharing economy services indicates that the overall use of shared services increases annually, while the most popular domains concern solutions for goods (including clothes, home appliance, food, and children's good) and transports. Moreover, an important increase in

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[81] **SVOD**: subscription video on demand
[82] Media Partners Asia, *Premium video platforms reached 85 bil. Minutes streamed in Jan-Aug 2021, led by Prime video, Tver, AbemaTV & Netflix*, published on 04/10/2021, accessible at : https://www.media-partners-asia.com/AMPD/Japan2021/AMPD_Japan_September_PR.pdf
[83] Statista – *Japan leading music streaming apps smartphone*, December 2019, accessible at: https://www.statista.com/statistics/1030164/japan-

most-used-paid-music-streaming-services-smartphone/ , Accessed on 24/11/2021
[84] PwC, 国内シェアリングエコノミーに関する意識調査 2021, [Domestic survey on awareness about sharing economy, September 2021, available at: https://www.pwc.com/jp/ja/knowledge/thoughtleadership/2021/assets/pdf/sharing-economy2109.pdf

awareness was observed in the category of skills and labor (e.g. housework, help, and sitter) in 2021. In this context, the Japanese sharing economy association estimates that the market will grow from about ¥19 billion in 2020 to ¥128 billion in 2030.[85]

Typical examples include solutions for shared taxi **mobility**, where the most commonly used shared application is the domestic app GO, followed by the app DiDi originating from China. **Food delivery services** are led by Uber Eats, followed by the domestic app Demaekan. More recently, the US-based giant Doordash has announced its investment in the Japanese market.

Examples around **sharing of goods and spaces** are multiple and include the US-based app Airbnb.

Figure 35 - Sharing economy map
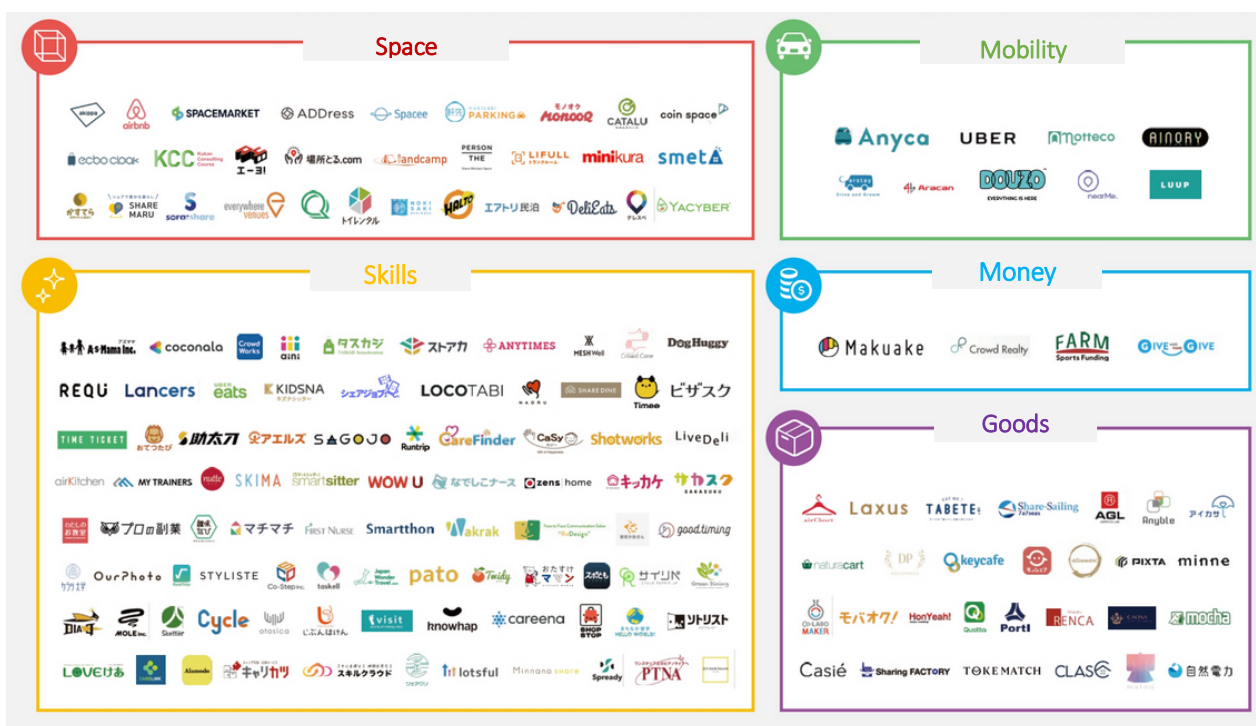
Source: Japan sharing economy association

Online platforms facilitating Consumer-to-Consumer market

Another key trend in solutions offered by platforms is the peer-to-peer economy. From crowdfunding, to house rental, various are the solutions that have emerged over the past years. One domestic successful case in Japan is Mercari, which emerged as popular alternatives to Rakuten's and Yahoo's marketplaces. The private venture categorized as a unicorn entered the Japanese CtoC market successfully through its mobile app in 2017, which recorded millions of monthly active users within the first years after its launch. The Japanese CtoC e-commerce market is estimated to 1,740.7 billion yen in 2019, with a registered growth rate of 9.5% from 2018 to 2019[86].

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[85] Japan sharing economy association, https://sharing-economy.jp/ja/, accessed on 28/12/2021.

[86] METI, *内外一体の経済成長戦略構築にかかる国際経済調査事業, [Domestic market research on building an integrated economic growth strategy inside and outside the country].*

05 OPPORTUNITIES FOR EUROPEAN SMEs IN JAPAN

Japan has been an attractive market for European companies for many years and represents a fertile ground for business expansion. It is characterized by a large and highly mature market, with a stable economy and untapped development possibilities. It offers an ideal space to deliver high-value, sophisticated products and services.

This chapter provides an overview of the market opportunities identified for EU companies throughout the report and highlights market trends, EU strengths, as well as challenges to enter the Japanese market.

Highlights

1/ Growing market and lack of domestic innovation. Forecasts suggest positive trends for digital solutions across all the industries. Japan represents a good opportunity considering the overall gap in digital transformation and the lack of innovation resulting from an undeveloped startup ecosystem. The shortage of domestic digital talents and the need for disruptive solutions pushes Japanese firms to look into foreign solutions which cannot be found locally.

2/ EU shows strengths in digital domains. Europe has demonstrated strengths in multiple areas, counting multiple startup and innovation hubs recognized internationally. It has strong solutions for trusted services and cybersecurity, healthtech services, cloud software for back-office operations, as well as solutions for e-government, autonomous vehicles and smart factories. Multiple use cases of successful exports of EU companies offering niche solutions suggest opportunities exist for Europe in Japan.

3/ Challenges. EU companies interested in the Japanese market may face multiple challenges considering old legacy systems, the language and cultural barriers, local regulations and the need to build trustful relationship, which may require patience and upfront investment. For some EU firms, digital branding may be an additional obstacle to attract interest from Japanese counterparts. Moreover, international competition is foreseen from US and Israel-based companies, as well as from firms based in the Asia Pacific region.

4/ Japan interest in EU market is growing. Industry voices indicate that Japan has shown a growing interest over the past few years to collaborate with European firms, suggesting a positive signal from the market.

5.1 Business opportunities for EU SMEs in Japan

The report has shown key trends arising from the introduction of digital technologies in the Japanese corporate environment. It pointed out great opportunities for development for BtoB solutions, where industries' voices indicate strong intension to undertake transition to digital, with a focus on the digitalization of business operations and processes. On the other hand when it comes to change in business models, enhanced products and services embracing advanced technologies also show opportunities in niche areas.

Based on market insights collected from the previous chapters of this report a well as through interviews organized with European Trade Organizations located in Japan[87], this section deep-dives further into the following **business opportunities identified for EU companies in Japan**:

Opportunity 1   BtoB solutions for data platforms and IT security
Opportunity 2   BtoB cloud based software-as-a-service (SaaS)
Opportunity 3   Public procurement for e-government and smart cities
Opportunity 4   IoT and AI for smart factory solutions
Opportunity 5   Software, AI and IoT towards L4AV and smart mobility
Opportunity 6   AI and connected devices for healthcare services
Opportunity 7   AI and platform solutions transforming the financial sector
Opportunity 8   Solutions for e-commerce and AR/VR, unmanned stores for offline shopping
Opportunity 9   Other promising opportunities

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[87] Interviews organized with European Trade Organizations' representatives located in Japan from December 2021 to January 2022 including France, Greece, Estonia, Portugal, Hungary, Denmark and members of the European Enterprise Network (EEN), as well as information collected through conversations and attendance to webinars organized by TPOs from other Member States.

Opportunity 1 – BtoB solutions for data platforms and IT security

🏬 Market trends

The section 2.3.1 has shown that the corporate landscape is in the process of digitalizing operations while priorities for future investments for IT solutions concern cloud solutions, electronic contracts/signatures and identification systems, as well as zero trust security solutions.

- **Corporate landscape moving to cloud and increased digitalization of back office**. While large companies have taken the lead of cloud adoption, smaller organizations are progressively following the path, with the pandemic as an accelerator. The transition suggests the need for supporting IT systems, system managements and security solutions is growing along with the trend.

- **Increased awareness around data governance and data management**. With the digitalization of processes comes along the increased need for a stronger data governance and the awareness around data management. The report has shown that Japanese corporations still lag behind European countries such as Germany in maturity level when it comes to data management practices, leaving large scope for future improvement.

- **Increased awareness around system security and cybersecurity**. Large corporations are indicating an increased interest in adopting zero trust security model, while overall awareness and concerns surrounding cyber risks has increased among SMEs.

💡 Opportunities for EU SMEs

- The **immature Japanese corporate landscape** in digital governance open opportunities in the following domains:
  - Digital trust and identification services. This include among others, electronic signatures, time stamps and security certificates.
  - Solutions for secure data transfers/data platforms.
  - Solutions for zero trust networks, zero trust architecture and cyber security.

- **European countries recognized for their competences.** Countries such as Estonia or Denmark show strengths in the provision of digital trust services, gaining international reputation for competently delivering government e-services. When it comes to cyber security, the Netherlands as well as Poland were placed among leaders in Cyber security solutions in Europe, while both have in place important security clusters, namely the Dutch "The Hague Security Delta" and the Polish "CyberSec Hub".

⚔️ Challenges

- **Competition with US-based and Israeli companies**. Important competition from US and Israeli companies is foreseen in the domain of trust services and cybersecurity.

- **Japan legacy systems** could potentially be a blocking factor for the deployment of advanced trusted services or cybersecurity solutions. As indicated in section 3.1, 60% of IT systems are foreseen to be older than 20 years by 2025, cross-company sizes and cross-industries.

- **Japan company culture**. Japanese users generally take longer time to reach a final decision, and may involve several meetings, very often in person, in order to clearly understand the product.

- **Customization and trust.** As a foreign company entering the Japanese market, product customization and localization are very likely to be required, while gaining trust from the business will be key considering that trust services and security solutions are supporting business critical functions. Particular efforts and a good understanding of the market is therefore foreseen to build trust with Japanese counterparts, which may require time and upfront investment to a certain extent.

BOX 5 – Use Cases - European data platforms and cyber security solutions in Japan

PlanetWay – Secure data collaboration platform - Estonia

PlanetWay is a Japanese-Estonian startup with its R&D unit based in Tallinn. Its main solution is Planetcross, a cross-industry secure data access platform. The solution connects the databases of various enterprises in a decentralized manner, connecting data between companies via the Internet without having to make major changes to existing systems or databases. It combines advanced e-government solutions incorporating technologies like blockchain to ensure the integrity and security of data and make it accessible to both individuals and corporations.

In 2019, the major Japanese gas company Nichigas has started using the Estonian solution ensuring secure data transfers through the use of digital signatures, encryption, authentications and logs. Nichigas has selected the solution to make it possible to find information across the databases of the group's five companies in their affiliated call centers. The company plans to expand the use of the system in the future.

Source : Invest In Estonia

Cybernetica – Secure data platform - Estonia

Cybernetica is an Estonian company that was founded in 1997 as an independent successor of the Estonian institute of cybernetics. It provides mission critical software solutions for governments and corporations, where its key products and competences include interoperability and secure data exchange (UXP and X-Road), digital identity, confidential data analysis and cybersecurity solutions. The company has established its presence in Japan since 2014, while it has been actively involved in research collaboration with the country since 2010, when joint research projects were started with the Japanese National Institute of ICT (NICT) .

Since then, Cybernetica has delivered its solutions at multiple occasions, partnering with Japanese companies such as Eltes, providing digital risk management services, or with Fujisoft, one of the largest IT solution vendor in Japan. Recent projects include the delivery of the UXP solution as an interoperability platform for finance and trustbanking related transactions for Sumitomo Mitsui. In 2018, the company has contributed to the provision of UXP for building medical services for the city of Yokohama.

Source : Cybernetica

Compumatica – Cybersecurity - The Netherlands

Compumatica is a Dutch Security Vendor delivering tailored solution to secure utility networks, creating secure boundaries in the network and encrypting all data within the power grid. In 2019, the company signed a MoU with TEPCO, the largest electric utility in Japan, to collaborate in the development of the secure Next Generation SCADA technology to control and monitor plants and equipment. Both companies have met each other during a trade mission to Japan in 2016, organized under the program "Partners for International Business Japan" coordinated by The Hague Security Delta.

Source : SecurityDelta

Opportunity 2 – BtoB cloud based software-as-a-service (SaaS)

🏯 Market trends

- **Estimated growth of the market**: The Japanese SaaS market is anticipated to record a CAGR of 19.3% during the forecast period, i.e. 2019-2027[88].
- **Ageing workforce and need to operate and respond to labor intensive tasks**. Deceasing workforce population in the nation is inducing organizations to adopt automated processes that utilize less labor-intensive approaches.
- **COVID-19 and shift to cloud to support telework.** The COVID-19 has been a major accelerator for firms to adopt solutions to support telework. Moreover, SMEs are investing in the adoption of cloud services on the back of increasing governmental investments for the development of ICT infrastructure in the country.
- **Improvement of business operations as a key priority when it comes to DX.** Voices from Japanese industries indicate the improvement of processes and operations as a major priority when undertaking initiatives toward DX.

💡 Opportunities for EU SMEs

- **Large room for progress for Japan ecosystem to adopt SaaS**. The section 2.3.1 has shown that Japanese corporations, in particular SMEs, are still in the process of being on boarded, while industry voices indicate investment in SaaS remains one of the priority for firms when it comes to investing in DX.
- **Increase in back-office solution demand and untapped vertical SaaS segment.** The post-corona situation has particularly seen an increase in demand for horizontal solutions covering back office tasks.[89] Interviews with European TPOs have highlighted that successful use cases in exports of software providing niche solutions to increase operations performances were observed. Identified promising areas are SaaS solutions for:
    - o Robotic process automation
    - o Data management and analytics
    - o Project management and process streamlining
    - o Marketing automation

  Whereas it is worth noting horizontal solutions are being more competitive with the strong positioning of domestic players, vertical solutions (designed for industries specific needs) could be an additional space for growth due to more untapped opportunities.

- **Several clusters ranked within world top 25 located in Europe**. In Europe, Paris, Amsterdam, Madrid, Berlin and Dublin were ranked among top 25 cities, as the main SaaS and cloud related startup ecosystems in 2018[90].

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[88] MarketWatch, *Japan Software as a Service (SaaS) Market Size, Industry Share and Forecast to 2027*, Accessible at: https://www.marketwatch.com/press-release/japan-software-as-a-service-saas-market-size-industry-share-and-forecast-to-2027-2021-09-02?tesla=y, published on 02/09/2021, accessed on 25/11/2021.

[89] BOXIL, *SaaS 業界レポート 2021, [SaaS industry report 2021]*, August 2021.

[90] Crozdesk, *Saas and Cloud Startup report 2018*, 2018.

⚔ Challenges

- As highlighted in the previous point, **Japan legacy systems** present a key challenge for the promotion of advanced SaaS solutions. Interviews with EU TPOs located in Japan indicated that legacy in-house systems are sometimes so outdated that it is not compatible with the offered software solution, a phenomenon particularly observed among Japanese SMEs.

- **Dynamic market with strong local and US-based competitors**. Japan's startup ecosystem is mainly composed of domestic SaaS providers, suggesting European companies could face strong competitiveness form local players. Moreover globally, the SaaS and cloud sectors are led by US-based companies, which benefit from larger funding and growth opportunities, as well as the strong label and recognition of "US-made-product". Barriers may be greater for European SaaS providers originating from smaller EU countries characterized by a weaker "digital branding" in comparison to other countries.

- Similarly to the challenges listed in [Opportunity 1](#), **the Japanese company culture** is often mentioned as challenging for deploying foreign SaaS solutions. Building trust may take time and patience, while the language is a key factor and solutions must be localized.

BOX 6 – Use Case: European SaaS for back office solutions in Japan

Probance - Marketing Automation Tool – France

Probance is a French-based SME providing a platform for BtoC marketing automation (MA), which incorporates machine learning to realize predictive communication. It has multiple offices in Europe as well as in the US and is commercializing its services in Japan. Clients include large corporates as well as SMEs.

The company has been collaborating with Brainpad, a Japanese firm specialized in providing services for digital marketing, which offers Probance's MA solution as one of its portfolio product.

In 2021, Itochu, one of the largest general trading company of Japan, has announced its collaboration for the creation of a new digital transformation support service in the marketing domain, where Probance will be contributing by bringing its solution and expertise in MA.

Source : Probance

Opportunity 3 – Public procurement for e-government and smart cities

Market trends

- **Current state of e-government services shows room for progress**. Only 13% of administrative procedures of the central government were digitalized in 2020, while only 7.5% of the citizens were using government apps for administrative services. [91]

- **The establishment of the Digital Agency (DA) as an accelerator for digital initiatives**. As highlighted in [section 1.2.1](), the recently established DA has been designated as the governmental body in charge of centralizing digitalization policies and measures. This includes initiatives such as moving to the cloud, implement data governance, digitalize administration services and set in place an e-ID system (MyNumber), as well as related trusted services.

- **The development of smart cities as one of the priority domains of the 6th STI plan.** On top of the digitalization of the government administrative services, the development of smart cities are also considered as a top priority with the objective of setting in place 100 projects by 2025. Among key projects are mobility, healthcare and government administrative services.

Opportunities for EU SMEs

- **European countries have shown successful implementation of e-government solutions,** for example with the case of Estonia, where 99% of government administration processes are digitalized. The GoJ has also closely looked at use cases in other EU countries such as Denmark and Sweden for reference. For EU SMEs with proven track-records in developing successful public IT services in their countries, Japan might be an interesting market to pursue.

- **IT services might be comparatively less complex than other sectors in responding to public sector demand**, as it is guided by international standards to a higher extent and knows fewer barriers such as local standards and certifications.

- **Europe is well positioned for smart cities, where initiatives are growing.** Zurich is classified second in the IMDB Smart city ranking 2021 among cities with the highest scores for technology indicators. Other European cities classified in the top 10 include Oslo (#3), Lausanne (#4), Helsinki (#6) and Copenhagen (#7)[92]. As multiple initiatives are undertaken across Europe, it opens opportunities for EU SMEs, which contributed to the successful procurement and delivery of solutions for smart cities.

Challenges

- **Procurement process and language barrier** remains a great barrier as the procedures take place in Japanese, suggesting that it is very likely required to have a local partner.

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[91] Mitsubishi UFJ Research and Consulting, 国・地方一体となったデジタルトランスフォーメーション, *[Digital transformation that unites national and local governments]*, Published on 25/02/2020, Accessible at: https://www5.cao.go.jp/keizai-shimon/kaigi/special/reform/committee/20200225/shiryo1.pdf.
[92] IMD, *Smart City Index 2021*, 2021, Accessed on 04/01/2022.

- **Tendency to prioritize domestic vendors**. In the daily public procurement practice thus far, Japanese government organizations depend on a relatively small pool of very large, mostly Japanese, IT system developers and integrators.
- **Legacy systems**. Similarly to the private sector, the GoJ, local prefectures and municipalities are no exception when it comes to legacy systems, which may be a challenge to consider when offering solutions or services that integrate advanced technologies.

BOX 7 — Use Case: European solutions for e-government in Japan

KMD – IT software solution for e-gov - Denmark

KMD holding is a company originating from Denmark, which is specialized in developing IT solutions for Danish municipalities and governments. It is a well-established organization which was founded in 1971 and which counted 3 200 employees by 2021. The KMD Group has subsidiaries in Denmark, Norway, Sweden, Finland and Poland, with more than 1 500 Danish and international customers.

In 2018, the Japanese electronics maker NEC announced it would acquire KMD Holding as part of its strategy to grow in the provision of digital services and software for the public sector. Part of the basis for acquiring KMD was the fact that Denmark is regarded as one of the role model for improving public-sector services, as the country came out no.1 for e-government development in the UN e-government Survey 2018.

Both companies found mutual benefits in this transaction, as those saw complementarities in know-how and potential integration of products. Moreover for KMD, it was a massive change as it was sold by local governments to a private group characterized by an international foothold, representing a strong new platform for developing KMD activities.

Source : KMD

Opportunity 4 – IoT and AI for Smart Factory solutions

🏭 Market trends

- **Estimated growth of the market**: Factory IoT is expected to more than double from ¥ 541 billion in 2019 to ¥ 1.100 billion in 2025[93].

- **Immature digitalization of the manufacturing processes**. In practice, digitalization of the manufacturing sector is still immature, in particular for SMEs. Introduction of sensors and data analytics along the production line or the adoption of wearable devices are still uncommon and led by large domestic players and forerunners.

- **The government is actively promoting Connected Enterprises** with multiple government support (including local regions and municipalities) in R&D programs, as well as to support innovation of manufacturing processes in SMEs (example: SBIR, municipalities' initiatives such as iToP Yokohama).

💡 Opportunities for EU SMEs

- **Increased interest of the manufacturing sector in incorporating digital solutions**: the report has shown in section 3.4 that manufacturers show clear interest in the digital transformation along the engineering chain, in particular when it comes to the industrial design and production process.

- Trends and forecasts suggest the **following domains as particularly promising** for further development:
  - Solutions for the digitalization of the production process, including the need for sensors capturing data and providing visualization along the production chain, relying on IoT and M2M solutions.
  - FA/ Industrial robots solutions for predictive maintenance and quality control.
  - Solutions for product and industrial process designs (e.g. digital twins and simulations).
  - System/software for manufacturers including ERP, MES, SCADA, production scheduling systems.

- **Strong initiatives are identified in Europe**, such as "Industry 4.0" in Germany, "Industrie du future" in France and "Industria 4.0" in Italy, while other countries such as Finland and Austria have also demonstrated advanced technological solutions in manufacturing.

⚔️ Challenges

- **A transition relying on the initiatives of the industry's giants**. The typical Japanese Zaibatsu system does not provide the incentive for small manufacturers to undertake digital transformation for the manufacturing process, as large companies themselves are not advanced in the adoption of such technologies.

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[93] JETRO, *Invest Japan - Manufacturing,* 2021, accessible at:
https://www.jetro.go.jp/ext_images/en/invest/img/attractive_sectors/manufacturing/manufacturing_EN_202103.pdf

- **Priorities of the management level differ with DX.** Although awareness around the benefits of adopting digital solutions is increasing, for the broader spectrum and approaching the industry as a whole, minimizing costs remains a key priority and convincing factories management to take actions and invest in costly solutions may represent a great barrier.

BOX 8 - Use case – European solutions in Japan for smart manufacturing

CENIT – 3D factory simulator software - Germany

CENIT Japan KK, the Japanese subsidiary of CENIT headquartered in Germany, was established in Tokyo in July 2011. The company has a global presence with 17 offices across Europe, North America and Asia, counting about 700 employees worldwide.

CENIT is engaged in IT software development and consulting, primarily for manufacturers and financial service providers. It places special emphasis on the development of software that predicts equipment failures through 3D simulations of entire factories by building virtual factories in cyberspace. The software conducts verification and analysis that is necessary before actual production and proposes an optimal production line based on the data collected via the network. Its aim is to improve productivity, reduce costs by decreasing the number of problems that can occur during the manufacturing process and eventually make factories fully automated in the future.

In 2016, CENIT has conducted experimental studies in partnership with HIROTEC corp., a leading Japanese manufacturer specialized in the production of automotive body parts, in order to develop a system that can quickly work out in cyberspace the best response to problems or emergencies that may occur in the actual factory. The software also enable predictions about potential equipment failure.

Source : Jetro

METRON – Cleantech solution for factories – France

METRON is a French-based startup founded in 2012. It has expanded to 9 locations globally, counting 120 employees across the world. It provides an AI-based enterprise platform to support energy management and reduction in factories.

The company has benefited from NTT investment in 2019, where the large Japanese corporation met the French startup in 2017 in Amsterdam, during the European Utility week. Since then, METRON has set a branch in Japan.

In 2021, OMRON, a Japanese manufacturer of control equipment and factory automation systems, has announced its investment in METRON's solution with the purpose of reducing greenhouse gas emissions from production activities. The company hopes to improve energy productivity in factories and to contribute to the realization of corporate carbon neutrality through the adoption of the software solution.

Source : EU-Japan

Opportunity 5 – Software, AI and IoT for autonomous driving toward L4 AV and smart mobility

🏬 Market trends

- **Japanese strong automotive sector is undertaking the development of L4 AV,** as well as the development of connected cars for the upcoming years, with multiple initiatives of open source innovation led by industry's leaders.
- The government is aiming to **put in place regulation and technical support** for the development of autonomous driving and is proactively working on the development of appropriate infrastructure and framework, in line with the development of MaaS solutions to promote smart cities.

💡 Opportunities for EU SMEs

- **The development of L4 AV and connected cars rely on multiple capabilities**, which solutions are very often delivered by startups. Use cases show that collaboration with foreign startups is considered by Japanese companies. Opportunities are foreseen particularly in the following domains based on market trends identified in section 4.2.1 :
  - Solutions for autonomous driving and connectivity including sensors and cameras for spatial localization, integrating AI solutions to control and enable autonomous vehicle, as well as IoT solutions for secure communication between the vehicles and infrastructure components.
  - Data management platforms and reliable transmissions systems from the vehicle to the cloud.
  - Solutions for connected services, leveraging data generated by the vehicle.
  - Solutions for shared mobility and fleet services.
  - Solutions for vehicle safety.
- **Connected cars and L4 AV solutions are also strongly promoted and developed in Europe**, where activities are growing with the emergence of startups in France, Germany as well as in Austria, Italy and Spain[94]. From a regulatory perspective, Germany is set to legalize the commercial use of L4 AVs as shuttle bus and autonomous public transportation bus by 2022.

⚔️ Challenges

- **Strong competition from the US startup hubs**. Similarly to the other software segments, the United-States is home to most of the firms involved in the development of such solutions for automated vehicles.
- As already highlighted for the SaaS industry, companies providing software solutions originating from European countries **characterized by a comparatively weak digital branding** may face greater challenges to attract interest or to build trust with potential customers and partners.
- **Undeveloped regulations for AV**. Regulations for automated vehicles are still in development, while clear standards and infrastructures are not in place yet. As such, the changing regulatory environment and compliance requirements may be a point to consider.

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[94] StartUs Insight, *Top 10 automotive industry trends and innovation in 2021*, Accessible at: https://www.startus-insights.com/innovators-guide/automotive-industry-trends-10-innovations-that-will-impact-automotive-companies-in-2020-beyond/ , Accessed on 24/12/2021.

BOX 9 – Use case – European solutions for L4 AV and connected cars in Japan

Veniam – Network for autonomous cars - Portugal

Veniam is accelerating future mobility by delivering intelligent networking software for connected cars and autonomous vehicles. With an IP portfolio of more than 160 patents, Veniam's data networking platform makes the most out of all available networks to improve quality of service and reduce the costs of moving massive amounts of data between vehicles and the cloud. Working closely with the world's largest Auto OEMs and Tier 1 suppliers, Veniam provides a solution for securely managing the data flows of a new and emerging mobility ecosystem – the Internet of Moving Things – where vehicles move people and goods efficiently but also expand Internet coverage and gather valuable data for smart city applications.

In 2018, the company has explored joint solutions for the connected vehicle market with DENSO, supplying advanced automotive technology, systems and components for major automakers, through a MoU.

As part of their collaboration, Veniam and DENSO will explore the integration of Veniam's intelligent data networking features in DENSO's Communication Management (DN-CM) systems. This combination will significantly improve the ability of vehicles to move large amounts of data by leveraging multiple different networks securely.

Source : Cision

EasyMile – Self-driving cars – France

EasyMile is a global technology company specialized in self-driving technology, founded in 2014. The company has been drawing attention for its cutting-edge software development of fixed route driverless technology. Its software for driverless solutions processes data fed by any platform's sensor set, analyzes it and teaches vehicles how to perform. Its clients include leading transport operators, city authorities, airports, business parks, universities, manufacturers, factories and logistics centers.

The company has entered Japan through the participation to business matching events, which ultimately opened opportunities to several projects, including small driverless automobiles that have started to be sold, as well as other projects that are currently undergoing demonstration tests.

For now, the company has its Japan base at an office at the French Chamber of Commerce and Industry in Japan, while it has announced it plans to launch soon a Japanese subsidiary in Tokyo and fully expand to Japan.

Source : InvestTokyo

Opportunity 6 – AI and connected devices for healthcare services

🏛 Market trends

- **Expected growth of the market**: Health technology market size is expected to more than double from ¥ 129.2 billion in 2020 to ¥ 270.2 billion in 2026[95]. Main contributing areas are solutions for prevention and health control, recuperation and rehabilitation, as well as consultation and treatments.

- **Low maturity of Japanese market when it comes to telemedicine services**, as indicated by a penetration rate of 5% of telemedicine use in 2018[96].

- **The Japanese silver economy is growing,** with a population of approximately 120 million people, of which 30% are projected to be 60 years old or older within a decade. The current state urges the need for more efficient services and reduction of costs of medical services, which can be leveraged through the introduction of digital technologies.

- **Healthcare/pharmaceuticals** as top-10 of most funded sector by VC firms in Japan in 2019.

💡 Opportunities for EU SMEs

- Market trends as indicated in section 4.2.2 suggest medtech offer interesting opportunities for EU SMEs providing AI and IoT solutions in the healthcare domain, with a strong focus on the **software component**:
  - AI solutions for clinical trials and drug development
  - Automated and AI powered diagnosis using medical imaging and data analysis

  But also for **advanced material and devices**:
  - Advanced equipment for labs and clinical tests
  - Connected and wearable devices for health management and health monitoring
  - Solutions for robots assistance for remote or assistance surgery

- **Europe holds a strong position in the medtech industry,** positioning second in terms of market size behind the US, with 27% of the global medical device market in 2018. In comparison Japan reached 7% the same year. Leading countries in this domain are Germany, France, Italy, Spain as well as the Netherlands. In 2018, there were around 27 000 healthtech companies in Europe, of which 95% of them were SMEs[97].

- **A rapidly growing segment in Europe.** The combined value of European healthtech companies has grown from $ 8 billion in 2016 to $ 41 billion in 2021. This has been brought on by telemedicine, operation software and insurtechs, while VC investment activity has moved beyond telehealth, to remote monitoring, AI-first products as well as digital therapeutics[98].

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[95] Statista, *Forecast of health technology market size Japan FY 2020 – 2026*, Published on 17/08/2021, Accessible at: https://www.statista.com/statistics/1030901/japan-digital-health-market-size/, accessed on 04/01/2022.

[96] IPSOS, *Global views on healthcare 2018*, Accessible at: https://www.ipsos.com/sites/default/files/ct/news/documents/2018-07/Global%20Views%20on%20Healthcare%202018%20Graphic%20Report.pdf

[97] Medtech Europe, *The European Medical technology industry in figures 2020*, 2020, Accessible at: https://www.medtecheurope.org/wp-content/uploads/2020/05/The-European-Medical-Technology-Industry-in-figures-2020.pdf.

[98] Dealroom, *Digital healthcare, patient first?* , April 2021, accessed on 04/01/2022.

⚔ Challenges

- **Heavy regulatory process characterized by long procedures**, while the documentation is most of the time in Japanese language. This eventually requires a connection with an experienced partner in Japan and may need to consider upfront costs.

- **Weak European brand offer**, as small EU SMEs and startups in the IT fields are not well known and may face preference for local products.

- **The distribution system may also represent a challenge** when it comes to solutions for advanced and connected devices, also considering the need to build up an after sales organization that satisfies Japanese companies.

BOX 10 – Use case – European solutions for healthtech in Japan

Coala Life – Smart Cardiac Monitoring - Sweden

Coala Life is a Swedish digital health venture founded in 2015, focusing on cardiac diagnostics and digital health. The company has developed a portfolio of patented medical products and services for user-centered digital remote monitoring and analysis of the heart based on advanced and smart algorithms. Coala's solutions enable analysis, remote monitoring, more effective cardiac assessments and integrated care services, all in real time.

In 2019, it entered in technology partnership with multi-billion Japanese medical device company Asahi Kasei to expand into the Japanese heart failure market. Together, they are exploring the possibilities to develop novel digital biomarkers for heart failure and evaluate the clinical solutions in terms of service feasibility in Japan.

Source : Coalalife

Sidekick health – Digital therapeutics/gamified digital care – Iceland/Sweden

The Nordic startup Sidekick Health provides a platform that combines clinical validation with gamification, behavioral economics and AI, delivering personalized experience for patients.

In 2020, the company partnered on a pilot project focusing on treating diabetes with SOMPO digital lab, which supports the digital innovation of the Japanese group. The proof of concept is primarily focusing on exploring the feasibility of the solution delivered by Sidekick for enabling basic heath outcome such as lower glucose level, improved sleep quality, weight loss and other parameters.

Source : Sidekick health

Opportunity 7 – AI and platform solutions transforming the financial sector

🏦 Market trends

- **The financial sector is among the most advanced in comparison to other industries in Japan** when it comes to the transformation of business operations, as section 2.3.1 highlighted that the adoption of cloud, RPA and AI was the most intensive in the industry.

- **Expected growth of the market**: FinTech market in Japan is expected to grow from 1.9 billion USD in 2019 to over 10 billion by 2022[99], largely led by digital payments solutions.
Among the rapidly growing fintech segments, the market size of insurtech grew at a CAGR of 22.05% from 2016 to 2019, reaching a market size of 809 million USD by 2019. The market is expected to grow further and accelerate as from 2020 to almost triple to more than 2 billion USD by 2022[100].

- **Japanese companies are in need for collaboration with fintech startups** and are actively promoting investment and partnership, as well as conducting proof of concept in the banking, securities and insurance domains as shown in section 4.2.3.

- **The GoJ is promoting deregulation,** positioning finTech as part of its national strategy since 2016, in line with its vision of Society 5.0. In 2016, the Banking Act was amended to encourage banks to establish IT related subsidiaries to develop fintech business, while the shift to cashless payments is also promoted with the goal to double Japanese consumer's cashless payments usage rate to 40% by 2025.

💡 Opportunities for EU SMEs

- **Japan is seen as a potentially lucrative market to expand into for EU-based fintech**, in particular when it comes to already developed commercial and operational know-how. The following are potential areas of expansion:
  - Banking and asset management solutions for payment and transfer systems, blockchain and cryptocurrencies, robo-advisory, lending solutions, but also security solutions growing in line with increased digital risks.
  - The number of insurtech companies in Japan is small for the size of the insurance market, while the country is a latecomer in the global market. On the European side, insurance companies were leading fintech sector's funding growth in 2021 [101], suggesting great opportunities for European startups to explore Japan's untapped market.

- **With the purpose of revitalizing Tokyo's position in the international financial market** the Japanese Financial Service Agency (FSA) as well as the Tokyo Metropolitan Government (TMG) have set in place dedicated teams to attract foreign Fintech companies interested to expand their business in Japan.

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[99] Yano Research Institute, *FinTech Market 2019*, 2019.
[100] Yano Research Institute, *A study undertaken on the domestic Insurtech market in the life insurance sector*, published on 12/03/2020.
[101] CBinsights, *Fintech funding trends in Europe*, 2021.

- **Europe counts multiple fintech hubs** leading innovation in banking, asset management and insurance. Among the biggest and rapidly growing hubs are Berlin, Paris, Stockholm, Vilnius, Amsterdam and Dublin.

⚔ Challenges

- **Uncertainty of the regulatory framework for disruptive solutions.** New participants entering the market with significant disruptive effect or solutions may face regulatory challenges due to the inexperience with the existing financial regulatory framework. In such cases compliance may be lacking or insufficient.
- **Competition with domestic startups and with firms based in the Asia-Pacific regions** is expected given the fintech adoption rate in those regions and the attractiveness of the Japanese market.

BOX 11 – Use case – European solutions for fintech and insurtech in Japan

Shift Technology – Insurance claim processing – France

Shift Technology is a French-based company established in 2014, providing a decision making platform designed for insurance fraud and claim handlers to increase their capacity to detect a wide spectrum of fraudulent and suspicious claim behaviors. It has expanded its activities to Europe, Tokyo, Singapore and Hong Kong and signed contracts with more than 50 insurers covering property & casualty insurance, travel, life and health business lines.

The company entered the Japanese market in 2017 through the participation to the Tokyo Metropolitan Government accelerator initiative, where it was chosen as one of the 8 finalists of the business camp. The program helped accessing support and providing exposure to insurance companies, the target group of Shift Technology.

Prior to entering Japan, the company has taken 6 months to prepare for the business activities in Japan to localize the solution and spent time physically in the country to establish relationships with the domestic insurance industry.   *Source : Invest Tokyo*

Wefox – Insurance management platform for consumers - Germany

Wefox is a German-based startup established in 2014 that provides a digital platform for insurance information management for consumers, insurance brokers and insurers by leveraging AI, big data and cloud solution.

The company has expanded its activities in Japan since 2019, establishing SBI Wefox Asia K.K. jointly with SBIHoldings, a Japanese company active in financial and asset management services. Together, they are deploying the platform solution providing consumers with a centralized app for managing insurance documents in one place, allowing update of policies and personal details through the platform, as well as to file claims through the app with real time status tracking.

Source : Fintech Futures

Opportunity 8 – Solutions for e-commerce and AR/VR, unmanned stores for offline shopping

🏬 Market trends

- **E-commerce sales are expected to rise at a CAGR of 5.9% between 2021 and 2025**[102]. Japan is no exception, as the COVID-19 has brought a permanent shift in consumer buying behavior and has accelerated their adoption of online purchases.

- **Online sales are led by large industry players,** indicating that market shares are largely hold by online retail platforms Amazon and Rakuten. In contrast, SMEs show a large room for further adoption of online sales practices.

- Offline shopping is recently showing **the emergence of unmanned stores**, where demonstrations and practical implementations are led by domestic convenience stores. The GoJ is largely contributing to its promotion with the support of the METI.

- **Initiatives in image recognition and VR/AR** to improve offline user shopping experience have been growing over the past years but it remains an undeveloped segment.

💡 Opportunities for EU SMEs

- The development of omnichannel approach requires companies to **improve online operations and customer experience**, opening opportunities in the following segments:
  - Front end solutions for e-commerce platform including interfaces with advanced functionalities for improved UX.
  - Back-end solutions such as API cloud for established companies to link and integrate their pre-existing systems to a newly launched e-commerce website, along with the need for cybersecurity solutions.
  - Marketing automation and data analytics tools (eg. SaaS solutions as referred in earlier in opportunity 2) arising from the deployment of e-commerce, including solutions such as deep-learning for demand prediction, dynamic pricing or machine learning for customer segmentation.

- Moreover, improvement of **in-store customer experience and operations** leveraging tech suggests opportunities for:
  - Solutions for image recognition and VR/AR to enhance customer experience with extended reality.
  - Solutions for robotics, inventory and logistic software to support shop automation and the development of unmanned stores, in-store shopping assistance, stores network optimization and delivery.

- **Investment in European retailtech has been growing by 10% YoY from 2015 to 2020** with a focus on SMACT technologies (Social, mobile analytics cloud and IoT), indicating a growing startup landscape in this domain. Leading countries in investment for the period in scope were France,

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[102] GlobalData, *"Japan e-commerce market to grow by 10.5% in 2021"*, published on 23/09/2021, Accessible at : https://www.globaldata.com/japan-e-commerce-market-grow-10-5-2021-says-globaldata/ , accessed on 11/01/2022.

Germany, Sweden and Spain[103]. The COVID-19 has been a great accelerator, with a particular increase in investment in 2019 in European startups developing tech solutions for marketing and research, payment platforms, last mile fulfillment for delivery, chatbots, interactive stores as well as solutions for operations including analytics, pricing tools, inventory and logistics. Japan may be a potential market for further expansion, given the similarly growing demand for these type of solutions.

⚔ Challenges

- **The retail and distribution sectors are the ones that have the greatest reliance on legacy systems**, where one third of the companies[104] in the industry are almost relying entirely on such systems. This is to be considered when deploying advanced solutions relying on established systems as it represents a great barrier for the digitalization and adoption of newer technologies. Moreover existing non-standardized products and customer IDs hinder supply/demand and customer data analytics.

- **Lack of in-house digital maturity and capabilities to deploy digital products**. Many retailers do not have in-house digital knowledge and understanding to drive deployment and change, whereas they very often outsource work related to digital to system integrators. This is to consider when bringing EU solutions to Japan and defining a market entry strategy.

BOX 12 – Use case – European solutions for retailtech in Japan

Virtusize – Online fitting solution - Sweden

Virtusize was founded in 2011 in Sweden and provides a way for customers purchasing online to check whether a listed garment would fit by either comparing it to a previous purchase or by measuring an item already available at home. By 2018, the solution was available on 20% of Japanese e-commerce websites for clothing and had partnered with 45 retailers in Japan including Uniqlo, Balenciaga and Acne.

The European startup was acquired for €11 million in 2018 by a group Japanese investors including Yahoo Japan Capital, Ideos Venture Cap fund, D4V and Toyoshima, a large company from the textile industry.

Source: *TechEU*

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[103] NautaCapital, *"How Europe's startup are driving the retailtech R/evolution"*, 2020.
[104] McKinsey & Company and ACCJ, *Japan Digital Agenda 2030*, February 2021, Available at https://ceaa17af-1e95-46ee-9cbf-fff62ee679ca.filesusr.com/ugd/c01657_e32b2f3f71974adcb0d0aba48059b852.pdf

Other promising opportunities

All industries without exceptions are disrupted by digital transformation, both from an operational and business perspective. It is worth mentioning this report has focused on a limited number of sectors and technologies given the complexity and the broad range of industries, processes and solutions concerned. The following segments are additionally identified as interesting opportunities, but not limited to, for EU SMEs and for which further analysis is worth to be considered.

[1] **Greentech solutions**. The growing concern around climate change and the need to shift toward more environmentally sustainable practices have played in favor of the development of greentech solutions, described as technologies used in production processes that enable sustainable forms of energy. A good example is the previously analyzed use case METRON, the French-tech startup delivering an online platform to reduce factories energy consumption. Another successful example of EU expansion to Japan in this domain is Doconomy, a Swedish startup that develops solutions for businesses and their customers to visualize their environmental impact when they make purchases. The company has entered into a partnership with the Japanese firm Datafluct in 2021. Together they plan to develop a green fintech solution that reflects the effects of carbon dioxide emissions and water consumption from users' payment data, for example, when customers pay with credit cards.

[2] **Infrastructure and construction sector.** Infrastructure and construction is a segment to consider given that, although very advanced, Japan public infrastructure is currently facing important deterioration. The country's rapid economic growth period has created a shortage of skilled labor and increased the financial burden for inspection and maintenance. Moreover the government has also indicated the development of infrastructure for disaster prevention as a key priority for the coming years. Employing digital tech solutions to increase accuracy, performances and maintenance in these domains has been strongly encouraged by the government's i-construction policy, which advocates the development of solutions for geospatial analysis, drones, as well as connected sensors. Recent example includes the expansion to Japan of the Finnish company, Iceye, delivering satellite solution to monitor earth data.

[3] **Agritech solutions.** AgriTech solutions are expected to grow in order to address the shortage of skilled labor. Cultivation and production control solutions have been popular, but sales and operational support, as well as precision farming are also forecast to grow significantly in the coming years. Japan has already shown interest in EU practices and solutions in this domain as shown by the successful expansion of Gremon Systems, a Hungarian startup founded in 2013. The company offers integrated cloud-based solutions using connected devices installed in plants. Those collect data about workers' activity as well as plants, which is processed through an in-house developed software. The solution provides growers with relevant information that helps them better exploit their resources, reduce costs and achieve higher profitability.

[4] **Extended reality for the gaming industry.** Japan being one of the leader in the gaming industry, software solutions in this domain have attracted the industry's interest, as suggested by recent partnership agreement between Virtual training, a company headquartered in the Czech Republic and growB Sports Communications, a sports marketing creative agency based in Tokyo. The Czech firm provides solutions for landscapes and countryside virtual visualization. Together they will create cycling courses and run events for the augmented reality platform, "ROUVY" delivered by Virtual

Training, while the Japanese partner will ensure an accelerated AR course production and will provide support for event management locally.

5.2 Recommendations for market entry and practical tips

5.2.1 Recommendations for market entry

Establishing presence in Japan

As already highlighted several times in the opportunities analysis, Japan is known for its corporate culture, which strongly values trust and long term relationships to tie any kind of partnership, requiring very often multiple in-person meetings and exchanges over time. This is particularly true when it comes to solutions that are linked to business critical systems. Although practices have slightly evolved toward online meetings in response to the COVID-19 pandemic, use cases suggest it may be of good benefit to have a physical presence in the country. A **sales representative** in Japan is an option to limit the costs and to connect with the domestic network.

Industry voices have indicated that once introduced to the Japanese market, the establishment of a **branch office** is not mandatory however a nice to have, in particular when the offered product/service requires aftercare maintenance or customer service, where Japanese customers are very often demanding to have a local presence.

Creating network and business touchpoints in Japan

Establishing a relationship with a **local partner** is highly recommended to benefit from support for product localization, language and translation, potential introduction to existing networks, as well as to get access to regulatory and compliance advices. This is particularly relevant for solutions with a strong need for localization (language and cultural fit) but also for heavily regulated sectors such as the financial or healthcare industries.

In recent years, the number of **business platforms and events** in relation to digital domains has increased, providing the opportunity to create networks, meet potential customers or gain visibility in the Japanese market:

[1] The amount of industry specific fairs promoting digital solutions has significantly increased over the past years. Recent examples of events organized in 2022 include the Smart Factory Expo Japan, the Smart Logistics Expo or the Healthcare IT Fair. Many others are taking place on a regular basis focusing on specific technologies or sectors.

Use cases which were presented in the [previous section](#) have shown that several successful cases of European expansion to Japan started from networks created during business fairs, suggesting it is an effective channel to gain visibility and connect to the market.

[2] **Matching platforms and events** are set up and organized by private as well as public organizations (e.g. European Union, European embassies, trade organizations or the GoJ) to encourage international business connections with Japan. It is worth looking into existing platforms, as well as to check on a regular basis whether events or programs are taking place to get in touch with potential Japanese partners or customers. As a consequence of the pandemic, many events are taking place online or in hybrid format, giving the opportunity to a larger audience to join with the advantage of reduced participation costs.

Moreover on the Japanese side, the GoJ has also created multiple platforms in specific domains to connect industries, academics and governmental bodies as part of its strategy to

promote DX (e.g. Smart city, IoT, AI, healthcare, quantum platforms). Although many of those are only available in Japanese, it may be worth exploring further network opportunities with the support of a local partner or representative.

[3] Open Innovation forums and business contests are organized by large Japanese corporations seeking for innovation utilizing technologies, ideas, resources and assets of external organizations. Although open innovation remains limited in Japan in comparison to global peers, the practice has become familiar to large Japanese companies and is continuing to expand. Multiple open innovation programs and business contests were organized across industries over the past years, of which examples include NTTData Open Innovation for the telecom industry or MUFG Innovation Partners for financial services.

It is also worth leveraging existing **institutions and hubs** to deploy a network in Japan, in particular considering the expanding startup community and the growing contribution of universities in the development of advanced technologies and in R&D.

[1] Startup communities, universities, accelerators, VCs, R&D and innovation hubs. The number of startup and innovation hubs has been increasing in Japan together with the growth of VC markets. As highlighted in [section 4.1](), those remain relatively small in comparison to global peers, however a positive evolution has been observed over the past years. The key startup cluster in Japan is identified as Tokyo, whereas innovation and technology clusters are identified in the capital, as well as in the areas of Osaka-Kobe-Kyoto and Nagoya. Multiple events for networking are

organized, for example, by the non-profit organization Venture Café Tokyo, which indicated close to 24% of the 19 000 attendees who participated to the organization's events between 2018 and 2020 were not from Japan[105]. For European startups active in the digital domains, it may be beneficial to investigate relevant hubs which could be potential channels to connect to the growing community of accelerators, mentors, and incubators as well as to VCs or CVC investors.

[2] Public Trade Promotion Organizations. European domestic Trade Promotion Organizations, the EU-Japan Center for Industrial Cooperation, as well as the Japan external trade organizations (Jetro) can help European companies to get in touch with markets and relevant industries in Japan, through the provision of various services to business and by connecting firms to their established networks.

A variety of market entry models

The preferred method for market entry will very likely depend on several elements including the nature of the solution (e.g. software, platform, device, service), its maturity stage (in development, ready-to commercialize, already commercialized with success) and the maturity of the company. Considering that tech solutions are very often delivered by startups, those may face other challenges and needs compared to long established companies (such as capital and resources) when considering market entry.

[1] Direct entry. Some companies opt for direct entry to market without partnership or support from a Japanese corporate venture nor system integrators. This entry method matches with solutions and products that have a proven business model and that have shown

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[105] Rueckert P., Bridging the culture gap: Venture café tokyo's plan to develop networking in japan, Startup Guide, published on 05/02/2020, Accessible at:

https://startupguide.com/venture-cafe-tokyo-plan-to-develop-networking-in-japan , Accessed on 14/01/2022.

commercial success in the country of origin or at international level, facilitating discussions with potential Japanese clients. The company has very often sufficient resources and expand to Japan as part of its internationalization strategy. Examples from the analyzed use cases include Shift Insurance (see Box 11), which have established a branch to directly operate in the country.

[2] **Partnership/Joint Venture**. Some EU companies enter the market through a partnership or joint venture with a local partner, which relationship is very often characterized by a complementarity in technologies or market knowledge. For example, the establishment of Wefox KK Asia (see Box 11) results from a joint venture leveraging Japanese SBI Holding's market knowledge and German Wefox's insurtech solution. Other use cases in this report highlighted partnerships of startups with industries giant to conduct PoCs and explore the commercial feasibility of the European solutions, such as CoalaLife's partnership with Asahi Kasei (see Box 10) or Veniam with Denso (see Box 9).

[3] **System integrators** play a key role in connecting Japanese companies with disruptive IT solution providers by scaling partnership with BtoB startups. Fujitsu, NEC, NTT data and Hitachi can be listed among main Japanese system integrators, whereas smaller IT service companies covering more specific areas (e.g. data analytics, digital risks, and so forth) are also cooperating with IT solution providers. This market entry approach is particularly relevant for EU companies delivering proven market products including software, trust services or platform solutions. Examples from this report include the Estonian firm Cybernetica (see Box 5),

which had an alliance with Eltes delivering the jointly developed tool Vizkey, or Probance and its partnership with Brainpad (see Box 6), deploying the French marketing automation solution to the Japanese market.

[4] **Corporate Venturing**, is a way for startups to get sufficient funds, industry expertise and connections, as well as market knowledge from a large and well established company. Tokyo has one of the largest presence of corporate investors among global ecosystems, with more than 60% of startup rounds having a corporate investor. This suggests the importance of CVC in the development of the Japanese startup ecosystem. Moreover, 15% of overall CVCs funding represented overseas investments[106], in a context where funds available for startups outpaces the amount of homegrown startups. This suggests a window of opportunity to attract capital from Japan for EU companies. The nature of investments are also responding to the need of startups in seeds phase, as it shows that Japan investors are more open in providing long term investments, as opposite to European VCs which tend to prefer quicker turnarounds and proven business models.

[5] **Public procurement.** When it comes to targeting the public sector and government services such as products and solutions for smart cities or solutions for administrative services, European companies will need to apply through local public tenders, which are very likely to be in Japanese. Given identified barriers to entry including language and favoritism to local vendors, a partnership with a local player or a participation to a consortium could potentially facilitate and raise the chance to get an engagement in public procurement.

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[106] World bank (2021), *Tokyo Start-up Ecosystem,* published on September 2021

5.3 Insights from Trade Promotion Organizations

5.3.1 Insights from EU Trade Promotion Organizations (TPOs) in Japan

- **Startups are the key players in exporting European digital solutions to Japan**. Although not limited to them, startups were identified as the main contributors by TPOs when it comes to opportunities or recent initiatives that took place in the digital domains from Europe to Japan.

- **Smaller countries from the continent are struggling to attract market interest.** Depending on country of origins, the approach may be more/less difficult in relation to the country's digital branding. Whereas France is known for its "French tech" or Estonia recognized for its "e-government" solutions, other countries which are less known for their digital competences may face challenges to attract interest for investments or partnerships.

- **European startups leveraging the "US-based" label to enter Japan**. In response to the above mentioned issue, some successful startups entering the Japanese market which have established their headquarters in the US did not disclose their European background for a better positioning and visibility in Japan.

- **Japanese market attracts less interest from EU companies in the digital domain.** Interest from EU SMEs has been comparatively lower in the Japanese market, as those have the tendency to favor other EU or US markets with less barriers to entry and closer relationships considering cultural differences, the language and the geographical distance. However interest remains strong for startups in niche solutions, with a greater incentive to expand globally and going beyond the EU or the US markets.

- **E-government market opportunity is of great interest.** Several EU countries have raised their interest in expanding e-government solutions in Japan, given current initiatives undertaken by the Japanese government. However the domestic procurement process, and in particular the language barrier, have been raised as a key issue to approach the market, suggesting further dedicated effort and support in this segment could open opportunities for EU companies.

- **Growing response and interest over the past years from the Japanese market.** Several TPOs have indicated that receptiveness and enthusiasm from the Japanese market to European digital solutions has been growing over the past 3 to 5 years, indicating a good signal for European expansion to Japan.

- **Large companies and system integrators remain the main clients and partners.** Successful cases of deployment of European digital solutions to Japan are very often taking place in partnership agreements and collaborative development as part of Open Innovation Programs or CVCs led by large industry leaders, or through the introduction of system integrators incorporating European solutions into their service/product portfolio.

5.3.2 Recommendations to the EU-Japan Center

Recommendations to promote EU digital solutions in Japan

[1] Europe to promote the Japanese market in the digital domain. EU countries that would like to promote the expansion of their solutions to Japan need to understand in the first place their domestic strengths (industries and technology solutions) and identify local startups/innovation hubs and networks. Moreover, they should actively promote and communicate the attractiveness and the benefits of the Japanese market in the digital domains to raise interest from EU firms, considering that those have the tendency to prioritize other EU countries or the US for international expansion.

[2] Counter weak digital branding with regional approach. For EU countries characterized by a weaker digital branding, it may be interesting to approach the Japanese market from a broader perspective. Promotion at a regional level (e.g. with "Eastern Europe" or "Europe" branding) may help for a more efficient positioning to counter weak domestic branding, for example, when participating to business fairs or when organizing business matching events.

[3] Startups and entry mechanism. Although expansion of EU solutions to Japan is not limited to startups, those play a key role in the digital revolution and as such, represent the main candidates that will eventually export digital solutions. Market entry mechanism and partnerships' targets may slightly differ from long established companies. Indeed, there is a growing role of CVCs, VCs, accelerators, R&D/innovation centers, universities and startup ecosystems. Main opportunities in Japanese markets were identified to respond to the needs of large organizations and system integrators seeking for solutions unavailable locally. It may be worth considering expanding networks for those channels and to monitor on a continuous basis VCs and CVCs initiatives to further identify opportunities for EU companies.

Opportunities for the EU-Japan Center for future research

[1] Evaluate opportunities in policy and R&D cooperation. Recent trends indicate that Japan as well as Europe are in favor of international cooperation. Multiple topics are considered, for example, to set up international standards to facilitate cooperation in domains such as Data Free Flow with Trust, cyber security, data protection or ethical AI. It is worth conducting further analysis around this topic and identify key policy and R&D cooperation areas that could strengthen EU-Japan relationships and benefit both parties.

[2] Conduct sectorial approach for future research. This report was conducted with a generic approach of the digital transformation in Japan, with the purpose of providing a holistic overview of current trends in the country. A more in-depth sectorial analysis may be valuable to generate more precise insights regarding a given sector or technology solution and guide the corporate landscape accordingly. Indeed, as stressed by the report, technologies such as AI, IoT, sensors, platform solutions or intelligent devices disrupt industries in multiple ways, while their importance and uses are fragmented from a sector to another.

CONCLUSION

CONCLUSION

A digital transition moving slowly in Japan

The report has shown that Japan still shows room for progress when it comes to DX. Both the public and the private sectors are concerned, whereas the GoJ is investing important efforts to guide the country toward digital shift. The comparatively low productivity level and the ageing population are urging the need for change, while the 2025 digital cliff and the COVID-19 pandemic have greatly contributed to accelerate the trend.

The country still faces multiple structural challenges to achieve the Society 5.0 as it envisions. The lack of digital talents, the low digital maturity of government services, the under-developed startup ecosystem, as well as the broad range of firms characterized by old style corporate management hinder the country's transition.

In this context, it is without surprise that the Japanese corporate landscape shows room to gain maturity in DX. Whereas facts and figures reveal that overall awareness around digital practices and benefits has been rising, it also shows it has not materialized yet. Overall, the digital transition is led by industries' giants while SMEs, composing 99% of corporate landscape in numbers, are largely lagging behind.

Industries voices indicate main priorities remain in the improvement of business operations, while established companies do not invest much in the development of new services/products leveraging digital technologies. Innovative initiatives transforming business models and products are led by forerunners in the automotive, manufacturing, healthcare, financial and retail sectors.

Key players driving digital innovation are startups, which ecosystem is growing, however remains comparatively small in Japan. The main contribution and demand are coming from corporate giants and system integrators, getting involved through open innovation programs, partnerships and CVC funds.

Window of opportunities for EU SMEs in Japan

EU firms interested to enter the market will need to overcome the challenges of old legacy systems, the language and cultural barriers, local regulations, as well as the need to build trustful relationships, which may require time and patience. Those may eventually feel the need to have at least a local representative or partner. For some EU companies, digital branding may also be an obstacle to overcome to attract interest from Japanese firms. Moreover, international competition is foreseen from US and Israel-based companies, as well as from firms based in the Asia Pacific region.

Nevertheless, opportunities for EU SMEs were identified within all industries disrupted by digital transformation, suggesting firms that can propose trustful and innovative solutions will find their place in the Japanese market. This is particularly true if they offer the potential to fill the domestic gaps resulting from the lack of local digital talents, as well as the lack of disruptive innovation.

For well-established firms, which can supply innovative solutions with proven business models to their Japanese counterparts, they can opt for direct market entry or work together with domestic system integrators to deploy their solutions. Alternatively, partnerships and joint-ventures are also a good option to leverage complementarity in technologies and to benefit from partners' market knowledge and resources. For startups in niche industries seeking for funds to grow, Japan also represents a good

opportunity as it counts multiple large CVCs seeking for innovation abroad that they cannot find locally. Finally when it comes to solutions for public procurement, it seems to be a promising but challenging channel, where EU companies may need to collaborate with local partners to overcome entry barriers.

As the report has shown, the market is characterized by positive trends, where some segments are forecasted to reach double digit growth. It has also identified numerous use cases of EU companies holding unique solutions that have managed to successfully enter Japan, suggesting that the country remains an attractive market to consider for international expansion in the digital domain.

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APPENDICES

Appendix 1 - SIP Research and Development themes (FY 2018):

Strategic Innovation Creation Program (SIP) Phase 2 (2018-) Issue List:
- Cyber space infrastructure technology utilizing big data and AI
- Physical space digital data processing infrastructure
- Cyber-physical security for an IoT society
- Autonomous driving (expansion of systems and services)
- Material revolution by integrated material development system
- Realization of Society 5.0 through light and quantum technologies
- Smart bio-industry and basic agricultural technologies
- Energy system of an IoE society
- Strengthening national resilience (disaster risk reduction and mitigation)
- Advanced diagnostic and treatment systems using AI (artificial intelligence) hospitals
- Smart logistics services
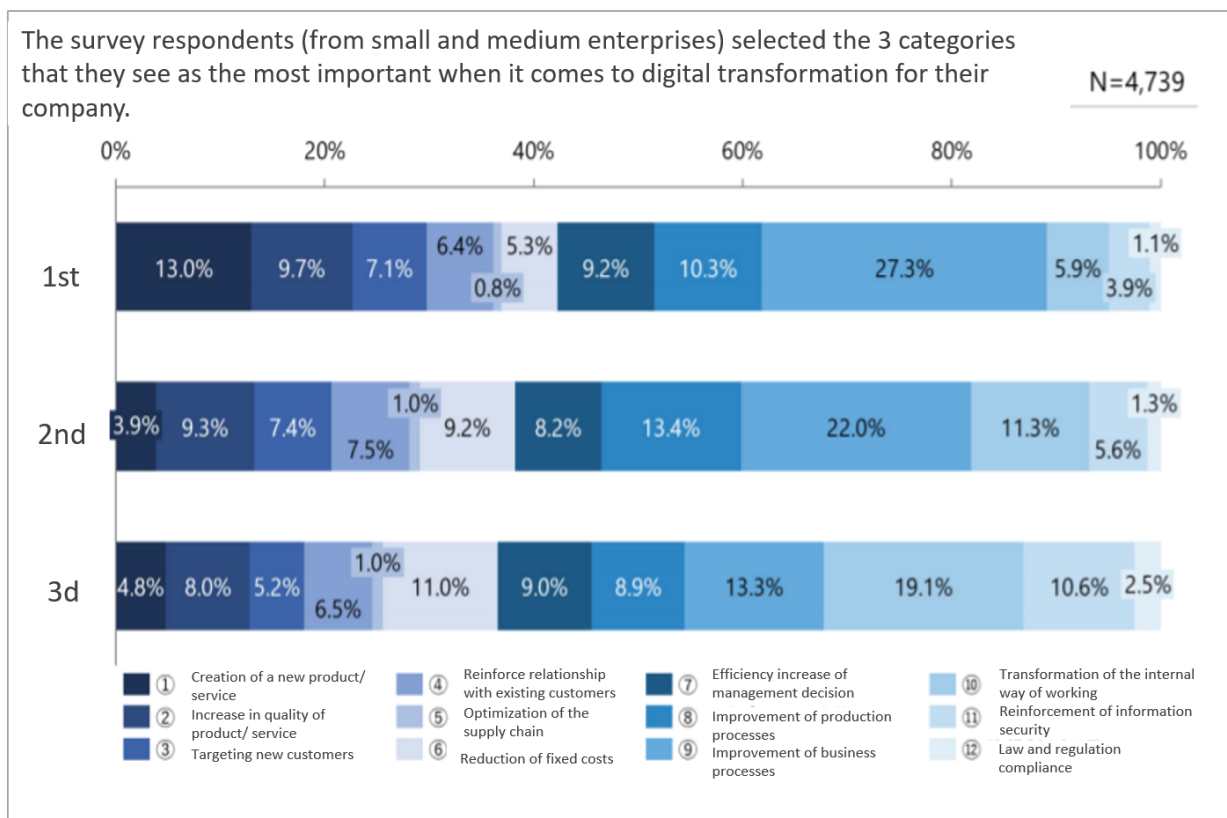- Innovative deep sea resources survey technology

Source: Cabinet Office website: https://www8.cao.go.jp/cstp/gaiyo/sip/index.html, Accessed on 11/11/2021.

Appendix 2 – Moonshot R&D program

Moonshot goals	R&D projects
GOAL 1 - Realization of a society in which human beings can be free from limitations of body, brain, space, and time by 2050.	The Realization of an Avatar-Symbiotic Society where Everyone can Perform Active Roles without Constraint
	Liberation from Biological Limitations via Physical, Cognitive and Perceptual Augmentation
	Cybernetic Avatar Technology and Social System Design for Harmonious Co-experience and Collective Ability
GOAL 2 - Realization of ultra-early disease prediction and intervention by 2050.	Comprehensive Mathematical Understanding of the Complex Control System between Organs and Challenge for Ultra-Early Precision Medicine
	Challenge toward the Control of Intractable Cancer through Understanding of Molecular, Cellular, and Interorgan Networks
	Challenge for Eradication of Diabetes and Comorbidities through Understanding and Manipulating Homeostatic Systems
	Towards Overcoming Disorders Linked to Dementia based on a Comprehensive Understanding of Multiorgan Network
	Understanding and Control of Virus-Human Interaction Networks
GOAL 3 - Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.	Smart Robot that is Close to One Person for a Lifetime
	Innovation in Construction of Infrastructure with Cooperative AI and Multi-Robots Adapting to Various Environments
	Co-evolution of Human and AI-Robots to Expand Science Frontiers
	Adaptable AI-enabled Robots to Create a Vibrant Society
GOAL 4 - Realization of sustainable resource circulation to recover the global environment by 2050	Development of technologies to recover greenhouse gases ("GHGs") and convert them into valuable materials
	Development of technologies to recover nitrogen compounds and convert them into harmless or useful materials
	Development of marine biodegradable plastics which can control the timing and speed of their degradability
GOAL 5 - Creation of industry that enables sustainable global food supply by exploiting unused biological resources by 2050"	
GOAL 6 - Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.	Research and Development of Theory and Software for Fault-tolerant Quantum Computers
	Development of Quantum Interfaces for Building Quantum Computer Networks
	Fault-tolerant Quantum Computing with Photonically Interconnected Ion Traps
	Development of Large-scale Fault-tolerant Universal Optical Quantum Computers
	Large-scale Silicon Quantum Computer
	Quantum Cyberspace with Networked Quantum Computer
	Development of Integration Technologies for Superconducting Quantum Circuits
GOAL 7 - Realization of sustainable care systems to overcome major diseases by 2040, for enjoying one's life with relief and release from health concerns until 100 years old	Development of method for complex tissue regeneration via tissue embryonization
	Realization of innovative medical systems that extend healthy lifespan to 100 years old by eliminating tissue inflammation- inducing cells
	Quantum and neuromodulation technologies to suppress tissue-specific disease-related micro inflammation
	Development of new-generation medical care systems through customizing sleep and hibernation
	Mitochondrial medicine

Source: Moonshot R&D Program official web page: https://www.jst.go.jp/moonshot/en/index.html , Accessed on 03/02/2022.

Appendix 3 – Priorities in digital transformation (SMEs)

The survey respondents (from small and medium enterprises) selected the 3 categories that they see as the most important when it comes to digital transformation for their company.

N=4,739

Source: Ministry of Economy, Trade and Industry, 令和２年度中小企業のデジタル化に関する調査に係る委託事業 報告書, [2020, Report on SMEs Digital transformation]

Appendix 4 – JUAS survey: Methodology

The industry survey was conducted by the Japan Institute Users Association of Information Systems (JUAS). The survey took place from September to October 2020 and reached 1146 companies, cross-industries. Those were classified into 7 main categories namely, (1) construction, (2) material manufacture, (3) machinery manufacture, (4) trading and distribution, (5) financial, (6) social infrastructure and (7) services.

1. The composition of the surveys' respondents is as follow:

			2020		2019	
			Count	Ratio	Count	Ratio
Manufacturing industry	1.	Food, drink, tobacco, food manufacture	42	3.7%	36	3.7%
	2.	Textile manufacturing	7	0.6%	10	1.0%
	3.	Paper and paper manufacture	10	0.9%	5	0.5%
	4.	Chemical Industry	54	4.7%	49	5.1%
	5.	Petroleum, coal, plastic manufacture	9	0.8%	10	1.0%
	6.	Ceramic, stone products manufacture	13	1.1%	15	1.6%
	7.	Iron and steel industry	16	1.4%	17	1.8%
	8.	Non Ferrous metals, metal manufacture	55	4.8%	35	3.6%
	9.	Electrical machinery and equipment	58	5.1%	52	5.4%
	10	Information and communication equipment	6	0.5%	9	0.9%
	11	Machinery and equipment for transport	43	3.8%	37	3.8%
	12	Other machinery and equipment	47	4.1%	43	4.4%
	13	Other manufacture	117	10.2%	84	8.7%
Non-manufacturing industry	14	Agriculutral, fishing an dforestry	5	0.4%	3	0.3%
	15	Construction	86	7.5%	70	7.2%
	16.	Energy, gas, heat and water supply	16	1.4%	13	1.3%
	17.	Image, audio, infomation, communication	12	1.0%	14	1.4%
	18	Newspaper, pubishing business	7	0.6%	6	0.6%
	19.	Information service industry	58	5.1%	62	6.4%
	20.	Hotel, travel and catering industry	30	2.6%	23	2.4%
	21	Transportation industry, postal services	60	5.2%	47	4.9%
	22.	Wholesale industry	114	9.9%	98	10.1%
	23.	Retail industry	96	8.4%	73	7.5%
	24.	Financial and insurance industry	48	4.2%	44	4.6%
	25.	Medical industry	9	0.8%	7	0.7%
	26.	Education and education support	3	0.3%	3	0.3%
	27.	Other non-manufacturing industries	125	10.9%	102	10.5%
	Total		1146	100.0%	967	100.0%

The following industry categories were created with the following composition:

Industry Group	2020		2019		Industries
	Count	Ratio	Count	Ratio	
Construction	86	7.5	70	7.2	15. Construction
Material Manufacture	206	18.0	177	18.3	1 Food, drink, tobacco, food manufacture 2 Textile manufacturing 3 Paper and paper manufacture 4. Chemical Industry 5 Petroleum, coal, plastic manufacture 6. Ceramic, stone products manufacture 7. Iron and steel industry 8. Non Ferrous metals, metal manufacture
Machinery Manufacture	271	23.6	225	23.3	9. Electrical machinery and equipment 10. Information and communication equipment 11. Machinery and equipment for transport 12. Other machinery and equipment 13 Other manufacture
Trading and distribution	210	18.3	171	17.7	22. Wholesale industry 23. Retail industry
Financial	48	4.2	44	4.6	24. Financial and insurance industry
Social Infrastructure	95	8.3	80	8.3	16. Energy, gas, heat and water supply 17. Image, audio, infomation, communication 18. Newspaper, pubishing business
Service	230	20.1	200	20.7	14. Agriculutral, fishing and forestry 19. Information service industry 20. Hotel, travel and catering industry 25 Medical industry 26. Education and education support 27. Other non-manufacturing industries
Total	1146	100.0	967	100.0	

Source: JUAS, 企業IT 動向調査報告書 2021, *[Corporate IT Trends Survey Report 2021],* **2021,** Accessible at https://juas.or.jp/cms/media/2021/04/JUAS_IT2021.pdf.

Appendix 5 – DX maturity (per industry)

Average score

3.35 — 5.23

Main subjects	DX subjects	Technology	Healthcare	Media	Food and Drink Services	Education	Advertisement and communication	Retail	HR and talent	Lifestyle	Manufacturing
Vision and strategy	01 Initial internal consideration of DX	5.23	4.70	4.90	4.64	4.76	5.06	4.78	4.83	4.76	5.02
	02 Examining ideal state of the company	4.99	4.42	4.67	4.49	4.49	4.82	4.52	4.50	4.55	4.80
	03 Formulation DX execution plan	4.82	4.18	4.36	4.24	4.28	4.47	4.34	4.33	4.43	4.56
	04 DX roadmap	4.78	4.15	4.30	4.23	4.25	4.43	4.26	4.26	4.27	4.55
Business transformation	05 Change in Business model incl. DX	4.67	4.08	4.27	4.11	4.20	4.44	4.16	4.21	4.22	4.39
	06 DX pilot project	4.66	3.97	4.25	4.02	4.17	4.35	4.07	4.06	4.15	4.29
	07 Cooperation with digital players	4.17	3.71	3.66	3.63	3.65	3.84	3.67	3.67	3.60	3.88
	08 Creation of new business from DX	4.39	3.79	3.93	3.73	3.88	3.99	3.83	3.81	3.94	4.00
Customer experience	09 Change in CX through digitalization	4.43	3.89	3.97	4.02	4.00	4.30	4.05	3.90	4.10	4.16
	10 Product/service personalization	4.31	3.81	3.83	3.83	4.07	4.01	3.92	3.75	3.90	4.04
	11 Dynamic pricing	4.25	3.88	3.90	3.82	3.92	3.91	3.89	3.84	4.04	3.97
	12 Optimization of omnichannel	4.25	3.83	3.86	3.81	3.97	3.92	4.03	3.93	3.93	4.05
Operations	13 Digitalization of back office	4.86	4.43	4.45	4.28	4.41	4.71	4.43	4.35	4.57	4.55
	14 Digitalization of RD activities	4.27	3.66	3.79	3.56	3.87	3.90	3.62	3.35	3.69	4.09
	15 DX of production processes	4.35	3.75	3.85	3.89	3.86	3.94	3.85	3.67	3.91	4.31
	16 Digitalization of distribution processes	4.14	3.96	3.82	3.97	3.87	3.93	4.03	3.58	4.02	4.24
	17 Interoperablity with existing systems	4.48	3.92	3.99	3.80	4.02	4.03	3.98	4.00	4.02	4.18
	18 Reinforcement of cyber security	5.01	4.64	4.69	4.59	4.68	4.78	4.69	4.66	4.65	4.75
	19 Agile management of projects	4.72	3.93	3.95	3.96	3.99	3.98	3.99	3.86	3.86	4.14
	20 Data collection from digital technology	4.71	4.02	4.29	3.89	4.14	4.38	4.21	4.05	3.91	4.29
Digital capabilities	21 Set up of a digital department	4.75	4.33	4.69	4.19	4.30	4.71	4.36	4.24	4.15	4.43
	22 Education of digital talent	4.60	4.08	4.20	4.08	4.19	4.38	4.20	4.12	4.03	4.27
	23 Securing internal digital capabilities	4.64	4.03	4.15	4.11	4.16	4.32	4.09	4.00	3.98	4.24

Source: Accenture, 業種別・企業規模別の DX の状況と課題が明らかに ～DX サーベイの調査・分析結果から見る日本企業の現状, [DX survey, analysis of state of Japanese firms, Insight on DX adoption based on industry and company size], published on 22/06/2021, Accessible at: https://www.accenture.com/jp-ja/insights/local/dxsurvey, accessed on 06/09/2021.

Appendix 6 - TOP 10 Japanese startups in funding received (H1 2021)

	Company	Business description	Year	Fund raised in H1 2021
1	Smart HR	Cloud based HR software	2013	145.31
2	SmartNews	News app for mobile devices	2012	131.95
3	Paidy	Buy-now pay later service	2008	121.92
4	Mobility Technologies	Taxi hailing app "GO"	1977	92.86
5	Net protection holdings	Payment services	2018	64.72
6	Netstars	QR code payment gateway "Starpay"	2009	61.29
7	Atonarp	Molecular sensing and diagnosis products	2009	50.54
8	Menu	Food delivery app	2018	46.43
9	Heartseed	Myocardial regenerative medicine	2015	37.14
10	UniFa	Childcare related technologies using AI/IoT	2013	37.14
11	Ubitus	End-to-end support for online gaming	2012	36.21
12	Bitkey	Platform for user account linking, authentication	2018	28.24
13	ThinkCyte	High speed next-generation cell sorting technology using AI.	2016	26.46
14	LegalForce	AI driven contract review software	2017	24.90
15	Axelspace Holdings	Solutions in the microsatellite domain from development to launch and operation	2020	24.01
16	WealthPark	Cloud based asset management SaaS product	1967	23.21
17	Open8	AI-powered automated video editing solution	2015	23.21
18	Kyukux	Next-generation material for OLED displays and lightning	2015	22.33
19	Noile-Immune Biotech	Immunotherapy solutions based on CART-cell terapy using patient's own immune system	2015	22.12
20	Reiwa Travel	App based international travel services	2020	20.90

Source: Initial, *Japan mid-term summary*, published on 20/08/2021, accessible at, https://initial.inc/articles/japan-startup-funding-2021-H1-en , accessed on 03/02/2022.