A DIGITAL SOCIETY FOR AN AGEING POPULATION
The Japanese experience

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Introduction

According to a UN (2020) report, the number of persons worldwide aged 65 or above is projected to double by 2050 to reach 1.5 billion people. Japan currently has the highest old-age dependency ratio (OADR) in the world, with 51 persons aged 65 years or over per 100 persons aged 20 to 64 years. UN (2020) projections indicate that in 2050, Japan will remain the country with the highest OADR (81 persons). Demographers have long written about the declining birth rates, on the one hand, and increasing longevity of the Japanese population, on the other, yet it could be argued that the discourse about Japan ageing started in the 1980s, amplifying when the term chōkōrei shakai (super-ageing society) began to appear in the late 1990s (Coulmas 2007). The topic of a super-ageing society is still prevalent today in policy discussions (Vogt 2008), academic debates (Coulmas et al. 2008; Tamiya et al. 2011; Heinrich and Galan 2018) and in the news media. Indeed, with Japan having the highest proportion of older adults in the world, the consequences of an ageing society are not limited to the health care and social security systems, but impact all levels of society.

It could be argued that the well-functioning and sustainability of Japan’s social system as a whole would be challenged by the economic costs and social implications of a rapidly ageing population. There is a need for comprehensive measures to tackle these issues, and the Ministry of Health, Labour and Wellbeing (MHLW), the primary responsible Ministry in relation to the ageing population, affirmed its commitment to move into the direction of community-based integrated care for the elderly in the report “The Japan Vision, Health Care 2035”, launched in 2015.

These people-centred, comprehensive and inclusive approaches to care for an elderly population clearly constitute an important pillar of any remedial measures. Alongside and complementing these health and care policies, what we observe today is the emergence of challenge-driven science, technology and innovation (STI) policy backed by digital technologies and data-infrastructure, with a particular focus on the issues of an ageing population. In this regard, Japan is an interesting benchmark for at least three dimensions. Firstly, it has spent heavily on STI over the last two decades, investing a high proportion of its GDP in research and development (R&D) (3.26% in 20181). Secondly, since 2016 the Japanese government in

1 Data accessed at https://stats.oecd.org/.
tandem with the Keidanren (Japanese Business Federation) has been promoting the concept of a “Society 5.0” as a response to the rapid evolution of information and communications technology (ICT), proposing a coordinated, forward-looking strategy that could ensure Japan’s leadership in an era of digital transformation (Carraz and Harayama 2018; Holroyd 2020). Just as “Industry 4.0” was a tentative response to the digital transformation in the manufacturing sector backed by Germany (Kagermann et al. 2013; Schwab 2017), Society 5.0 emerged from the need to master the challenges of digitisation and connectivity across a wide range of platforms at all levels of society, that is, to achieve the digital transformation of society itself. Thirdly, these investments and policy initiatives are mobilised to address ageing population issues, and some policy measures are already implemented in the field. For instance, the use of robots for healthcare to alleviate the shortage of care workers for seniors is already implemented and culturally accepted (Ishiguro 2017), even though the deployment of new digital technologies is sometimes blocked due to a lack of clarity on the regulatory framework for the collection and use of personal data and privacy issues.

The fact is that the Japanese government has decided to explore the potential of digital transformation and is opting for a whole-of-government approach to address the societal challenges of an ageing population. On this point, the Tsukuba Communiqué, launched at the end of the G7 Science and Technology Ministers’ Meeting, which took place in 2016 under the G7 Japanese Presidency, is insightful. It states:

We recognized the importance of helping promote a society with active ageing, where elderly citizens continue to be fully engaged within their societies in ways befitting their capacity and interests. We also recognized the role of Science, Technology and Innovation in contributing to this thorough well-designed health system for elderly care, including prevention, timely diagnosis, treatment, assistance and care of age-related health issues, and the social and physical infrastructure that enhanced inclusion.

(Cabinet Office 2016)

In our view, this statement translates perfectly the standpoint of the Japanese government vis-à-vis its ageing population. On the one hand, it is striving to promote a society where active ageing is favoured through people-centred approaches. On the other hand, it is aiming to harness the contributions of science, technology and innovation empowered by the digital transformation.

More concretely, in the elderly care and nursing sectors, the use of ICT and robotics is expected to contribute to enhancing quality of life and ensuring mobility, as well as to mitigate the on-site burden of healthcare and caregiving. The potential is there, and several R&D programs have been launched by the Japanese key funding agencies, such as Japan Science and Technology Agency (JST), New Energy and Industrial Technology Development Organization (NEDO) and Japan Agency for Medical Research and Development (AMED). These programs provide the opportunity to explore new ideas to address the societal challenges of ageing and the means to test on-the-ground prototypes or models derived from these ideas.

This brief overview of how Japan is addressing the challenge of an ageing population shows the complexity of taking multi-dimensional and multi-stakeholder issues, and there is a need for

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3 All Ministerial documents in this chapter were accessed on 21 April 2020; additionally, we have tried to use an English version when available. G7 Science and Technology Ministers’ Meeting. 2016 May 15–17. Tsukuba, Ibaraki (Cabinet Office 2016).
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After this introduction, in the following section, we describe the challenges of an ageing population in the Japanese context and the government’s policy responses. Afterwards, we introduce an STI policy perspective, and in the successive section, we revisit ageing population issues from this perspective and highlight the main STI policy programs implemented by JST, NEDO and AMED, the three principal policy-oriented funding agencies. We end with our conclusion, which summarises key lessons learned from the Japanese experience.

The challenge of ageing populations

Ageing society

Japan, with demographic pressures characterised by a declining population under the age of 14 and the rapid growth of those over 65 (Figure 31.1), is entering into a phase never experienced before by any other country around the world. Data\(^4\) show that the life expectancy at birth continues to increase (81.25 for men and 87.32 for women in 2018), while the total fertility rate remains low (1.42 in 2018); people tend to marry later (31.1 years for men and 29.4 years for women in 2018) and the first birth tends to come later as well (average age 30.7 years in 2018).

Following these trends, there is no indication that these demographic pressures will decrease. Also, despite this prospect of longer life, the gap between healthy life expectancy at birth and life expectancy at birth remains at around 8 years for men and 13 years for women (Cabinet Office 2019).

\(^4\) Statistics gathered from multiples MHLW documents.
Despite the fact that the current social security system was established in the phase of a growing population, and even though multiple revisions have occurred in the past, its sustainability in the future is nevertheless under threat. A positive sign we may note is that the employment rate by age increases among the senior population; in particular, those aged between 65 and 69 gained more than 10% points in 10 years from 2008.

Additionally, the family structure has evolved over time, in particular after World War II. The average number of household members, which was about 5 in the mid-1950s, decreased from 3.41 in 1970 to 2.33 in 2015. Meanwhile, the number of elderly households (private households with members aged 65 years old and over) increased from 12.7 million in 1995 to 21.7 million in 2015, and during this period, the number of one-person households has more than doubled (Bureau 2019). Japan should therefore address these demographic challenges, namely of a “super-ageing society”, on different fronts.

Policy responses

Guideline of measures for ageing society

In this vein, the Japanese government promulgated the Basic Law on Measures for the Ageing Society in 1995, and according to this law, the Conference on the Measures for the Ageing Society, chaired by the Prime Minister, was established. This Basic Law also stipulated the formulation of the Guideline of Measures for Ageing Society, which constitutes the basis for national policies related to ageing society; the first version was adopted in 1996 (Cabinet Office 2018). Since 1997, the white paper Annual Report on the Ageing Society has been published on the topic on an annual basis to accompany this policy framework.

The Guideline was revised in 2001, 2012 and 2018 in order to reflect the changing socio-economic environment, as well as to expand the fields of R&D related to the ageing society. While the changing socio-economic environment has been considered one of the principal pillars in the Guideline from the beginning, the priority areas have evolved considerably over time.

Indeed, starting with the initial focus on gerontology, assistive devices and universal design products in the 1996 Guideline, the 2001 revised Guideline shed a particular light on dementia, cancers and lifestyle-related diseases as priority research areas. The 2012 revision, however, was initiated with a view to alignment with the five-year Strategy for Medical Innovation (2012), on one hand, and putting greater emphasis on research centred on Intelligent Transport Systems (ITS) to facilitate the mobility of the elderly, on the other.

This alignment with other policy areas became even more apparent with the latest revision of the Guideline (2018), which includes not only R&D components but also employment and income, health and welfare, learning and social participation and living environment, demonstrating that the entire Guideline has been adapted to the concept of Society 5.0 as the government’s response to the rapid evolution of ICT and digitisation of the economy. By providing policy directions with a view to creating an “age-free society”, consolidating local community and promoting innovation – in other words advocating for an inclusive and elderly centred policy, backed by the digital transformation – this revision illustrates the intention of the Japanese government to consider the “ageing society” as a privileged field for the implementation of Society 5.0.

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6 This concept will be discussed in detail in the next section.
Ministry of Health, Labour and Wellbeing (MHLW) policies

The Ministry of Health, Labour and Wellbeing (MHLW), one of the ministries on the front line of the ageing transition, has been implementing national health care reforms in order to respond to the present and future needs of a Japanese health care system, with a particular focus on the ageing populations. An important document to guide these reforms has been “The Japan Vision, Health Care 2035”, launched in 2015. It has marked a fundamental paradigm shift from “system inputs to patient value” (MHLW 2017: 1), from the quantity of services provided to patients to quality, from cure to care and from specialisation of services to integrated approaches across medical and social service sectors, while putting more emphasis on a community-based integrated care for the elderly. The guide also advocates for mobilising innovation in health care and for a more efficient use of information. More concretely, it proposes to develop a health care database to support telemedicine applications and to build and utilise a health care network that links data using unique identifiers, signalling a first move toward data-driven health care (MHLW 2015).

Another important topic addressed by the MHLW is that of dementia. Even though the Japanese government’s action on dementia goes back to the mid-1980s with the creation of centres for the elderly with dementia, the most comprehensive approach was initiated by the Ministry in 2012 with the launch of the Five-Year Plan for the Promotion of Dementia Measures (2013–2017). This so-called Orange Plan advocated establishing four main objectives: a standardised dementia care pathway; early detection of dementia; the establishment of local structures for the provision of care services; and the creation of training schemes for medical and care staff.

As a follow-up to the G8 Dementia Summit (2013) initiated by the UK government, Japan organised a Legacy Event on prevention and care in 2014. This event led Japan to move to a more comprehensive approach on dementia, and thus the Orange Plan has been adjusted accordingly to become the “New Orange Plan” (2015). The idea behind this updated version of the Plan was to focus actions on people-centred and community-based approaches, aiming at promoting the “development of dementia-friendly communities and to improve the living environments of people with dementia by enabling them to continue living in familiar spaces and environments as long as possible”. Many policy measures have since been initiated, such as “Alzheimer Cafés” – events to gather people with dementia and their families, and to converse with the community, their supporters and specialists.

Alongside the New Orange Plan, MHLW is taking policy measures in line with the Framework for Promoting Dementia Care, a cross-ministerial initiative launched in 2019 by the Ministerial Council on the Promotion of Policies for Dementia Care chaired by the Chief Cabinet Secretary. The framework aims at promoting further collaboration across ministries and agencies around the guiding principles of “inclusiveness”, that is, that persons with dementia may live with dignity in our society and “risk reduction” i.e. delaying or slowing the onset of dementia and not necessarily targeting its eradication. The framework recommends policy actions such as the promotion of research on dementia, or expanding the Project for Supporting Community Preventive Long-Term Care Activities. This last initiative, called “Kayoinoba” in Japanese, is worth noting in that it is a bottom-up initiative. It focuses on creating a space in a given local area designed and managed by its residents with the aim of bringing together local citizens and people suffering from dementia, contrasting with still prevalent traditional top-down decision-making procedures.

7 Information about the New Orange Plan can be found here: http://japanhpn.org/en/1-2/.
Policy considerations

As we have mentioned in this section, ageing is a longstanding trend in Japan, with widespread implications for the whole society, including increases in health and social budgets and an almost flat nominal economic growth prospect. In the last 20 years, all government expenses have been decreasing proportionally except for national debt services and social security expenses, the latter going from 23.6% in 1997 to 34.6% of the total in 2017.\textsuperscript{8} That is to say, almost all other items are in competition with social security expenses. From the STI policy perspective, enhancing innovation capacity has been considered a key to addressing the societal challenges of an ageing population; in the longer-term, in fact, it is expected to contribute to the reduction of social security expenses. Yet, the Japanese government still has to proceed to a certain arbitrage between R&D and social security. The question that remains unanswered is whether the proposal of Society 5.0 will contribute to a move beyond this arbitrage and reconcile these two policy priorities: innovation-led economic growth and financing of an ever-increasing social security budget led by the ageing trend.

The Japanese government has enacted a series of laws and regulations to deal with the ageing issue and its ballooning costs. Nevertheless, situations where alignment to the Cabinet’s guidance would not be the priority may happen, given that each ministry has its own policy goals, which could partially conflict with this alignment. In the past, Johnson (1982), for instance, showed in his seminal book about the Ministry of International Trade and Industry (MITI) how tensions between competing ministries could unfold and hamper the government’s responses. Reflecting this thinking in terms of policy actions, the Cabinet Office is expected to play the role of coordinator through its aforementioned Conference on the Measures for the Ageing Society chaired by the Prime Minister, and distribute policy measures among ministries, in particular MHLW; Ministry of Education, Culture, Sports, Science and Technology (MEXT); and Ministry of Economy, Trade and Industry (METI). Thus, the structure is in place to put into practice the whole-of-government approach, with a strong leadership and coordination role by the Cabinet Office.

Moreover, the paradigm shift from “system inputs to patient value” mentioned earlier has a significant implication on the practice of policy making. Indeed, the traditional top-down policy making process has a limited capacity to fully capture the information on the ground. Therefore, the government has recognised the need for a more decentralised way of decision-making, with a view to soliciting community-based actions, and to engaging stakeholders with grounded experiences – in short, to supplement a bottom-up channel in the loop of the policy making process.

In our view, another important dimension to addressing ageing issues is the nexus with science, technology and innovation (STI) policy, and there too a decentralised process is necessary. In terms of the expected contribution of STI, in particular the deployment of digital technologies and data analytics, there are extended fields to be explored, as noted in the Fifth Science and Technology Basic Plan (2016–2020);\textsuperscript{9} these include the development of new drugs, medical devices and medical technology; the establishment of medical ICT infrastructures for use in examination, treatment and medication; and the greater utilisation of data in the fields of medical and long-term care in order to improve their quality. This exploration cannot be conducted alone at the ministerial level with centralised decision-making processes. The collective

\textsuperscript{8} Statistics gathered from multiples Cabinet Office documents.

\textsuperscript{9} A five-year comprehensive plan for the promotion of science and technology: https://www8.cao.go.jp/cstp/english/basic/5thbasicplan.pdf.
challenge of ageing has to be addressed collaboratively by universities, private companies and government agencies to meet the best interests of society at large. The overarching strategy to respond to the pressing ageing challenges is to be found in the concept of a Society 5.0, which aims to improve the innovation environment in Japan; we will define it more precisely in the next section.

**Mobilising science, technology and innovation (STI)**

**STI policy framework**

In the 1990s, Japan’s economy was struggling and the government was seeking additional ways to recover momentum, besides its monetary and fiscal policies. One such action was to invest in science and technology, expecting that this investment would contribute to a boost in economic growth. In 1995, the Science and Technology Basic Law was promulgated as a legal foundation of this policy engagement, and the Council for Science Technology Policy (CSTP), chaired by the Prime Minister, was founded to administer this policy within the Cabinet Office. Also, based on the Basic Law, the five-year so-called Science and Technology Basic Plan has in place since 1996.

In the 2000s, the mainstreaming of innovation became apparent in the science and technology policy arena, as illustrated by the launch of OECD’s Innovation Strategy (2010). Japan was no exception; in 2014, CSTP was renamed “Council for Science, Technology & Innovation” (CSTI), and henceforth became responsible for formulating science, technology and innovation policy and ensuring its sound implementation. As a result, we have observed the convergence of growth strategy and science, technology and innovation (STI) strategy.

In fact, the main focus of the Basic Plans has evolved over time, starting with the consolidation of science and technology infrastructures (First Basic Plan – Fiscal Year (FY) 1996–FY 2000), passing through a more technology-focused policy formulation (Second and Third Basic Plans) and moving to a challenge-driven approach (Fourth Basic Plan). Notably, the Fifth Basic Plan (FY 201–FY 2020) marked a leapfrog over the previous ones.

Observing that the world is increasingly interconnected beyond traditional national and institutional borders, that this connectivity is evolving at an accelerated rate never experienced before and backed by the digital transformation empowered with artificial intelligence (AI) and internet of things (IoT), CSTI recognised the limitations of being able to predict the technological trends even just five years ahead. Therefore, CSTI decided, instead of identifying key technological areas or key challenges as before, to place emphasis on the “preparedness” for this unpredictable and unforeseeable near future with the preparation of the Fifth Basic Plan during 2015. Therefore, the capacity to design future industry and society has been considered as instrumental, and the prospect of investing in people and providing the space to experiment their ideas emerged.

Furthermore, 2015 was the year the Sustainable Development Goals (SDGs) were adopted at the United Nations. Recognising that innovation will play a central role in addressing these global challenges, CSTI’s stance was to ensure that the Fifth Basic Plan would be compatible by design with SDGs, with the consequence of expanding the scope of innovation policy into the sphere of sustainability and wellbeing.

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10 For a historical account of Japan’s STI policy, refer to Carraz and Harayama (2018).
11 In Japan the government’s fiscal year (FY) runs from April 1 to March 31.
What we observe here is the shift from the traditional technology-driven to a more society-centric innovation policy, and from planning to an experience-based approach in its implementation. With this in mind, the Fifth Basic Plan was composed of four main pillars:

1. Preparing the next: future industry and society;
2. Addressing socio-economic and global challenges;
3. Investing in “fundamentals”: people and excellence;

These four pillars are formulated around Society 5.0 and offer new guiding principles for innovation, which could be considered as a concept proposal from Japan, with the expectation that this concept would inspire the global community.

**Society 5.0**

In 2015, the CSTI took into consideration how the coming digital transformation could become a dominant driver for societal transformation. Given that many innovations driven by technology have been a factor for social change in the past, the main question under debate by the executive members of the CSTI at the early phase of preparation of the Fifth Basic Plan was, why should we formulate STI policy from a different perspective this time?12

What we observe today is arguably just a tip of the digital transformation. CSTI executive members’ opinions converged on scenarios around the potential magnitude in scale and scope of its impacts on not only the economy and society, but also, and more particularly, human beings. This human-centred tropism largely outdoes the sphere of what can be decided alone by STI professionals, such as scientists, engineers, entrepreneurs, technocrats or politicians.13 Therefore, CSTI considered that humans must remain central actors, active subjects to the contingencies of technological systems, and that the engagement of all stakeholders, including citizens, was critical in designing our future society backed by STI. This idea is widely debated in the literature; recent changes in how we do science, for instance, are in part driven by powerful collaborative tools enabled by the internet (Nielsen 2020); innovation is more democratised (Von Hippel 2005) and helped by collective intelligence processes (Tovey 2008).

Also, within the context of unstable and ever-changing socio-economic and political conditions, which characterise the first half of the last decade, it became imperative to identify key values on which future society would be founded, and in this vein, the SDGs advocating for the value of sustainability and inclusiveness have been considered as a reference. Consequently, “human-centred” and “value-based” dimensions became the guiding principles of this new breed of STI policy.

So, why “5.0”? Conceptually, the CSTI took a very long look at human history in the exercise of foreseeing our future, starting with a “hunting and gathering” society (1.0), where people were living in a perceived symbiosis with nature in order to ensure the continuity of our species. Given that curiosity and exploration are integral parts of human nature, humans were

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12 Even though it is out of the scope of this chapter to delve into these ontological questions, a worthy read on the topic is certainly the seminal book written by Mokyr (2002) on the historical origins of the knowledge economy.
13 This statement reflects the convergence of views among the executive members of the CSTI during the preparation of the Fifth Basic Plan, and it underlines two CSTI documents: “Toward the Fifth S&T Basic Plan” (October 2014) and “Guiding Framework for the Formulation of the Fifth S&T Basic Plan” (April 2015). All translations are by the authors, unless otherwise specified.
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not satisfied being entirely dependent on nature, and a “farming” society (2.0) emerged, leading to a more structured form of society. Then, starting with the invention of the steam engine, fossil fuel-powered machines opened the door to mass production and tech-driven manufacturing – the so-called “Industrial” society (3.0). Today we are experiencing digital transformation – the “Information” society (4.0). Increasingly, values are created by deploying and combining information, and in our everyday life, at work, in public space, as well as at home and in private, we are already strong users and consumers of information, as illustrated by the intensive use of the smartphone as a tool to access ubiquitously digital content. Our dependency on connectivity seems to be irreversible, transforming the way we interact. “Society 5.0” is expected to be the next stage: a human-centred society, still unknown, yet to be built by all stakeholders based on these “human-centred” and “value-based” guiding principles.

Behind the eye-catching titles and programme initiatives – such as Third Industrial Revolution (Rifkin 2011), Fourth Industrial Revolution (Schwab 2017), Industry 4.0 (Kagermann et al. 2013) or the FIWARE open source platform supported by the European Union and Japan’s Society 5.0 – lies a fundamental shift in how economies may be structured in the future as industries, academia and governments create, store and integrate various data streams into daily production processes to provide goods and services. For the last 30 years, Japan’s government has been actively promoting its national innovation strategies. Society 5.0 represents its latest effort to reboot its policy perspective by putting societal needs at the centre of scientific and technological transformations. Yet, since its inception, Society 5.0 has had to be nurtured, tested and developed in order to become an operational concept, in particular to serve as the basis for formulating the Fifth Basic Plan, knowing that the latter expects to meet the four following overarching goals: the advancement of science, technology and innovation (STI); the achievement of economic growth and wellbeing; addressing societal challenges; and contributing to global prosperity.

Data and digital technologies at the heart

The Basic Plan also indicated the approach to orient policy actions toward Society 5.0. More concretely, it proposed 11 focus areas – among them, Intelligent Transport System, Energy Value Chain, Monozukuri (manufacturing) System, Regional Inclusive Care System, Disaster Reduction System, Hospitality System – where advanced digital technologies and data infrastructure would be developed and tested. This would take shape along the lines of the system of systems perspective and the integration of a wide variety of data sources.

The 11 focus areas are those which have been investigated previously by the Cross-Ministerial Strategic Innovation Promotion Program (SIP), a program initiated by the CSTI in 2013, ahead of the Fifth Basic Plan, with the aim of confronting the most important societal challenges facing Japan, as well as contributing to economic growth through collaboration among ministries and agencies and between the private sector and public research institutions. By doing so, CSTI expected to capture and explore the early results of this program and to advance one step further in the direction of systems backed by the digital infrastructure. A common data and digital technology platform was conceived in the Basic Plan, which consists of a set of working frameworks, such as the standardisation of data formats and interfaces, cybersecurity technology and open data systems to serve all these focus areas and to facilitate data exchanges across areas. Among them, three areas, specifically, Intelligent Transport System, Energy Value Chain and Monozukuri System, have been identified as a test bed to realise data integration.

Beside these data infrastructures, the Basic Plan recommended investing in key technologies, such as cybersecurity, internet of things (IoT) system architecture technology, big data analytics,
artificial intelligence (AI), device technology, network technology and edge computing, on the one hand, and to consider ethical, legal and social implications (ELSI) before any implementation of these digital technologies and the use of data sets, and to revisit the regulatory framework to secure the protection of personal information, on the other hand.

**Challenges of ageing populations revisited**

*MHLW’s policy alignment*\(^{14}\)

**Plan for reforming healthcare and welfare service**

At the MHLW level, a “headquarter meeting for social security and work style reform for the year 2040” was established in 2018 to identify the direction of the Japanese social system reform in general and healthcare reform in particular, and the Plan for Reforming Healthcare and Welfare Service was reported in 2019, advocating for the “effective use of robotics, artificial intelligence (AI) and ICT, and Data Health Reform (DHR)”. For this purpose, smart assisting devices and systems are expected to be developed and tested in collaboration with the Ministry of Economy, Trade and Industry (METI) and the Ministry of Education, Culture, Sport, Science and Technology (MEXT), with the support of the Japan Agency for Medical Research and Development (AMED). In addition, pilot programs are recommended in order to attract the interest of those who are in the elderly care business in the use of robotics and sensing devices. With regard to the DHR, efforts will be made by MHLW to better equip data infrastructure, including Personal Health Records (PHR), to ensure the interoperability of different medical and health-related data sets and to promote the use of national databases.

This policy orientation fully reflects the prospect of Society 5.0 and indicates the alignment of MHLW to the latter. However, MHLW did not wait until 2019 to move in this direction. Within the Ministry, the ground has been prepared by the Advisory Board on the Use of AI in Health and Medical Care (formed in 2017), which was consolidated as a Consortium for Accelerating Development of AI in Health and Medical Care, on one hand, and by Data Health Reform Promotion Headquarters (also formed in 2017), on the other.

**Use of artificial intelligence (AI)**

In its final report, the Advisory Board on the Use of AI in Health and Medical Care identified six fields where AI would be introduced relatively early and recommended investigation of these fields to develop and make use of AI technologies. “Nursing and dementia care” was one of them, while the Advisory Board insisted that the direction R&D takes should be guided by the needs of those working in the nursing and dementia care services, instead of seeking for application once the technology has been developed. Based on this recommendation, the Consortium for Accelerating Development of AI in Health and Medical Care took over to determine more precisely those issues to be addressed with a view to accelerating the development of AI technologies and facilitating the adoption of these technologies by healthcare service providers. The Consortium was also charged with identifying potential obstacles for implementation, and proposed a roadmap listing actions to be taken to remedy them.

\(^{14}\) Information in Japanese was retrieved from the MHLW internal documents and website.
In the case of nursing and dementia care, the Consortium proceeded, in its early phase, to a hearing of the director of the Center of Assistive Robotics and Rehabilitation for Longevity and Good Health to have a grasp of the current situation and challenges of the use of AI and robotics. The latter reported the preliminary results of the research studies under investigation at the Center on the use of devices such as robotic canes, humanoid robots, conversational robots, urination sensor systems; in the context of nursing and dementia care services, the Center expressed the need to create a data platform in order to collect and manage data generated by these devices alongside other vital and relevant environmental data, which would enable them to extract value from these devices with AI, network technologies and the internet of things (IoT).

After a series of hearings and a review of regulations related to the health and medical data, and taking into account observations from in the health and medical care fields, the Consortium attempted to identify potential roadblocks to the development, implementation and adoption of AI. Their report, published in June 2020, specified a list of issues to be addressed, which we summarise as follows.

In the development phase of AI, the availability of data for learning and training AI is essential. Given that in the field of health and medical care, most of these data rely on personal information, which may contain medical records, genetic information and other vital data, the collection and use of data should respect not only the Act on the Protection of Personal Information, but ethical guidelines as well, with data security and data management guidelines in place. However, the Consortium expressed a particular concern about whether patients were appropriately informed on the use of their data and how their usage could potentially benefit public interest in terms of better health and medical services, particularly when the development takes place in partnership with the private sector. They thus suggested revisiting ethical guidelines, in particular informed consent regulations, and collecting and analysing cases and making them accessible to the public.

As regards transfer and security management related to health and medical data, there are already three Guidelines from three related ministries in place, namely Guidelines for the Security Management of Medical Information Systems (published in 2005, revised in 2017) by MHLW; Security Management Guidelines for Cloud Service Providers Handling Medical Information (2018) by the Ministry of Internal Affairs and Communication (MIC); and Security Management Guidelines for Information Processing Providers Dealing with Medical Information (2012) by METI. Meanwhile, the Consortium recommended a better coordination of these Guidelines and expressed the need to continuously revisit them in order to adjust them to the advancement of technologies as well as the standardisation of electronic health and medical records.

On the use of cloud systems for data processing and storage, the Consortium noted that the need to ensure transparency, to improve speed of data transfer and to design data management systems according to the characteristics of data are commonly recognised among stakeholders. However, the Consortium observed that consensus on the requirements has not yet been achieved; therefore, it suggested work on prototype developments as a first step.

**Data Health Reform**

Capturing the concept of Society 5.0, and recognising that health-related data will be playing a critical role in exploring the potential of digital transformation in the field of health, medical care and the nursing care system, the MHLW in 2017 established the cross-sectoral Data Health Reform Promotion Headquarters within the Ministry, with two main objectives: firstly...
to extend healthy life expectancy and secondly to improve the efficiency in medical and nursing care service provision.

In 2018, eight categories of service as well as an institutional reform of the health insurance system were identified as areas to be investigated to move forward with digitalisation. This was with a view to offering accurate options to patients and creating a one-stop health data management platform, deploying evidence-based care and supporting the fight against cancer. After this kick-off, the strategy to promote Data Health Reform was reshaped in 2019, based on the observation that digital transformation is occurring at an accelerated rate in all policy areas, and that health, and ageing in particular, was becoming a privileged field for the implementation of Society 5.0, as noted in the previous section. Henceforth, the following four goals of the Data Health Reform have been clearly defined and the services mentioned above are expected to be initiated to support to realise these goals:

1. To advance genomic medicine and the use of AI with a view to realising personalised medicine and making health and medical services more efficient.
2. To implement operational personal health record (PHR) system, which will allow all citizens to have access to check their health data from their own devices.
3. To promote the use of data in the medical and nursing communities, aiming at enhancing the quality of services.
4. To promote the use of national databases, in particular Japan Diagnosis Procedure Combination Database (DPC) and National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB), by ensuring interoperability; adjusting the institutional and regulatory framework; improving the quality of data; and integrating databases under construction, such as CHASE (Care, Health Status and Events: data related to nursing care called).

To move forward and to ensure that efforts are made collectively and in a coordinated way, the Plan for intensifying health data reform was formulated by the MHLW in July 2020 (MHLW 2021). It consists of three focus areas for action. The first goal is to expand further the framework for health and medical data sharing at the national level. The second goal is to put in place a reformed regulatory framework to implement an online system for electronic prescriptions. Finally, there is a need to standardise medical and health data and the related legal framework, in order to allow access and use by individual citizens and patients of their own health and medical records. There is a precise timeline of two years for implementing these goals. It is worth noting that these actions intend to make better use of “My Number System”, which consists of assigning a single 12-digit identifier to every resident in Japan. It was introduced in 2016, but it is still at the early phase of deployment.

The realisation of this ambitious plan is not only technically challenging in terms of data management and data security but also relies on the capacity of MHLW to mobilise key stakeholders – in both the public and private sectors – to collaborate with local governments and to attract the interest and engagement of ordinary citizens.

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15 Such as “sharing of health records”, “health scoring”, “health data analytics”, “cancer genomics” and “artificial intelligence”.
16 “My number” is used in administrative procedures in the areas of social security, taxation and disaster response.
Funding agencies’ response

Research and development on dementia by AMED

The Japan Agency for Medical Research and Development (AMED) was established in 2015 under the joint effort of MEXT, MHLW and METI, with the aim of supporting R&D seamlessly in the medical field from basic research to clinical trials with the prospect of fostering practical application and medical innovation. It had an overall budget for FY 2020 of around ¥127 billion (€1.1 billion\(^{18}\)) and allocated a budget of ¥9 billion (€78.2 million) for basic and applied research in the field of geriatrics and dementia and psychiatric and neurological disorders.

The number of dementia and Alzheimer sufferers increased greatly over the last quarter century in the general population of the Japanese elderly (Ohara et al. 2017), and its worldwide prevalence is expected to triple by 2050 (Prince et al. 2016). Therefore, the development of effective measures is an important public health concern in Japan. Yet currently, no simple and minimally invasive method for making an objective diagnosis of dementia is available, and thus making a differential diagnosis of dementia is difficult. In these circumstances, AMED is promoting intensive integrated R&D in the field of medicine, from basic research to clinical trials, focusing on the five aspects of dementia: clarification of actual condition, prevention, diagnosis, treatment and care.

For instance, the “dementia initiative” that spans from 2016 to 2020 aimed to integrate state-of-the-art basic neuroscience and clinical research to elucidate the mechanisms by which Alzheimer’s disease originates and develops new antibody therapies (AMED 2019). On a more applied level, the dementia technology development group is focusing on the development of new technologies for brain science such as new neural network manipulation technologies, physiological measurement technologies and new behaviour analysis methods.

In June 2019, a Framework for Promoting Dementia Care has been adopted by the Ministerial Council on the Promotion of Policies for Dementia Care at the Prime Minister’s Office. In order to support the independence of people with dementia and reduce the burden on caregivers, the framework recommended AMED to investigate the develop devices that utilise Japan’s cutting-edge robot technology, sensors and ICT technology, with a strong emphasis on drawing upon participatory design principles, and with users of the technology being seen as active partners in the project. Indeed, the development of practical equipment suitable for the needs of nursing care sites requires the demands of the nursing care facilities to be reflected from the early stages of development through design, testing and prototyping, as a user’s intention to adopt a particular technology is often determined by its perceived ease of use and perceived usefulness (Davis 1989). To take a first move into the direction of this recommendation, a call for proposal for grants on “Research and Development on AI and IoT Systems for Dementia” was launched in January 2020.

Realisation of smart society through AI technology application by NEDO

The New Energy and Industrial Technology Development Organization (NEDO) is a funding agency under the jurisdiction of METI that aims to promote industrial technology. By funding R&D projects to explore advanced new technology as well as practical application and promoting standardisation of technology and services, NEDO acts as an “innovation accelerator”.

\(^{17}\) Documents and information were retrieved from the funding agencies’ websites; the documents were in Japanese.

\(^{18}\) 1 euro = 115 Yen | 21 April 2020
NEDO’s overall budget for FY 2020 is around ¥159 billion (€1.38 billion\(^{19}\)), while it has allocated a budget of ¥45 billion (€39.13 millions) for R&D in the field of industrial technology.

To align to the concept of Society 5.0, NEDO has developed a “Strategy for Realization of Smart Society through AI Technology Application” in FY 2017. Three domains – (1) productivity; (2) health and medical and nursing care; (3) mobility in space – have been identified as the primary focus areas, and NEDO proposes to establish a five-year R&D program based on public and private partnership. The program, Realization of Smart Society through AI Technology Application, was launched in 2018, and in the domain of health, medical and nursing care, “AI-powered ambient sensor”; “daily life function of the elderly”; “life phenomenon modelling”; “health promoting behaviours”; and “IoT and AI-assisted health and nursing care service system” are the areas to be explored initially.

NEDO’s report “Realization of Smart Society through AI Technology Application – R&D Projects” (2020) gives us an overview of ongoing projects, with their key technological challenges and expected outcomes. Among them, four projects are related to nursing care:

1. Designing and testing data-driven nursing care assisted by robotic devices and promotion of its implementation.
2. Prototyping a program of physical exercises leading to a self-sustaining motivation.
3. Designing and testing in the field of an effective care service provision system using data from wearable sensors and assistive robots and capturing the mental and psychological state of the person in care.
4. Assisting and supporting caregivers with the use of digital tools and data analytics.

What is common to all of these projects is that they not only explore data resources and data infrastructure, but also focus on the motivation of elderly people and working in close collaboration with nursing care service providers. It is worth noting the presence of large private companies from outside the care business, such as Panasonic, Takenaka and Seiko Instruments.

Improving quality of life by JST

The Japan Science and Technology Agency (JST), under the jurisdiction of MEXT, whose aim is to promote basic research and development activities linked to innovation and commercialisation activities, has been actively engaged to address the challenges of an ageing society by creating new programs through two channels: Creation of Science, Technology and Systems that Enriches the Ageing Society and Redesigning Communities for Aged Society, which was proposed and is supervised by the Research Institute of Science and Technology for Society (RISTEX) – JST’s internal body, established in 2001 – in order to promote R&D to address Science, Technology and Society (STS) issues. The first program was initiated in 2010 for ten years, the main objective being to help the elderly stay active professionally and in their everyday lives, through mobilising the power of STI with a particular eye on information and communication technology (ICT) and information-robotics technology (IRT).

More concretely, this program focused on the sensory, brain and physical functions of the elderly and proposed to work on the circulation of information connecting these functions. Four projects have been selected with a budget of approximately ¥70 million (€610,000) per year for each project:
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1. Development of robot support systems for the elderly with memory and cognitive decline.
2. Intelligent car-driving system to support the autonomy of the elderly.
3. R&D to create an ICT platform operating as a depository of experiences and knowledge of the elderly population.
4. R&D to create the technology for assisting the elderly’s social participation and establishment of an assessment system.

The program was completed in FY 2019, and the ex-post evaluation is planned during the course of FY 2020. However, the mid-term evaluation report, which was published in 2017, gives us a taste of what has been the challenge of this program. The activity on basic research contributing to a better understanding of the phenomena and development of component technologies in assistive devices have been positively assessed, although the report noted that to move ahead from this stage to the preparation of prototypes and their implementation, the needs on the ground – such as feedback from the elderly, regulatory issues and social acceptance – should be carefully examined.

The second program, Redesigning Communities for Aged Society (2010–2015), reflects the guiding principles of RISTEX, which place value on interdisciplinarity, the development of methodologies to implement a multi-stakeholder approach and “interactive practice in in the field of humanities and social sciences, as well as the natural sciences”. It therefore aims to realise “community-based co-design/co-production of science & technology for ageing community development”. This multi-stakeholder and community-based program contrasts with the more technology-driven approach of the program Creation of Science, Technology and Systems that Enriches the Ageing Society.

More concretely, a call for proposals was carried out with the aim of developing a methodological framework to address societal issues of ageing while at the same time encouraging the prototyping of solutions. A total of 15 projects were selected. Given that these projects place more emphasis on community-based actions, the focus on the development of digital tools is less apparent compared to the first program. However, the project “Ageing in place with ICT” constitutes an interesting case, since it bridges these two approaches. In fact, its strategy consists of creating a monitoring network system called the “HOW ARE YOU network”. This was developed by the Iwate Prefectural University and supported by an Iwate prefecture’s organisation; it links elderly citizens with monitoring centres managed by local social welfare councils and social welfare workers by using a telephone system equipped with an “I want to talk” button operational at any time, and by applying existing digital technologies and digital infrastructure.

The program was completed by March 2016. In order to capitalise on the outcomes of this program, a general incorporated association, “Co-Creation Center for Active Ageing”, was established in April 2017, offering a training program for community-based, problem-solving skill development and a support program for the creation of living labs.

Conclusion

In this chapter, we described in detail the policy initiatives led by the government in Japan. As such, we are placing ourselves in the footsteps of Johnson’s concept of a “developmental state” – an interventionist state that combines private ownership with state guidance – to characterise the role played by the Japanese state in the unexpected post-war high economic growth.

20 The interim evaluation covers the first three projects, the last one having been completed in FY 2013.
We face a political system where the state bureaucracy is given a sufficient timeframe and scope to take initiative and operate effectively, while at the same time there are multiple and continuous interactions between the bureaucracy, universities and companies through various informal and formal forums, associations and platforms for exchanging ideas and propositions. For instance, Keidanren (Japan Business Federation), the largest representative of the business community in Japan, has been in constant discussion with the CSTI in developing the concept of a Society 5.0, with the aim of promoting an innovation ecosystem that contributes to solving social problems while creating business opportunities (Holroyd 2020). In that respect, the Data Health Reforms engaged by the government to allow the collection and utilisation of anonymously processed medical information have the potential to advance medical research, innovative drug discovery and new business creation. Already, 260 million results of the specific health check-ups for the population aged 40 to 75 have accumulated in the National Database of Health Insurance Claims and Specific Health Checkups and could be used to study lifestyle diseases (Kumar 2019). Japanese data sets, with their specific demographic trend, could be valuable information and increasingly in high demand as other countries follow the ageing trend.

As already mentioned, three ministries have been at the forefront of the policy momentum, reforming the legislative structure to adapt the ageing society, the Ministry of Health, Labour and Welfare (MHLW); the Ministry of Economy, Trade and Industry (METI); and the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The social and healthcare dimensions have been combined with scientific and economic considerations from the mid-1990s, with a guiding vision from the Cabinet Office. In our view, the Japanese policy experience we have described in this chapter can be summarised from three perspectives: policy convergence; paradigm shift in health system; and digital transformation.

Firstly, we have seen in the previous sections that the framework to respond to an ageing society and to reform the STI policies was greatly overhauled in the 1990s, with the enactment of the Basic Law on Measures for the Ageing Society, on one hand, and Science and Technology Basic Law, on the other. Facing major challenges in the 1990s, the Japanese government had to adjust its policy responses. What is interesting to note here is that, 25 years later, although initially these two Basic Laws were founded independently, we now observe the convergence of these two policy frameworks, the driving force being the recognition of the central role played by STI policy, one of the principal components of Society 5.0, as a horizontal policy tool across ministries.

Secondly, as we mentioned, “The Japan Vision, Health Care 2035” drafted by the MHLW suggests a paradigm shift for the health system, redirecting its focus from “system inputs to patient value”, from the quantity of services provided to patients to quality, from cure to care and from specialisation of services to integrated approaches across medical and social service sectors. Here again, the concept of Society 5.0 plays the role of a unifier by putting people at the heart of societal transformation.

Thirdly, it could be argued that Japan is in a strong position for mobilising innovation in health care and for putting in place measures toward data-driven health care. Indeed, based on the successful experiences in the country’s post-WWII technology-led industrial development, Japan sees the potential of mobilising and deploying technological capacity, in particular digital technologies in the health care sector. The Guideline of Measures for Ageing Society revised in 2018, as well as the Digital Health Reform revisited in 2019, reflect this approach, again under the one roof of Society 5.0. It is worth noting that Keidanren published in April 2019 its policy recommendations on the social security system, titled “For Securing a Social Security System With a View to 2040”. It encourages the promotion of the “digital transformation” by investing...
in technologies such as robotics, sensing devices, ICT and AI and mobilising the “creativity of people in its diversity” to address this challenge, with the goal of making Society 5.0 a reality (Keidanren 2019).

What we observe here is that the concept of Society 5.0 frames these three perspectives, leading and in some cases supporting changes in policy making with regard to this multi-dimensional challenge of an ageing population. The policy implementation is underway, and it is too early to assess whether these measures are inducing societal change, as advocated by Society 5.0. Even though we reported in the last section of this chapter on the emergence of community-based actions led by the different funding agencies that accompany the top-down types of policy measures, we still need to see whether the concept of Society 5.0 will gather enough momentum to translate from policy elaboration to societal implementation.

In that respect, the implementation of Intelligent Transport Systems (ITS) will be interesting to follow; mobility services constitute a fundamental element of social life and therefore impact the quality of life of the elderly and in particular those living in rural or suburban areas. Indeed, the Guideline of Measures for Ageing Society 2018, as we already mentioned in this chapter, recommends advancing R&D in ITS, which includes Traffic Signal Prediction Systems (TSPS); Driving Safety Support Systems (DSSS); and Electronic Toll Collection System (ETC) 2.0; it also recommends R&D in advanced automated driving systems, with a particular eye to unmanned automated driving transport services for the elderly. It is worth noting that all these systems are heavily reliant on the use of data, data analytics and AI technologies. A successful implementation will need to combine legal reforms (Imai 2019), upgrading digital and physical infrastructure (Mahmassani 2016), access and sharing of data and investments in STI. Countries are developing ITS with the goal of attaining greater mobility for the elderly and handicapped persons, improving safety and maintaining the competitiveness of their transport industry (West 2016). Japan is in a leading position in developing the technology as it has a powerful industrial base, government and legislative support and a strong basis for experimentation with its ageing population. If the technology is successfully developed and socially accepted, Japan could use its comparative advantage to export it.

To conclude this chapter, we raise the following issues to be addressed further in view of better exploring the Japanese experiences:

1. We have observed that Japan is testing new approaches in the field, in particular using digital technologies and data analytics to address ageing issues and cumulating experiences. However, even in the case where expected results are obtained, the problems of scaling up, gaining social acceptance and ensuring the sustainability of the new schemes remain; these need to be addressed for further implementation.

2. The existence of an overarching policy framework such as Society 5.0 was necessary to ensure a policy coherence when confronted with multi-dimensional and multi-stakeholder issues, particularly in our case of an ageing population. The remaining question is whether this overarching policy framework facilitates experience-sharing and cross-learning among stakeholders.

3. In Japan, community-based actions are advocated alongside top-down policy making, such as Guidelines, Strategies, and Plans, expecting that both approaches complement each other. However, given the diversity and multiplicity of communities, there is no one-size-fits-all solution. The articulation should be designed carefully to take advantage of this potential complementarity, and this piece is still missing in this complex policy system in place in Japan.
Finally, we would like to note that by addressing the societal challenges of an ageing population, we are all invited to reconsider the sense of “community” to leave a better future for the generations to come.

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