

Digital Approaches to Dealing with Ageing-Related Challenges at Different Levels in Japan

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1 ABSTRACT

The “World Social Report 2023: Leaving no one behind in an ageing world” by the United Nations describes the ageing of the world's population as an irreversible global trend. This trend is particularly significant in Japan. Here, the ageing processes have progressed much further than in other countries, also driven by two age cohorts with particularly high birth rates, known as the baby boom, followed by decades of a baby bust (Nennstiel 2011; Reher 2015). This has fundamental social and spatial implications (Pauly and Pallagst forthcoming).

Digitalization processes are being strongly promoted in Japan. As part of the Japanese government's Society 5.0 program, all areas of life are to be digitalized as an approach to overcome social challenges. Cyberspace and physical space are to be merged (Hitachi-UTokyo Laboratory 2018; Pallagst et al. 2024).

This raises the question of how the Japanese approach to digitalization actually addresses the social and spatial challenges posed by ageing processes. At national level, the PLATEAU project must be mentioned in this context, in which the Japanese government is developing a national digital twin in which around 500 cities are being modeled (Seto et al. 2023, MLIT n.d.) as well as a national big data analysis tool for strategic benchmarking purposes (Matsuura 2020). On the local and regional level, on the other hand, there is a focus on the development of platforms that create a digital space designed to overcome barriers caused by physical limitations and social isolation. Metaverse environments of communities with use cases like avatar cafés, for example, are emerging. (Pauly and Pallagst forthcoming).

The mentioned digital approaches at different levels in Japan are discussed in this contribution and linked to ageing-related challenges that were derived as part of the research project “Ageing Smart – Designing Spaces Intelligently”. Interviews with experts and stakeholders on site in Japan in 2024 provided important insights in this regard.

Keywords: Digitalization in Spatial Planning, Social and Spatial Challenges, Ageing Society in Japan, Digital Twin, Metaverse

2 INTRODUCTION

In Japan, there is a strong affinity for new digital technologies. The Japanese national government often plays a key role in technology development, creating strategic plans and funding their implementation with significant financial resources. One example of this is the Society 5.0 vision in the “Science and Technology Basic Plan” by the Japanese government. Through this funding program, digital innovations are being developed to address social and societal challenges (Hitachi-UTokyo Laboratory 2018; Pallagst et al. 2024).

A major example of social and societal challenges is population ageing. It is by no means a phenomenon that is limited to a few regions in the world. Rather, it is a global trend that emerged in the middle of the twentieth century and is considered irreversible (United Nations 2023a, p. 18). In 2022, 9.7% of the world's population were 65 years old or older, and 16.4% are projected for 2050 (United Nations 2023b, p. 8). More developed countries have generally been confronted with the ageing process for many decades, while for many less developed countries it is a new phenomenon and they are still in transition (United Nations 2023a, p. 18). The ageing of the population and resulting population decline are the crucial characteristics of demographic change. It is a trend that has not lost its relevance, but on the contrary, is becoming increasingly important. Demographic change is a topic that has global effects and requires in-depth investigations and an international search for solution strategies.

Ageing populations sometimes lead to drastic problems that pose significant challenges for countries and their municipalities. An ageing society has very specific demands on services and infrastructure, which must therefore be adapted. While there is an increasing demand for personnel in the healthcare and elderly care sectors, the number of people in the working age population simultaneously decreases (OECD 2019, p. 19;

Swiaczny et al. 2008, p. 200; Yu and Lee 2017, pp. 442-444). The phenomenon of social isolation is increasingly spreading in society, and more spaces with homogeneous age structures and 'ghost towns' are emerging (Interview with Dimmer 2024).

However, social and spatial issues arising from ageing are influenced by various factors. They do not solely result from population development but also from path dependencies that differ depending on the country's context. Cultural and governance-structural issues can play a role, among others. Therefore, it is necessary to consider ageing problems and potential approaches for solutions within a specific country context.

As part of the research project "Ageing Smart – Designing Spaces Intelligently", the ageing processes in three countries – the USA, Finland and Japan – were compared with each other. Japan was identified as an extreme example where population ageing is particularly advanced (Pauly and Pallagst forthcoming). This finding is taken up in this article and used as an opportunity to take a more focused look at ageing in Japan and the resulting problems and approaches to solutions at various levels.

The aim is to look beyond the German context in which the research project is situated. Japan represents an extreme example in this regard. Age-related problems have been particularly pronounced here for at least two decades and have a significant impact on civil society. Studying a country where demographic change has been recognized as particularly advanced for a longer period offers distinct advantages for the research and learning opportunities. The investigation makes it possible to identify solution strategies that could also be applicable to other contexts around the world. The findings can provide valuable information for countries and municipalities that are increasingly confronted with demographic challenges and are looking for strategies to address them.

This contribution first examines indicators that describe the ageing processes in Japan. For this purpose, population data is used and analyzed. Then, the social and spatial challenges Japan faces due to its demographic developments are described. Building on this, the digital solution strategies Japan is implementing to address these challenges are explored. For the investigation of the social and spatial implications as well as possible digital solution strategies, guided interviews were conducted on-site in Japan. These interviews involved experts from the academic field in Japan, as well as stakeholders from public administration. On the academic side, interviews were conducted with a researcher from Waseda University in Tokyo and with representatives from the German Institute for Japanese Studies. On the administrative side, interviews took place with officials from the Tokyo Metropolitan Government and the city administration of Takamatsu. Additionally, on-site walks were conducted in Tokyo and Takamatsu.

3 POPULATION AGEING IN JAPAN

As part of an international comparison, Pauly and Pallagst (forthcoming) have carried out an analysis of population data that is suitable for describing ageing processes in a country. This analysis is taken up and summarized here for the specific case of Japan.

The ageing of a population is strongly linked to the number of births in that population. If the number of births declines, the proportion of older people in the population slowly increases over time. The crude birth rate is the ratio of the number of births to the total population and thus provides information about the fertility of a society. However, these factors are closely linked to mortality, for example indicated by the number of deaths in each period. Inward and outward migration also influences the structure of the population and thus ageing processes. Another influencing factor is life expectancy. If life expectancy increases, this means that the people in society tend to get older. Such a trend alone would already lead to ageing. In combination with falling birth rates, this is an aggravating factor. Looking at the composition of the population by age or age group reveals how large the proportions of people of certain ages are. If the development is observed over several decades, trends in the population composition can be identified. Finally, the factor of the proportion of people aged 65 and over indicates how large the proportion of the older population actually is.

In terms of population development, it can be observed that Japan experienced strong population growth in the twentieth century. Since the end of the 1970s, this growth has continued to slow down. In 2009, the population peaked at just over 128 million inhabitants. Since then, negative population growth has been observed. By 2021, the population had shrunk by almost 3% to less than 125 million inhabitants.

Fig. 1 shows a comparison of the population trend with the trend in live births and deaths. It illustrates that live births have fallen almost every year since the 1970s. At the same time, the number of deaths has been steadily increasing since the 1980s. In 2005, the number of deaths exceeded the number of live births for the first time. This trend has continued up to the latest available data and can explain the population development with initially weaker growth from the 1970s until the peak was reached in 2008 and the subsequent population shrinkage. What is striking about net migration is that it has alternated between a positive and a negative migration balance over the course of history, without appearing to have a significant influence on population development. Since 1988, net migration has always been above zero, meaning that there is more immigration than emigration in Japan. Net migration reached its highest level in 2019. Nevertheless, it should be noted that the positive migration balance is not able to compensate for the population decline caused by the negative natural population balance.

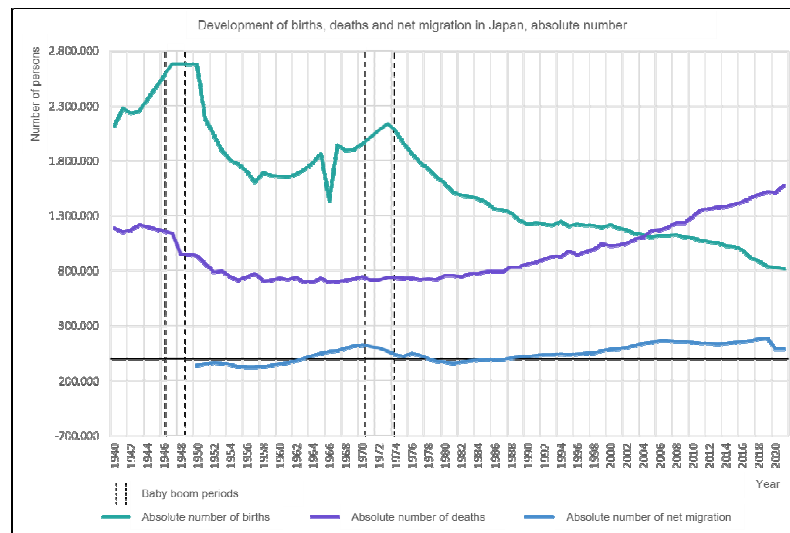


Fig. 1: Development of Births, Deaths and Net Migration in Japan, Own Representation, Data: United Nations, Department of Economic and Social Affairs, Population Division 2024, National Institute of Population and Social Security Research n.d., Statistics Dashboard, Statistics Bureau, Ministry of Internal Affairs and Communications n.d.

Even in the first half of the 20th century, the number of live births was already at a high level. After the Spanish flu, then concerns about the social consequences of overpopulation and the prospect of war caused a decline in births in the previous decades, social policy in the late 1930s and early 1940s led to marriage and childbearing being strategically promoted in the context of military conflicts, resulting in an increase in births (Nennstiel 2011, p. 334). The effects of the Second World War also caused the birth rate to fall in 1944 and 1946. Very quickly after the end of the Second World War, however, the number of births rose again, leading to a first baby boom from 1947 to 1949. Remigrants from former overseas territories and war returnees were factors influencing this development (Nennstiel 2011, p. 335). A subsequent renewed decline in births can be explained by eugenics policy and the associated reduction in legal barriers to abortions (Nennstiel 2011, p. 336). In 1966, the graph shows a strikingly sharp decline in live births. This can be explained by the myth about the Year of the Fire Horse, which recurs every 60 years and states that people born in these years are considered to be particularly aggressive (Nennstiel 2011, p. 330). The second baby boom in Japan took place between 1971 and 1974, with a direct connection to the first baby boom generation, as the people who were born during the first baby boom became parents themselves in the early 1970s (Nennstiel 2011, p. 339).

The decline in births in the following decades up to the present cannot be unambiguously explained. Influencing factors discussed include the increased employment of women, but also a decreasing tendency to marry and start a family due to the risk of social demotion against the background that the income of a male single earner is no longer sufficient for the living costs of a family (Schad-Seifert 2006, p. 34-35).

It can be stated that the baby boom in Japan has a statistically detectable effect. There is the peculiarity that two different cohorts are associated with the baby boom:

- 1st baby boom 1947 to 1949
- 2nd baby boom 1971 to 1974

The crude birth rate, which indicates how many live births there were per 1000 inhabitants within a survey year, can be used to make a statement about fertility. If the crude birth rate falls in the sense of a long-term trend, this inevitably means that the population is getting older, as the age group distribution is changing. In theory, this effect could only be compensated by particularly strong and young migration and/or the occurrence of particularly young mortality with falling life expectancy, but this is unlikely to occur in practice.

For Japan it can be observed that the crude birth rate is falling rapidly, which indicates a significant ageing of the population. While the birth rate was particularly high at the beginning of the period under review in 1950 with over 28 births per 1,000 inhabitants, it was extremely low in 2021 with less than 7 births per 1,000 inhabitants. The high birth rates of the 1940s and 1950s are due in particular to the first baby boom. After the subsequent fall in the birth rate, however, the trend is initially positive again, culminating in a second baby boom from 1971 to 1974. This is followed by another negative trend, which continues to the present.

Life expectancy is another factor in connection with the ageing process of a population. If life expectancy were stable in its development, a falling birth rate alone would cause the proportion of older people in a population to rise, ignoring migration effects. This makes it clear that life expectancy, which in reality is not stable but actually increasing, is an additional driver for ageing.

In Japan life expectancy has risen sharply. In 1950, it was just over 59 years, whereas in 2021 it was almost 85 years. This clearly shows that rising life expectancy is continuing to push the ageing population forward.

In order to better illustrate the characteristics of ageing processes in Japan, fig. 2 analyzes the population according to age groups and the statistically surveyed genders male and female. Four points in time were selected with an interval of 20 years. The observation period was chosen so that the population distribution is shown over several generations.

In Japan, the baby boom of the years 1947 to 1949 is very clearly visible in 1960. This is illustrated in the age groups 10-14 and 15-20, which represent the largest groups in the population in 1960. It is noticeable how small the population proportions of the older age groups are. This makes it clear that the population in Japan was very young at this time.

Twenty years later, in 1980, the baby boom cohorts are still visible as particularly large age groups of 30-34- and 35-40-year-olds. It is also clear that there were fewer births in the following years. However, the second Japanese baby boom of 1971-1974 can now be seen in the 5-9 and 10-14 age groups. Both baby booms are now clearly visible and form the two largest population cohorts in Japan.

This is still the case in the year 2000. It can be seen that the cohorts of the two baby booms are now each 20 years older. In the cohorts after the second baby boom, there are now significantly fewer births and the percentage of young age groups in the total population is shrinking considerably. Ageing has therefore already visibly set in at this point.

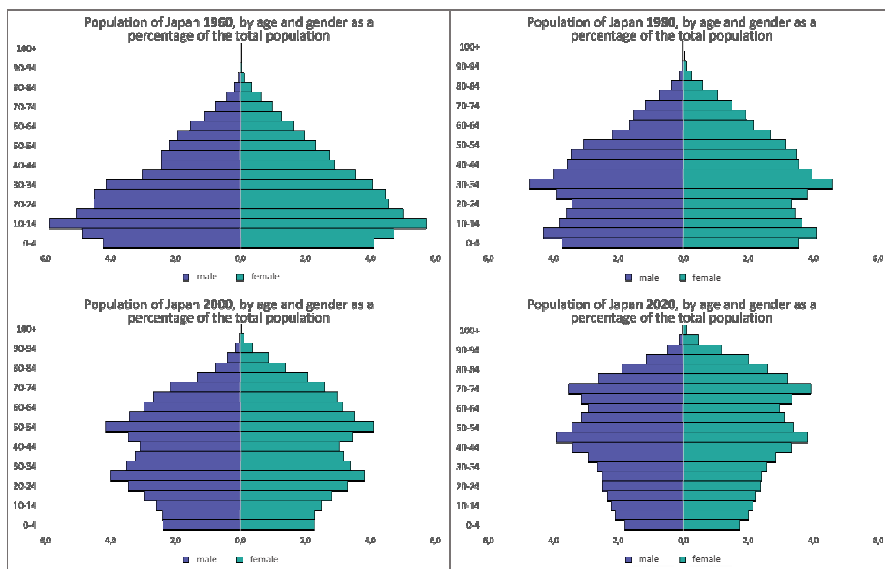


Fig. 2: Population Development in Japan by Age and Gender, Own Representation, Data: United Nations, Department of Economic and Social Affairs, Population Division 2024.

In 2020, it can be observed that the two boom generations have become another 20 years older. The cohorts of the first baby boom in the 70-74 and 75-80 age groups are still very much in evidence. The same applies to the cohorts of the second baby boom in the 40-44 and 45-50 age groups. The older population groups dominate the younger generations with their percentage of the population. The population share of the younger age groups has decreased once again.

Overall, the composition of the population in 2020 is completely the opposite of that in 1960. The population has aged considerably and will continue to age in the coming years.

In addition to population development by age and gender, the group of 65-year-olds and older as a proportion of the total population can also be used as an ageing indicator. The same observation years were used for this purpose.

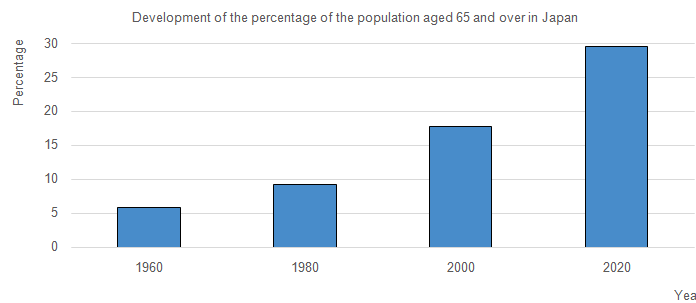


Fig. 3: Development of the proportion of people aged 65 and over, Own Representation, Data: United Nations, Department of Economic and Social Affairs, Population Division 2024

It is evident that the population trends mean that the proportion of people aged 65 and over is continuing to rise and was already almost 30% in 2020. Furthermore, the increase is to be classified as very extreme and proves that the issue of ageing is not new to Japan. An international comparison also shows that Japan is an extreme case. If you compare the indicator of the proportion of people aged 65 and over Japan certainly stands out.

SDGRegion	2022 (percentage)	2050 (percentage)
Worldwide	9,7	16,4
Sub-Saharan Africa	3,0	4,7
North Africa and West Asia	5,5	12,5
Central and South Asia	6,4	13,4
East and Southeast Asia	12,7	25,7
Latin America and the Caribbean	9,1	18,8
Australia/New Zealand	16,6	23,7
Oceania	3,9	8,2
Europe and North America	18,7	26,9

Table. 1: Proportion of people aged 65 and over in a global comparison in the year 2022, Own Representation based on United Nations (2023b, p. 8)

Japan is assigned to the East and Southeast Asia SDG region. This is one of the regions in which ageing is currently strongest and where, in view of projected future trends, a very sharp increase in the ageing process is to be expected. Japan, where the proportion of people aged 65 and over was almost 30% in 2020, is an extreme example not only internationally but also within the region, which is also strongly characterized by ageing.

Looking at the population data, it is clear that Japan is affected by ageing to an extreme degree. The country was also affected by the resulting challenges earlier than other countries. At the same time, it is foreseeable that the trend will continue, and the population will become even older. This situation is not expected to change until the people born during the second baby boom have passed away. How birth rates will develop between now and then, however, remains an unknown factor. It is therefore difficult to predict the future population development.

4 SOCIAL AND SPATIAL IMPLICATIONS

Ageing processes in society bring with them various social and spatial challenges. From an economic perspective, the value produced by both the very young and the elderly is lower than their consumption. Between these age groups, however, people produce more added value than they consume (United Nations

2023a, p. 50). If this principle is applied to a society's public system and the related public services, this means that children, young people and older people receive education, health services, social security, pensions, eldercare, etc. from the proportion of society that is of working age. This working generation, at the time, consumes less of the public services. As a society ages, these age groups shift. On the one hand, this can lead to many more people using the existing services of the public system than before and, on the other hand, to a reduction in the group of people who support the public system (United Nations 2023a, p. 50).

It can be concluded from this that ageing processes demand the adaptation of public services. The associated public infrastructure must be adapted to new conditions too – both quantitatively and in terms of new needs. At the same time, it is becoming difficult to provide public services and infrastructure economically, both financially and in terms of human resources. This means, in practical terms, that it will be more difficult to provide the necessary level of healthcare, and elderly care pensions, for example, which will be even more heavily utilized due to an ageing society (OECD 2019, p. 19; Swiaczny et al. 2008, p. 200).

The changing demands in public services can also give rise to issues of where they should be located. This makes it clear that, in addition to social challenges, specific spatial issues also arise. The topic of 'housing' seems particularly important here. On the one hand, forms of housing must be adapted to the changing conditions associated with an ageing society (Yu and Lee 2017, pp. 442-444) and, on the other hand, cities are often confronted with the fact that older people occupy a disproportionately large living space, which conflicts with the effort to achieve compact urban development (Nelson 2020, p. 480).

However, social and spatial problems arising from ageing are caused by different factors. Various interviews were conducted for the country-specific context of Japan. The interviewees are stakeholder from Japanese-based scientific institutions and public administration. Additionally, on-site walks took place to better understand spatial effects. The findings are now used as the first step to illustrate the implications of an ageing population.

Social Implications

First of all, the social challenges that are perceived in connection with ageing in Japan will be described here. One major issue that is also a major topic of debate in society is the loneliness and isolation that many people face. Older people are particularly affected by this (Interview with Dimmer 2024). In this context, the 'hikikomori' phenomenon must be mentioned, which describes the situation in which an "individual has left the group and is isolated" (Kato et al. 2019, p. 427). The term 'kodokushi' is also often used in this context to describe the solitary dying of people living alone and in isolation (Toyama and Poudyal 2021, p. 2). Both are major media phenomena, which sheds light on the fact that many people are no longer involved in social life and very rarely leave their own homes. This also means that fewer people are visible in public spaces on top of that. Spaces in which people communicate and interact with each other are becoming fewer (Interview with Dimmer 2024). Although older people may be more affected by these phenomena, it is also impacting the society as a whole, if only because of the statistically dominant significance of the older population.

This is also reinforced by the fact that both densely populated urban districts, mostly in outlying areas, and villages in rural regions have a less mixed age structure. This means that older population groups are usually concentrated in one place. This exacerbates the negative social and societal consequences (Interview with Dimmer 2024; Interview with Waldenberger et al. 2024).

Another obvious problem has already been mentioned. The challenges associated with the need for care are a major consequence of ageing in Japan. The individual life situation of a person in need of care can vary greatly. For a person who is socially and familiarly well integrated, care can often be provided by relatives. However, given the trend towards isolation and loneliness, care as a service is becoming increasingly important. Due to the rapid ageing of the population, more and more capacity is needed in this service area, while at the same time care workers are already in short supply (Interview with Dimmer 2024).

Spatial Implications

In addition to the social challenges, there are also significant spatial challenges resulting from ageing. These are presented below. While large metropolitan areas such as Tokyo are confronted with settlement pressure in city centers and areas close to city centers, there is a vacancy problem in rural regions. While many people of working age move to the metropolitan areas to work, it is usually the older generations who stay behind in

rural areas. This results in areas that are ageing and affected by strong shrinkage trends. This also has an impact on the public infrastructure in rural areas. Local public transport and the provision of important shopping facilities, such as grocery stores, are no longer viable. As infrastructure is being scaled back, and people are not adequately supplied, these rural areas become even less attractive as residential locations (Interview with Dimmer 2024; Interview with Waldenberger et al. 2024).

At the same time, however, it can also be observed that people who once moved to the city move back to the countryside, for instance after they reach retirement age. They usually return to their own family home, which was inherited after the death of their parents, for example, or move back to their parents to care for them. Those city-dwellers for whom moving is not an option are encouraged by the Japanese government to buy a second home in the countryside. There is also a market specifically for foreign clients, where properties in the countryside with traditional Japanese architecture are specifically promoted (Interview with Waldenberger et al. 2024).

Many (single family) homes in Japan have a very short lifespan of about 30 to 40 years (Komatsu 2008, p. 2202), as they are often demolished and rebuilt generation by generation. When used properties are sold, their value has often fallen sharply and they are in need of renovation, despite their young age (Barlow and Ozaki 2005, p. 11). The renovation of houses with traditional architecture or the construction of a second home is therefore associated with a high financial burden. The undersupply of infrastructure and services further contributes to these properties being unattractive as potential living spaces. As a result, both approaches to reruralization movements do not have a major effect overall, so that the shrinkage and vacancy trends are not being relativized (Interview with Dimmer 2024).

In contrast, there is high settlement pressure in the city centers and adjacent districts of metropolitan areas. Despite this pressure, there is a measurable ageing of the population and the emergence of vacancies here too. However, the spatial effects are different. If older buildings in inner-city locations in metropolitan areas, often with only one residential unit, become vacant, they are usually demolished plot by plot and replaced by a much denser new-built project with many residential units. Although this creates a higher population density in inner-city locations, buildings that once characterized the neighborhoods also fall victim to this development, while new buildings dominate the cityscape. However, these new buildings, like the single-family homes mentioned above, are often built cheaply for a short life cycle, also with an awareness that new construction is not intended to last for centuries, but that there is a possibility that in a few decades urban transformation could place new demands on the use of the land. This leads to a constant process of successive, fragmented transformation and revitalization of the city with a lot of construction activity (Interview with Dimmer 2024).

A different development can be observed in urban peripheries. Many suburban regions have been developed as New Towns. These are mostly large-scale housing complexes on the periphery of the city, which were developed in Japan in the 1960s and 1970s and in which there is a strong functional dependence on the city center (Tanabe 1978, p. 39). At that time, mostly young people of the same generation moved into these areas, resulting in a homogeneous age structure. Nowadays, the same generation still lives in the New Towns, making ageing effects particularly visible here. As this generation is ageing, it will also reach the end of their life expectancy together, which means that deaths accumulate over the course of a few years leading to major social changes in the districts. In this way, systemic vacancy arises very quickly (Interview with Waldenberger et al. 2024). Colloquially, one can speak of the emergence of 'ghost towns' in less attractive locations.

It can be summarized that the social and spatial implications of ageing processes in the country-specific context of Japan largely correspond to the general problems outlined at the beginning. Nevertheless, there are some special characteristics in Japan. On the one hand, the issue of loneliness and isolation plays a significant role and, on the other hand, the strongly homogeneous age structures, both in rural and suburban areas, are particularly noticeable. In contrast, the difficulties in providing infrastructure and services, the need for elderly care and the rise in vacancies are more general and typical implications of ageing.

5 APPROACHES AT DIFFERENT LEVELS

In connection with the implications described above, various problems arise for Japan. There are approaches at various administrative levels to deal with the problems. From an administrative perspective, Japan is

highly centralized, and the national government generally acts as the main actor in the country's development (Pallagst et al. 2018, p. 7; Martinez-Fernandez et al. 2016, p. 13). Therefore, the approaches from a national perspective are discussed here first. Local and regional approaches will be outlined afterwards.

National Level

At a national level, the Society 5.0 initiative should be mentioned first. Society 5.0 expresses the Japanese governments vision of pushing forward digitalization in all policy areas with the aim of merging cyberspace and physical space (Deguchi et al. 2020, p. 2; Cabinet Office Japan 2017; Pallagst et al. 2024, p. 138). This can be classified as a kind of funding program aimed in particular at researching and testing new technical possibilities. It originated from a Japanese development instrument, the “Science and Technology Basic Plan”, which is updated every five years, has received a lot of media attention and was seen as a response to Germany’s “Industry 4.0” (Interview with Waldenberger 2024).

One specific digitization project that has been developed and implemented at the national level is the “Project PLATEAU” of the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The project aims to develop a national digital twin to support urban development tasks and aims to have developed 3D CityGML models in around 500 Japanese cities by 2027 (Seto et al. 2023, p. 202; MLIT n.d.a) Although there is little information about how the project is organized, the MLIT itself offers some insights (MLIT n.d.b, Uchiyama and Ishimaru 2022, p. 15). With the ministry, the highest administrative body at national level is the main actor in the project. This approach to the governance structure corresponds to the top-down, centrally organized administrative system in Japan. Although this is a project that requires large-scale implementation, it is not surprising that development is nevertheless being steered by a higher-level body. However, the technical implementation is not being carried out by the MLIT alone. A consortium has been formed with various participating institutes, organizational units and local authorities. According to MLIT, these come from the fields of science, industry and local administrations. The Association for Promotion of Infrastructure Geospatial Information Distribution is responsible for the provision, creation and maintenance of geographical and other spatial data. Nonetheless, the specific roles of the various stakeholders are not always clear in detail and are difficult to categorize independently. However, it is clear from the MLIT's explanations of the more specific use cases within 'Project PLATEAU' that industry and research institutes play a leading role in their development in particular (MLIT n.d.c).

The overall aim of “Project PLATEAU” is to provide a data platform for geodata, building data, geographical data and other spatial urban data relating to the built environment and to make this available as open-source data. In addition to static data, dynamic camera and sensor data are also used in individual applications (Uchiyama and Ishimaru 2022, p. 13). In this context, Seto et al. (2023, p. 202) found that in spatial planning practice in Japan, data relating to population, settlement areas, land use, traffic and landscapes must be collected and mapped every five years. In many local authorities, however, these maps are still only available in paper form. This makes it clear that the development of digital twins as part of 'Project PLATEAU' is primarily understood as a spatial planning tool. It should make it possible to visualize urban data and thus gain knowledge. MLIT also places the project in the context of the Society 5.0 vision and the associated goal of solving the country’s social and societal problems. It is referred to as the “digital transformation of urban planning” and is intended to connect various actors involved in spatial development, such as administration, private companies, researchers, engineers, etc., via the data platform in the form of digital twins to enable more efficient collaboration. The MLIT aims to model around 500 Japanese cities (MLIT n.d.a). In a first step, 56 Japanese cities have already been modeled, including particularly populous cities (Uchiyama and Ishimaru 2022, p. 7). It is clear that the PLATEAU project is unprecedented in the world due to its intended scale. With regard to other digital twins in an urban planning context, such as that of the city of Helsinki in Finland, the national digital twin in Japan with its formulated goals appears to be very ambitious, but at the same time a logical consequence and comprehensible approach in view of the Japanese government’s policy.

The basic functionalities in the CityGML model, which can be accessed via the “PLATEAU View” application, include, for example, any perspective view within the model, including pedestrian view, the shadowing by the built environment based on specific date and time input and also the possibility for users to add geometric objects to the built environment and works therefore like a scenario visualization. With regard to building modeling, each building can be selected individually or in combination with other building units

in order to obtain specific information associated with the objects. This also includes information relevant to spatial planning, such as building heights, usage typology and information on built-up areas (MLIT n.d.d). In addition, there are special use cases for certain functionalities, some of which have been developed by local administrations for specific problems.

Mayer et al. (forthcoming) took a closer look at two of these use cases and concluded that they hold great potential for spatial planning. Work processes can be made more efficient and the functionalities also offer new opportunities for spatial planning. As the project was developed with the intention that various stakeholders can design and implement more specific use cases based on the linked CityGML models and the basic functionalities, it is also possible to thematically address general trends and crises that are shaping spatial planning. This means that there is also potential for age-related problems. So far, however, there is no use case that deals exclusively with this topic, although general planning-related use cases involving locations for infrastructure and the organization of land use naturally have important cross-references for ageing problems. Mayer et al. (forthcoming) consider the project to have great potential for strategic spatial development but also note that there is a need for greater transparency regarding the processing of the data used. Through national implementation, municipalities benefit from the tool that is made available to them without having to incur high development costs themselves. However, due to the aforementioned short lifespan of many buildings and the constant fragmented transformation of the city, high maintenance costs are to be expected. And although there is a risk that local specific needs are not taken into account during development, this can be counteracted by the expandability based on local use cases.

A similar project at national level that should be mentioned in this context is the “RESAS Portal”. The name is an acronym that stands for “Regional Economy Society Analyzing System”. It is a tool for big data visualization, that brings together large amounts of regional data that make it possible to compare regions and municipalities in Japan with each other using selected indicators. “RESAS” is thus used for regional benchmarking in Japan (Interview with Waldenberger et al. 2024). The system was developed by an international company from the private sector, which also has a head office in Tokyo. The commissioning party is the Japanese 'Ministry of Economy, Trade and Industry', which is strongly committed to promoting regional economic policy (Takram Japan Inc. n.d.). This once again illustrates the typical steering system in Japan, where it is the Japanese national government that develops and implements concrete policies and takes action.

The aim of the “RESAS” tool is explicitly related to economic development with special emphasis on the support of regional economic policies. Among other things, it makes specific reference to the challenges associated with demographic change (Takram Japan Inc. n.d). Population declines and ageing, as well as unequal demographic development in rural and urban regions and the resulting economic weakness in certain regions are seen as problems that the instrument is intended to support (Matsuura 2020, p.3-4). It was designed for a broad user group and is not only available to public administrations at all levels, but also to the private sector, citizens and educational institutions. (Takram Japan Inc. n.d.; Matsuura 2020, p. 3).

The tool offers users two main views. Firstly, a geographical image of Japan, which is viewed from a bird's eye perspective, and secondly, a breakdown of specific information on an indicator under consideration, in which regulators can also refer back to the geographical view. Both views can be controlled interactively. In addition to the national borders, the geographical view further shows the borders of other administrative units, such as prefectures and municipalities, but also other vector-based elements at local level, such as the road infrastructure of a city, which enable better orientation. Various methods are used for data visualization. Among other things, areal and octal representations are used, but also different forms of diagrams, some of which are assigned to polygons on the geographical view. In addition, there are network visualizations in which relationships can be established from one polygon to other polygons (Takram Japan Inc. n.d.). Overall, the interactive functionalities are very versatile. And so is the data that the tool can visualize. There is a clear focus on economically relevant data. For example, there are indicators relating to the regional economy such as the production of certain goods and their distribution, the cultivation of food in agriculture, the economic structure by sector, the labor market and employment figures, energy use, consumption of goods by certain population groups, tourism by overnight stays and accommodation destinations and much more. However, there are also indicators on other topics, e.g. population development, municipal finances, taxes and healthcare. In addition, there is a separate category for relevant indicators in urban planning, which

includes urban structures and some types of public services, such as education (Cabinet Office Regional Revitalization Promotion Office n.d.).

“RESAS Portal” is an outstanding tool that can provide and analyze exceptional amounts of data. For the strategic development and planning of cities and regions, it can thus provide important support for decision-making and help to ensure that decisions are made based on facts and free from intuitive evaluations. The competitive approach can incentivize structurally weak regions to become more competitive. However, as the tool is also explicitly aimed at the private sector and location issues are examined for economic viability, there is also a risk that decisions made based on economic interests may not always preserve the overall view of Japan’s development. The question therefore remains as to how much the tool contributes to solving social and regional problems.

Both projects described show that the national level plays a key role in the development and implementation of digital tools and innovations. It can be observed that the government has an affinity for drawing up large-scale plans that are then rolled out across the country. In these processes, participatory approaches are often lacking and future users or consumers, where the needs lie, are rarely included in the processes (Interview with Waldenberger et al. 2024). At the same time, however, this ensures fast development times in which coordination requirements are kept to a minimum.

The potential arising from the tools presented for the ageing problem is huge. The basic functionalities alone make it possible to visualize specific spatial distributions of relevant indicators, provided the data is available to the tool. This could serve as decision-making support for spatial planning, which could, for example, help to make age structures more heterogeneous in certain areas and strategically determine locations for public services and infrastructures that play a role for an older population, as well as counteract gaps in services. However, this potential applies to all sectoral topics with spatial relevance for which data can be provided. In this respect, it is striking that there are no specific use cases related to ageing so far.

Local and Regional Level

Although national government policies and instruments set the standard and projects at local and regional level are much smaller in scale, digital platforms still play a major role here too.

As part of the smart city Initiative in Japan, many municipalities have developed smart city strategies. The authors talked to responsible people from the administration in Tokyo and the much smaller city of Takamatsu. It emerged that both smart city strategies have great potential to provide a supportive tool for finding solutions to ageing-related problems. Both strategies already include implemented map-based platforms that can be used to visualize certain data on a pointwise or area basis (Interview with Masashige and Asad 2024; Interview with Munenori and Mitsuhiro 2024). This could be used to better coordinate locations for certain services and infrastructures that are needed according to the needs of an aged population, and to analyze the residential distribution of the older population to make it more heterogeneously through spatial planning.

In both Tokyo and Takamatsu, however, the smart city platforms are mainly used for operational issues such as traffic control and many more. So far, there is no approach to planning use or to making strategic decisions about the development of space. There is also no specific link to ageing issues (Interview with Masashige and Asad 2024; Interview with Munenori and Mitsuhiro 2024). Nevertheless, there are indirect links between smart city strategies and ageing issues. The topic of mobility and transportation is central to the Japanese smart city initiative and represents important use cases for the two strategies described above, too (KANTEI n.d., p. 10). This can benefit accessibility to important facilities for an elderly population. In addition, smart city strategies have the potential to make administrative tasks more efficient (Narmeen and Jawwad 2015, p. 9). Since fewer and fewer people are of working age due to ageing processes, this provides an important contribution that can help to maintain important administrative structures.

Metaverse platforms are a development that addresses the problems of loneliness, isolation and unattractive rural areas. These are projects at a local level. Here, certain environments of places are graphically recreated digitally. The target group is citizens. The development usually takes place in the private sector, with citizens taking on the role of consumers. They can use avatars to move around the recreated environments and interact with each other. Virtual reality hardware is also used in some cases. In many cases, metaverse platforms are used to entertain users or to advertise products or businesses. In some cases, it is also used to impart knowledge, for example in museums (Interview with Waldenberger et al. 2024).

However, it is also seen as an approach to create new meeting and opportunity spaces against the background of many people's loneliness and isolation. People who normally find it difficult to leave their own homes due to physical disabilities, whether caused by illness or ageing, can also participate. In rural areas, metaverse platforms are also used by municipalities affected by population decline to promote them as residential locations with their digital image and increase residents' identity with their town. Users then have the opportunity to explore and get to know the municipality digitally (Interview with Waldenberger et al. 2024).

Another avatar-based approach, which takes place without the use of metaverse but is instead intertwined with physical space, are avatar cafés. In these cafés, robots that resemble humans are able to move within the premises. People who are unable to leave their homes can visit the café remotely via an avatar. The digital avatar takes on the appearance of one of the robots in the café. This allows for interpersonal interactions within the café, where some visitors participate physically and in human form, while others are represented by the robot avatars (Interview with Waldenberger et al. 2024).

The impact of such projects is difficult to assess. In general, however, a great affinity with new technologies can be observed in Japan. People base their actions strongly on pop-cultural imaginaries and also identify themselves as part of them. New technologies and manga graphics are key components of this (Interview with Waldenberger et al. 2024). In this respect, the social and spatial effects that could be triggered by this should not be underestimated. At the same time, this raises the question of whether such approaches could actually be transferred to societies with other cultures.

There are many other digital approaches that are being applied at the local or regional level. These include, for example, ideas for providing peripheral areas with goods using drones. This can be particularly advantageous when municipalities are located on islands, where quick delivery of essential goods may not always be possible, such as in the case of medications. Another example addresses the issue of transportation infrastructures being reduced in rural, shrinking regions. At the same time, it addresses the problem that many people in retirement age remain willing to work. Therefore, Japan places a strong emphasis on volunteer work in sectors that would otherwise not be able to operate due to lack of profitability. This also applies to the transportation sector in rural areas. Such projects are supported by digital technologies, such as platforms where individuals can register for transportation services, and volunteer drivers are then notified and assigned the task of providing the transport service (Interview with Waldenberger et al. 2024).

These types of digital solutions seem to have greater international transferability, as they are less tied to pop culture and imaginary contexts in Japan. The practicality of the solutions appears to be evident, as they directly address existing issues in a very immediate way.

6 CONCLUSIONS

The paper shows that Japan can be a very pertinent example in terms of researching the effects of ageing in the population. Ageing in Japan is particularly advanced compared to other countries. Effects from the decline in births and fertility coupled with a simultaneous increase in life expectancy have a statistically high significance that can explain the ageing process. The baby boom cohorts are a particularly strong driver of ageing.

Generally, insights on demographic trends in Japan and their spatial and social impacts can be transferred well to other countries, especially to developed countries, where ageing processes are evident too. A key difference, however, that needs to be highlighted, is the factor of migration. In many developed countries, there is a clearly positive migration balance. In Japan, the migration balance is also positive, but it is rather small and not statistically significant compared to the total population. For Japan, this means that this mitigating factor for the ageing effect does not apply. Nevertheless, the effects of ageing which are more advanced in Japan than in other countries can serve as an example from which lessons can be learned.

The social and spatial impacts of ageing pose enormous problems for Japan and force the government and administrations to find solutions.

Various such solution approaches have been presented here. It has been noted that the national government plays a special role in Japan. This is due to the centrally organized governance structure. Development and implementation at the national level, as in the cases of Project PLATEAU and the RESAS Portal offer several advantages. The development and implementation process can be organized by a single body. The need for coordination among different stakeholders is minimized. In addition, powerful platforms are provided to

local governments throughout Japan. Even small, structurally weak municipalities have the opportunity to benefit from digital innovations and are dependent on their own finances and do not depend on the possibility's local efforts.

At the same time, the centralist approach also carries risks. For example, local specificities and interests may not be sufficiently taken into account. The processes are less transparent and leave no room for participation. Another criticism is that national strategies are being rolled out across the country and local authorities may be unprepared. Furthermore, actual local problems cannot always be addressed by these policies.

Applied to other countries' contexts, it can be noted that the centralist approach has both advantages and disadvantages. Coordination in a central body at the national level and funding from that body is an approach that is transferable to other countries, although this could mean that local administrations may have to give up authority fields. However, it would be necessary to implement well-functioning participatory processes, with both actual local needs and specificities forming the basis for the development of digital solutions.

In contrast, the local and regional approaches to the metaverse and avatar platforms are difficult to transfer. Yet, the reliance on Japan-specific pop cultural imaginaries makes adaptation in a different cultural context unlikely. Thus, this approach to solving age-related problems is questionable.

In contrast, the approach of allowing willing retirees to work as volunteers in sectors that provide essential public services and infrastructure, which are increasingly difficult to maintain due to population ageing, seems highly transferable. It is considered worthwhile conducting further research in this area to explore through case studies how digital solutions can provide support in this context.

In the approaches examined at various levels, it is notable that there is rarely a direct connection to real, existing problems related to ageing. Although indirect connections exist, and the potential becomes apparent, further research is needed to determine the extent to which the implemented solution strategies contribute to a transformation process in addressing these challenges. For this purpose, it is assumed that examining path dependencies through empirical case studies will help describe the synergies related to supporting solutions to aging-related challenges through new technologies.

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