Ageing Smart – Digital Instruments in a Municipal Context: Data, Analyses and Strategies (not only) for Baby Boomers

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1 ABSTRACT

The project addresses the baby boomers born between 1955 and 1969. As they gradually enter retirement age, municipalities are required to create age-appropriate residential locations and supply structures. The project brings together spatial planning, infrastructural and supply-side approaches from the perspective of the "baby boomers" and the municipalities. The aim is to develop a data-supported decision support system (DSS) that serves as a decision-making aid for public actors in their planning processes. The research project focuses on three fields of investigation: Residential locations and the associated requirements for opportunities in the residential environment and mobility, behaviour with regard to leisure and recreational activities and the provision of medical and related health infrastructures..

Keywords: decision support system, local infrastructures, municipalities, babyboomer, digital instruments

2 BACKGROUND AND RESEARCH QUESTIONS

The number of papers that emphasise digitalisation and artificial intelligence in the context of demographic change has increased significantly in the last 5-10 years. However, the debate has focussed on technical assistance systems and the need for care (cf. aal-deutschland.de). We are pursuing a different goal here: we are not focussing on the individual, but rather on supporting stakeholders who are responsible for infrastructure and services close to home in order to help maintain and safeguard the quality of life of the cohort of babyboomers in particular. A systematic analysis of supply and demand in seven municipalities from three spatial types (urban, suburban, rural) leads to the development of a data-based decision support system for local and regional stakeholders. We are combining research strands from various disciplines from a practice- and technology-orientated perspective.

The babyboomer cohort comprises almost a fifth of the German population, but little is known about their social situation, mentalities and behaviour (Nassehi 2019, Körber-Stiftung 2020). In the next ten years this cohort (born between 1955 and 1969, more than 1,1 million births each year), will enter retirement age. Changes in people's behaviour and demands on residential locations are assumed to take place with this fundamental change in the lifecourse. As long as these older adults do not continue working, individual time budgets and mobility patterns are changing radically; activities that were previously assigned to "recreation" and "leisure" (e.g. playing sports, shopping, excursions, basic supplies) determine everyday life. A change of residence might be desired or necessary, mainly for cost reasons or due to a lack of suitable opportunity structures. This biographical transition is of particular importance in terms of spatial planning, Municipalities are facing a variety of socio-spatial challenges, e.g. for healthcare provision, community acctivities and age-appropriat leisure facilities. The spatial behaviour of this generation - with its individualised and diverse lifestyles - has hardly been researched and can therefore hardly be foreseen.

On the other hand, the social and health infrastructures as well as infrastructures and public and private services are undergoing a profound restructuring via digitalisation.

The existing system is being called into question and new forms of services such as online administration, online shopping as well as telemedicine become more selfevident. The regional and municipal authorities responsible for spatial planning and services of general interest are facing onsiderable challenges. Following research questions shall be answered:

Which services do babyboomers require at the municipal level in which analogue-virtual interlinking, and what effects can digitalisation have on municipal infrastructures and services in the future?

How can social and spatial characteristics and their interactions be mapped in an interactive decision support system (DSS) in such a way that local actors in urban, suburban and rural areas are supported in their

strategic decisions on infrastructures and services specifically for the babyboomer cohort entering retirement age?

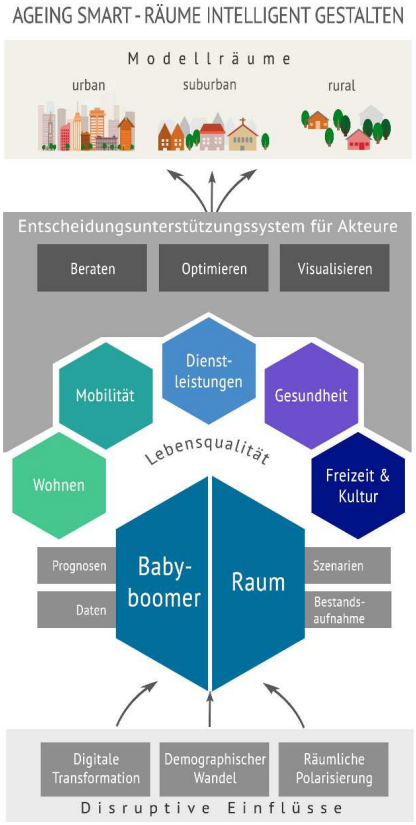

Fig. 1: Approach of the project "Ageing Smart – Designing spaces intelligently"

How can complex mathematical models based on uncertain amounts of data be handled theoretically and algorithmically in such a way that socio-spatial questions can be answered in the form of an interactive DSS and decision-making processes can be optimised at local level?

And which artificial intelligence (AI) technologies can be used sensibly and transparently?

3 OBJECTIVES AND FIRST RESULTS

The central objdective is to be able to show model-based solutions for selected municipalities from the three spatial types urban, suburban and rural and thus prepare decisions in order to improve urban structures, residential locations, infrastructures and services in line with demand. Based on different criteria, the following municipalities were chosen:

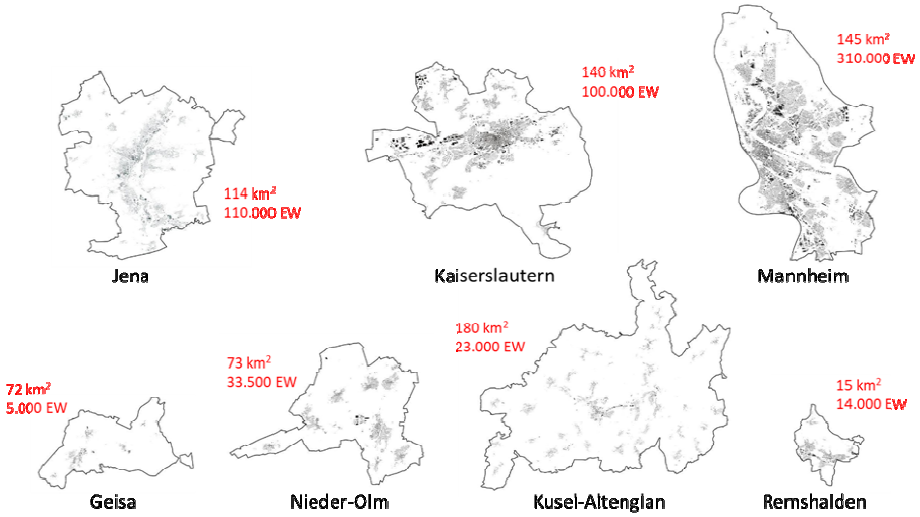

Fig. 2: Comparison of the settlement structures of the seven model municipalities.

All of the municipalities prioritised have agreed to participate in the project (see Fig. 2). These are: Kaiserslautern (RLP), Jena (TH), Mannheim (BW), Remshalden (BW), the municipality of Nieder-Olm (RLP), the municipality of Kusel-Altenglan (RLP) and Geisa (TH).

The research project is based on the integration and processing of a large number of different and sometimes complex data bases (including population data, cadastral data, localisation of infrastructures) using algorithmic methods of mathematics. In the context of the transition of babyboomers into retirement age, the focus is on the following areas:

- the development of urban structures and residential locations, e.g. the monofunctional residential areas of the 1970s and 1980s, but also the city centre districts as potential migration destinations for this cohort,
- locations, size and characteristics of community, leisure and recreational facilities in terms of demand and accessibility, but also taking into account local climatic and air quality conditions,
- healthcare, general practitioner care; taking into account hybrid service models that include mobile and digital services (telemedicine, video consultations, e-health systems, etc.) in addition to stationary facilities such as medical centres,
- the provision of cultural facilities, taking particular account of the dynamically developing demand and the high mobility and individuality of the baby boomer cohort,
- local public transport, which is coming under pressure to adapt due to the shift in commuter flows on the one hand, and new solutions on the other, and
- social situations, lifestyles and lifestyles of babyboomers in these three spatial types.

The household composition according to age and spatial differentiation is analysed by the sociological team. Household size decreases with increasing age, as children are more likely to have moved out of the parental household (Table 1). Household size is smaller in eastern Germany than in the western states. Children were born earlier here and therefore set up their own households earlier. There are more one-person households in cities; two-person households are mainly found in suburban and rural areas. Households with four people are more common in rural areas and large families in suburban areas. However, there is no clear allocation of families to suburban or rural areas, they live in cities to the same proportion.

			1955-1969 (Babyboomer)									
Size of House-hold	BRD	Born 1950 - 1954	1955 - 1959	1960 - 1964	1965 - 1969	Baby-boomer	West	East	Urban	Sub-urban	Towns in rural areas	Vill age s
1	43	38	35	33	32	33	32	40	40	27	34	22
2	33	55	52	41	25	40	40	43	35	45	39	54
3	12	6	9	15	20	15	15	12	13	14	18	14
4	9	1	3	8	17	9	10	4	8	11	6	8
5 +	3	0	1	3	6	3	3	1	3	3	4	2
n=	19027	1620	2002	2078	2541	6621	5079	1542	2842	2182	1299	298

Table 1: Household size by age group, baby boomers, West-East Germany and settlement structure (in %).

With regard to housing, more than half of baby boomer households are owner-occupiers, with the older cohorts (born 1955-1959) more likely to be owners than the younger cohorts (58% compared to 54%). In the West, the ownership rate is almost 10 percentage points higher than in the East, but even in the East, the rate in this cohort corresponds to the overall German level (58% compared to 47% in East Germany; FRG as a whole: 46%). In rural areas, almost three quarters of households own their own home.

Besides these illustrative results of sociological analysis, the author would like to draw attention to the following main areas of work:

- In addition to local geodata, small and micro-spatial data well below the neighbourhood level are processed (grid-based locations 100x100 metres in focus, e.g. location or statistical information in a hectare grid or finer, network and accessibility analyses). Creation of a list of quality of life

indicators from everyday goods (bakeries, butchers, drugstores and supermarkets) and green spaces (parks, squares, open green spaces and forests) and analysis of these using an internally developed evaluation procedure for availability, accessibility and diversity (Bielik u.a. 2019). Visualisations (visualisation, methods in planning: Berchtold and team (dvmp))

- Development of a mathematical model (see Laporte, u.a. 2015; Jena u.a. 2016; Schäfer u.a. 2020), which allows a time-dependent, intermodal accessibility analysis of the POIs in the model municipalities based on real timetable data, with the possibility of freely selecting numerous parameters to enable a target group-specific analysis. Population data based on the 2011 census is spatially localised so that weighting is also possible. (Mathematical optimisation: Ruzika and team)
- Development and implementation of several algorithms for calculating hiking routes: Based on existing hiking trails, alternatives are determined which are more suitable from a health perspective (isoprene exposure). (Optimisation, together with Physical Geografy: Henninger and Team)
- Current theoretical research focus is the integration of intermodal accessibility into mathematical location planning. (Optimisation; see Figure 3)
- In the eyes of many, green infrastructure plays a decisive role in the evaluation of a place to live (Henninger, Weber 2020). Urban areas with limited open spaces are increasingly seen by many people as a burden on health. Empirical surveys have shown that the general state of health of respondents whose homes were within a radius of 1 km to 3 km of the nearest green space was consistently positively influenced. Such results are particularly significant for older people (Wagner, Kuttler 2014). One research gap that the Ageing Smart project aims to fill is the question of whether the available retreat areas can be used by every group of people depending on the meteorological conditions.Development of a hiking trail isoprene cadastre using the example of the Kaiserslautern study area and transfer to the city of Jena. (Physical geography: Henninger and team and optimisation). Research into the relevant indicators (e.g. the allergy potential of trees, shading) to check the transferability of the chosen approach. Revision of the digital tree cadastre for Kaiserslautern (PhysGeo, DFKI)

- Studies on services of general interest have not yet made it clear how offers and approaches at municipal level for securing and expanding services of general interest are assessed. This project aims to answer the research question of how the choice of location of service providers (doctors, physiotherapy practices, pharmacies, etc.) can be influenced by the municipalities and which location factors are relevant for the most important service providers (especially doctors). We carried out structural analyses in the model municipalities and determined small-scale data on healthcare provision. Planning, implementation and initial evaluation of the survey on healthcare provision. (Regional development: Mangels, Stieving)

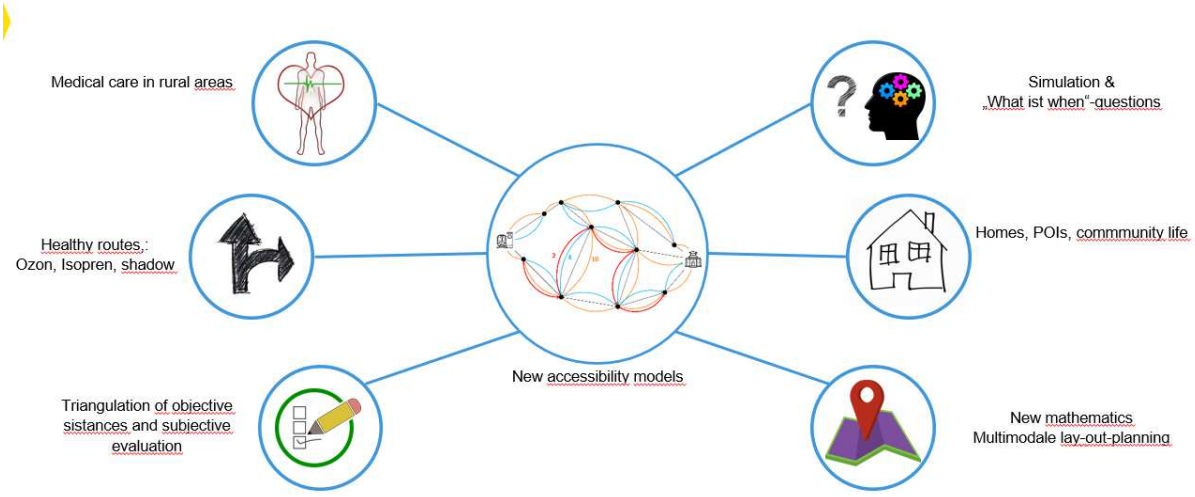

Fig. 3: Interdisciplinary use of the accessibility models; Design: Stefan Ruzika, Otimisation.

- One task is to quantify the concept of the 15-minute city in order to be able to carry out the accessibility analyses clearly and transparently. This also includes the identification of relevant POIs. Investigation of what accessibility is appropriate for infrastructures in terms of the 15-minute

city and how this can be guaranteed and improved. Selection of urban structure types as a spatial reference level; mapping of the urban structure types of the model municipality Jena in GIS and characterisation with profiles. The model municipality Kaiserslautern will follow as soon as the required data is available. (Urban planning: Kurth, Schittenhelm)

- Financing basis: effect of changes in population size and age structure on the municipal share of income tax; financing requirements: demand in the care sector) for subsequent processing using simulation techniques (economics: Junkernheinrich, Hestermann)
- Development and expansion of the "metadata tool" as a catalogue for data used or generated in the project, as a basis for quality management, transparency and explainability of the DSS. Processing and analysis of various data with the help of AI processes, including floating car data to extract information on mobility behaviour.(DFKI: Memmel, Meyer)
- Organisation of workshops in the model municipalities and initial consolidation of results (IESE: Berg and team)
- Development of priorities for the visualisation of municipal and research data (overall project) in order to design basic functionalities of the DSS in the area of data management and data visualisation (IESE; dvmp)
- Work of the data commission, which defines data-related processes and tools, specifies responsibilities and thus creates the framework conditions for sustainable and efficient data utilisation. (DFKI: Memmel, Meyer; urban sociology: Hartung; data, visualisation, methods in planning: dvmp)
- Demographic change is a global phenomenon that affects a large number of countries worldwide. Japan in particular, with its massive ageing population due to low birth rates and restrictive immigration policy, is regarded as a pioneer in the development of policies and strategies for dealing with demographic change. In other countries, such as the USA, the issue has only been discussed in the last decade, but here too demographic change will have a massive impact on society in the future (Henderson u.a. 2017). The collection of relevant examples of existing decision support systems used in spatial planning is in progress. Case study surveys with trips to the USA, Finland and Japan are conducted (site visits, expert discussions, interviews and analysis of statistical data) (International Planning Systems: Pallagst and team)

The networking of mathematics, computer science, social sciences, and spatial and environmental planning opens up new interdisciplinary perspectives in basic technical and mathematical research. The DSS to be developed will initially bring together a wide range of existing data sets of different origin and resolution (e.g. spatio-temporal settlement structure data, small-scale socio-demographic data from the registration system, statistical and socio-economic data) according to the classical model, develop innovative forms of visualisation for this purpose and provide the respective user with a broad overview and points of comparison to which he can relate his own situation. In addition, numerous mathematical application areas (such as location, layout or route planning) in the context of an ageing society are characterised by data-based, behaviour-oriented, dynamic and multi-periodic aspects. The aim is to depict these in suitable mathematical models and to show the decision-maker alternative courses of action obtained through optimisation processes in a DSS. If possible, demonstrably good solutions should be calculated so that the quality of the various decisions can ultimately be quantified and weighed up.

As the DSS envisaged in Ageing Smart is to be used in contexts that will have a direct influence on the way people live, the topics of ethics, transparency and explainability play a special role. The discipline of machine ethics is concerned with the question of how principles of ethical behaviour can be applied to the assessment of the "actions" of a machine and its design (on the fundamental philosophical questions of machine ethics. Such ethical questions are already highly relevant today and are even more so in the field of self-learning (Misselhorn 2028) systems. A further step is to analyse the repercussions of technical systems on people's social actions and on local governance structures, both of which are areas that have hardly been researched or predicted to date (Batty 2018).

4 CONCLUSION

With the central objective of developing a decision support system to optimise infrastructures and services for the baby boomer generation, the "Ageing Smart - designing spaces intelligently" project has a high level of social relevance. The DSS is intended to help local stakeholders from politics and administration to justify strategic considerations on location issues on the basis of data, to react safely to risky developments and to plan for the long term (housing, services, sport, recreation, health). During the project, the significance of the tool is continuously analysed in regard to ethical consequences. The iterative approach to developing the DSS and data-driven scenarios in workshops at local level is useful to further develop the understanding of complex interactions between physical and lifestyle aspects. Not only are services and infrastructures identified, but priorities and policy contexts will be considered. We hope to reduce the widespread scepticism towards mathematical models and data-driven decisions in municipalities.

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