

Smart Silver Villages as part of Social Infrastructure for Older Adults in Rural Areas

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Rural areas in the European Union are ageing faster than urban areas, in many cases due to outmigration of young cohorts. Social innovations based on the digital transformation of health care and social care delivery systems can support older adults to live autonomously and independently in their own communities and postpone or even prevent their having to enter a nursing home. Extension of these innovations in service provision to rural areas is the subject of this paper. Development of Smart Eko Social Villages presents opportunities for the development of new, digitally supported health and social infrastructure in rural areas. The innovations will enable a more efficient combination of the existing societal resources in the communities for the provision of health care and social needs to the ageing members of the society. They are dependent on the help of others due to illness or functional decline. On the supply side, new scientific (optimisation of the supply networks), organisational (self-managed communities) and technological innovations, like robotics, domotics, cyber physic systems (CPS) based on the Internet of Things and cloud computing, offer new utilities and create new businesses for the supply of goods and services to older people, and also provide new job opportunities for the younger residents. This paper aims to consider the development of Smart Silver Villages as part of social infrastructure in rural areas, supporting the autonomy and independence of the rural population in their old age.

Keywords: ambient assisted technologies, smart village, independent living, assisted living, housing with care, health care, long-term care, population ageing

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1 INTRODUCTION

Rural areas in the European Union are ageing faster than urban areas, in many cases due to outmigration of young cohorts. The rising demand for health, social and informal care services due to the growing burden of chronic diseases, is projected to increase health and care expenditure on average by 1-2% of GDP until 2070 (Ageing report 2018 -EC, 2018), at constrained public resources for Long-term Care (LTC). The expected shortage of labour supply in caring services is estimated to reach 20 million in the next five years (EIPonAHA, 2017). More sustainable models for health and care delivery, increasing the effectiveness and resilience of health and care systems are needed to deliver new treatments and effective care at an affordable cost also in remote rural areas where patients' needs appear. Also, better integration of health and social care is needed to realise a triple win: better quality of care, more sustainable and more efficient delivery systems, and creation new jobs in the networks of the optimal hierarchical structure of functional areas and regions (Drobne and Bogataj, 2012, 2014, 2015, 2017, Janež et al., 2016, 2018). Optimal care coordination between primary, community to hospital, care, integrated with social care and families is detrimental to the quality of these networks and increasingly required as a precondition to the LTC sustainability. These requirements are placed at the centre of healthcare innovation and policy reforms (EIPonAHA, 2017) and shift the focus from acute, hospital-based care to early prevention procedures in community and home-based care. It also requires much stronger participation of citizens and modern participation of carers and healthcare professionals, getting new roles and skills in using new technologies and systems engineering

knowledge. The ICT platforms need to include new governance models between users, payers and providers, supported by innovative solutions.

Physical and social environments are key determinants of whether people can remain healthy, independent and autonomous long into their old age. Falls often cause severe injuries and are one of the costliest health conditions among older adults (Goswami, 2017; White et al., 2019). Many falls are preventable. Access to an age-friendly environment that can accommodate the functional capacities of residents and the development of smart silver villages are important factors that can enable older adults to live longer in the community. Creating an age-friendly environment in smart silver villages in different housing arrangements (Figure 1) is, therefore, one of the most effective approaches to respond to demographic change in rural areas. The main components that make up a smart silver village include: (a) support to residents to develop smart silver villages – especially resident empowerment, (b) access, (c) services and amenities, (d) built and natural environments, (e) social networks/wellbeing, (f) housing. Figure 1 is showing that the Smart silver villages enable different types of support to residents with decline functional capacities. Consequently, Smart silver villages allow to stay longer in the ICT equipped communities spread over a broader rural area, and therefore postponed or/and prevents reallocation to nursing homes. This is shown by movement from point X to point X' and consequently by movement thresholds downwards.

The European Charter of Fundamental Rights (EUR-Lex, Document 12012P/TXT, 2012) secures the rights of the elderly to lead a life of dignity and independence and participate in the

social and cultural life (Article 25), as well as the right to social and housing assistance to ensure a decent existence to all who lack sufficient resources (Article 34(3)).

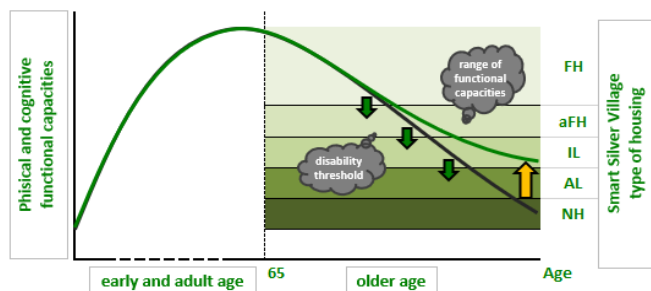


Figure 1: Evolution of functional capacity of people from birth to old age

Legend: FH – family home, aFH – AAL adapted family home, IL – independent living houses, AL – assisted living residences, NH – a nursing home. Optimisation procedures move the intersection with the threshold to the right

Ambient Assisted Living (AAL) comprises concepts, products and services that combine new technologies and the social environment to improve the quality of life at any age. Using assistive technologies enables older adults to live independently for as long as practicable. Ambient Assisted Living technologies to create an ecosystem of different types of sensors, computers, mobile devices, wireless networks and software applications that assist, support and control older adults with declining physical and cognitive functional capacities living in the community (Figure 2). AAL technologies should be used in combination with the development of an age-friendly environment in smart silver villages. Buildings and public spaces without obstacles that are an essential property of smart silver villages promote the mobility and independence of people with declining functional capacities. Families experience less stress if their older members have community support and a suitable living environment. Ambient assisted living with information and communication technology (ICT) support and big data analytics representing a cyber-physical system (CPS) supporting human-machine interaction using the Internet of Things as infrastructure embedded in the age-friendly smart silver villages offers a safe and pleasant environment to older adults in rural areas that is adapted to their functional capacities. An age-friendly environment of smart silver villages including specialised housing and public spaces achieved with around-the-clock maintenance and control that eliminates all physical barriers and risky elements enables safe mobility and substantially decreases the probability of accidents like falls that can result in bone fractures. Ambient Assisted living technologies embedded in silver villages can create value for organisations managing health care and social care services and supply networks (Božič and Dimovski, 2019), improve efficiency and effectiveness of service provision and therefore decrease the operational costs of smart silver villages, which influences sustainability of long-term care systems in rural areas (Peterlin et al., 2018). This is especially important due to the projected shortage of nurses and social care workers in the context of shrinking of the workforce.

Table 1: Some examples of the AAL technologies

ICT category	Examples of ICT solutions
ICT support to health & wellbeing, health & social care delivery / EHRs, management of health data / health information exchange	<ul style="list-style-type: none"> ▶ Interoperable Electronic Health Records, Patient Portals ▶ Electronic consultations and appointments ▶ Secure and reliable search portals for health information ▶ Booking solutions for care support ▶ Health data management solutions ▶ Personal health folder apps ▶ 24/7 eHealth call center (e.g., run by nurses) ▶ ICT for integrated care supporting e.g., shared care plan, multidisciplinary team (MDT), etc.
Telehealth / Telecare / Home care / Tele-monitoring	<ul style="list-style-type: none"> ▶ Teleconsultations with child and mental health services ▶ Monitoring of health parameters (weight, blood pressure, blood glucose, etc.) ▶ Internet of (medical) Things ▶ Telecare personal alarms (Panic button service, Medication reminders / smart medication dispensers, Access to assistance during emergencies) ▶ Vibrating carer alerts linked to movement sensors ▶ Electronic diary with visual and auditory reminders ▶ Physical training solutions e.g., to monitor running or other sports or activities ▶ Self-monitoring of frailty ▶ Tele-assistance subscription service – supervising daily activity trends of elderly people, notifications of potential risk situations
Education, including gamification or serious games; health and digital health literacy, empowerment	<ul style="list-style-type: none"> ▶ Web platform for digital and health literacy ▶ Massive Open Online Courses (MOOCs) ▶ Information on relevant support infrastructures in the region ▶ Healthier lifestyle management: Games for physical exercise, Computerised anger management, Management of chronic conditions ▶ Healthy cooking and eating
Smart homes and age-friendly environments (e.g., home sensors, IoT, AAL, IL) Social or peer support /	<ul style="list-style-type: none"> ▶ Home or property sensors (domotics) ▶ Internet of (non-medical) Things ▶ Regulated heating systems ▶ Food shopping support ▶ Home health / wellbeing monitoring (see also Telehealth) ▶ Support for daily routines ▶ Wearables ▶ Networking apps (e.g., sports or cooking clubs, social events, healthy lifestyle groups)
Other	<ul style="list-style-type: none"> ▶ Assistive technology / wearable robotics – exoskeletons

It will reduce available human resources in rural areas (Žnidaršič, Dimovski, 2009; Grah et al., 2018; Dimovski, Grah, Colnar, 2019), where shortage of health care professionals and especially nurses is expected to present a special challenge. Improvement in education can significantly increase productivity and sustainability of supply systems (Peterlin, et al., 2018), especially when supported by wireless sensor networks embedded in ambient intelligence systems based on Internet of Things as infrastructure (Arh, Jerman-Blažič and Dimovski, 2012). Ambient assisted technologies can support the development of knowledge-intensive learning environments (Škerlavaj et al., 2010). Especially useful are interactive learning environments (Škerlavaj and Dimovski, 2007). The smart silver villages supported by ambient intelligence enable faster dissemination and acquisition of knowledge among organisations providing facilities and services to older adults in rural areas. Intra-organisational learning (Dimovski et al., 2008) could contribute to faster adaptation of ambient technologies and development of personalised long-term care services in smart silver villages that cater to the needs of older adults with declining functional capacities in rural areas, improving their wellbeing while decreasing the cost of services due to increased performance (Dimovski, and Škerlavaj, 2005; Hernaus, Škerlavaj, and Dimovski, 2008).

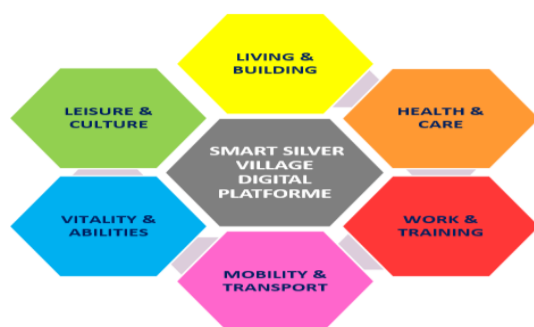


Figure 2: Smart silver villages supported by digital platform

As it is shown in Figure 2 Smart silver villages, digital platform represents healthy ageing with the support of digital solutions. It could be covered by innovative, transnational and multidisciplinary collaborative digital sub-platforms: living and building, health and care, work and training, mobility and transport, vitality and abilities, leisure and culture.

Several international covenants impose a binding obligation on EU Member States to fulfil the right to housing, such as the Universal Declaration of Human Rights (UN General Assembly, 1948) in Article 25 and International Covenant on Economic, Social and Cultural Rights (UN General Assembly, 1966) in Article 11(1). According to the General Comment No. 4 on Adequate Housing, the right to housing is a right enjoyed by all individuals (UN Committee on Economic, Social and Cultural Rights, 1991). Although the General Comments are not binding, they impose a binding obligation on the state to fulfil the right to adequately built housing units.

According to our research done in 2018, most of the municipality residents in rural areas (58%) do not have experience with decline in functional capacities. They do not

have a friend or family member who is dependent on the help of others. From this, we can conclude that a survey that includes the whole population in the sample is not properly constructed to capture the preferences of older adults who are dependent on the help of others. Demand for AAL housing to meet the needs of older adults with decreasing functional capacities could be calculated using the multiple decrement model. Therefore, we can determine the needed structure of housing stock on the basis of the multiple decrement approaches developed by Bogataj et al. (2016), using the principles of actuarial mathematics (Gerber, 1997).

2 THE CONCEPT

The concept of smart communities is already very well established for Smart cities, but less so for the rural areas (Ismagilova et al., 2019). Smart cities employ ICT to improve their local economy, transport and traffic management and contribute to the quality of life of their citizens. Smart cities enable a smart environment, smart living and mobility and smart spatial planning, architecture and construction for their citizens and government. There is human capital development, besides sustainable living standards and renewed concerns for the ecology that have redirected city planners to be concerned about sustainable cities and low carbon emissions (Sodiq et al., 2019). The concept of a Smart village has only recently gained attention (EUROMONTANA, 2019). Some considerations for Smart cities such as energy efficiency, the utilisation of sustainable resources and waste management are even more appropriate for villages (Nizetic et al., 2019). Smart technologies can solve many population challenges and provide the foundations for a sustainable future. They give us an opportunity for knowledge integration, which is necessary to address the crucial problems of contemporary cities and also the challenges in rural areas. It ensures a balance in the economic development of the society, from efficient and balanced resource utilisation to circular economy and integration of renewable energy systems, for better connecting and pooling all age cohorts in the communities.

"The Smart Village Initiative" was first put forward in the European Parliament in 2017, to "map out challenges and opportunities in rural areas, provide a definition of 'Smart Villages', and identify good practise examples and case studies on the topic". In this document, it is concluded that "the opportunity for smart villages comes from key drivers of change in the countryside, including the impact of existing and emerging digital technologies, environmental activities related to the conservation of the rural landscape and the circular economy, bio-economy, new short supply chains, new patterns of mobility and better transportation and communication with cities".

In this context, Europe understands smart villages as more or less dispersed but well-connected rural communities that can take advantage of the technological developments and the benefits of rural "greening". Though the ageing of the European population is not in the focus of the Smart Villages yet, it also fits the context of developing the Smart Villages and a European "silver" economy. The Silver Economy has caught the attention of scientists, policymakers and economic

operators alike. They agree that the ageing of wealthy European cohorts promises higher demand for products and services, more jobs and thus economic growth.





Group	Input - components of Smart Silver Villages	Residents	Time to Failer	Performance measurement	Output
Environment	Age Friendly Public Spaces (AFPS)			SERVIVAL MODEL	MODEL OF SMART SILVER VILLAGES 
	Ambient Assisted Living (AAL)				
	Independent Living Housing Unit (IL)				
	Assisted Living Housing Unit (AL)				
	Memory Care (MC)				
Activities	Nursing Home (NH)				
	Social Activities (SA)				
	Recreation Activities (RA)				
Services	Education (ED)	Residents with declining functional capacities			
	Gardening (GA)				
	Supply Network (SN)				
	Social Care (SC)				
	Health Care (HC)				
	Nursing Care (NC)				
	Transportation Services (TS)				
Maintenance (MA)					
Digital	Assisted Technologies (AT)				
	Ambient Intelligence (AI)				
	Cyber-physical Systems (CPS)				
	Wireless Sensor Network (WSN)				
	Radio-frequency Identification (RFID)				
Domotic (DO)					
SOCIAL INFRASTRUCTURE for active and healthy ageing in Rural areas					

Figure 3: Concept of Smart Silver Villages with the technologies from table 1.

According to the definition, a Silver Economy is an economy where the consumers are over 50 years old. If ranked among nations, the European Silver Economy is the third-largest economy in the world, only falling behind the USA and China. Because of the ageing of the European population, it will increase. A new EC report conducted by Technopolis (Varnai et al., 2018) writes about this opportunity and explores its real economic potential and gives us directions on how to capture it. Along with this change in the age demographic of the European countries, while the population in the rural areas is ageing the houses in villages are becoming empty and decaying. This process has been rapidly evolving at a time when the European Commission is supporting the deinstitutionalisation of long-term care and the development of community care (LTC).

One of the most relevant questions for older adults is where they would wish to reside when their functional capacities fall substantially, and when they will not be able to overcome the built barriers of their family home. The preferences of the European population regarding the delivery and organisation of LTC are reflected in the results of the Eurobarometer 283 (EC, 2007). It states that 90% of European older adults prefer care in their own homes even when their functional abilities fall far below the threshold of managing their home space. Though we may understand "ageing in one's own home" as ageing in the house where the elderly have lived in full functional capacity, in the developed world this usually means ageing in a residence where the elderly have "all housing rights, which guarantee him autonomy, independence and protect his dignity, where one can enter only at their will. It also means a place of residence close to friends, relatives and acquaintances (takes a closer look at the Eurobarometer 283 report, which states that 82% of Europeans want exclusive home care after they become dependent on others. From this,

- 45% of older adults give priority to the care provided in the loving home environment of relatives,
- 24% of them would remain in their own homes but with the provision of professional long-term care providers,

- 12% would opt for home care provided by a personal assistant,
- a similar proportion would move into their own or a rented adapted housing (sheltered).

Only 9% of those being included in the survey prefer institutional care in nursing homes. But we should not neglect the research reports from the UK, where the National Health Service has estimated 50% lower health care cost for elderly adults living in sheltered housing in comparison with older adults living in the conventional dwellings and neighbourhoods (Wood, 2017), and prevent them from going to a nursing home for many years. According to the MEARS Group (2019), there is reasonably strong evidence that extra care housing residents, who are living in the specially adapted housing units for senior residents, visit a doctor less frequently. They require fewer community nurse visits; also, they have a reduced number of ambulance callouts (fewer falls), due to the property being better designed and adapted to meet the needs of older people, and also due to regular contact with staff and other residents.

Specialised housing units can be also less dispersed in rural areas. Namely, the dispersion of users influences the higher cost of services because of travel time and also reduce the lead times in the system. Therefore, in the optimisation procedures of AAL systems, the overcoming time delays due to greater distances between clients is of utmost importance, where the formalised solutions known in logistics and production can be introduced (Bogataj and Bogataj, 2004, 2007; Bogataj and Grubbström, 2012, 2013; Bogataj et al., 2005, 2011; Usenik and Bogataj, 2005), which could significantly also influence the higher value of the rural real estate (Bogataj et al., 2011, 2012, Lisec et al., 2008) and improve other costs of communal infrastructure (Kovačić and Bogataj, 2013; Kovačić et al, 2015, 2017).

In specialised communities, where homes are more adapted to reduced functional capacities than average at-home care services, care support is more accessible and less expensive. The Mears Group considers care at properly adjusted 'retirement communities' as a preventive alternative to the ordinary home care provided for many people. They calculated that the taxpayer's lifetime savings per person from delaying or preventing a transfer to a hospital or nursing home could be as much as £ 5,000. Those moving to assisted living housing earlier are less likely to enter expensive long-term care in a nursing home, compared to those living in the community under the home care setting in a typical family house. Mears Group has strong evidence that residents of community care in the specialised housing for older adults have reduced loneliness, which makes for better mental health and memory and gives feelings of higher independency, autonomy and safety. All these factors generate health and social care benefits of £2,441 per annum per person in community-based care in extra adapted sheltered housing. Therefore, the UK is considering subsidising the move of older adults to such community-based extra adapted housing for older adults based on the significant benefits that it provides to the national health system and to the local system of home care by reducing their expenses.

3 DISCUSSION ON INSTITUTIONAL ARRANGEMENTS SUPPORTING DEVELOPMENT OF SILVER VILLAGES

As an example of excellent institutional arrangements which allows for successful implementation of new assisted technologies in rural areas, we studied the Spanish legislation regulating LTC, infrastructure and provision of services named Autonomy and Care for Dependency (SAAD). At the end of 2006, Spain introduced regulations for the LTC system that recognised the right to social protection for dependent people. The system guarantees universal coverage, introducing cooperation between the central government and the Autonomous Communities, which is integrated into the network of regional and municipal social services. The system provides cash benefits also to informal caregivers and for personal support. In practice, it is perfect mix combining the coverage of public benefits with informal care in households. In this system, more than 62.4% of the caregiving women is employed. In this system, the main beneficiary group are also women (73.8%). Due to the population ageing, the burden of women would be too heavy. Therefore it will be necessary to strengthen formal care structures and introduce more ICT support. The SAAD was assessed comprehensively 10 years after its creation. Over its 10 years of existence, the SAAD's performance as the social policy has demonstrated highly positive aspects in support for informal caregivers and expansion in community services. In average, 17.58% of Spanish beneficiaries are included in the teleassistance. In rural areas of Andalusia, more than 30% of users are included in the teleassistance of modern ICT support and have an excellent opportunity to be improved with innovative solutions, because many research centres of Spanish universities are involved in European AAL projects and offer a range of new solutions.

4 CONCLUSIONS

Smart silver villages offer a solution for older adults in rural areas to stay autonomous and independent longer and postpone moving to a nursing home. What matters most to older adults in European villages and how their wishes can influence the future growth of Smart Villages in the context of the mentioned European initiative has not been investigated yet. How can their preferences be included in the legislation and ICT solutions is subject of further research. While many solutions are already widely used in cities, in rural areas the problem of overcoming greater distances between caregivers and the problem of time delays due to greater distances is one of the central challenges for successful further research and application work. Therefore, some formalisations of optimisation and control systems, well known in production and logistics could be successfully implemented also in AAL technologies.

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