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## **Supporting Active Ageing: Challenges and Opportunities for Information and Communication Technology**

### **Introduction**

Nowadays, population ageing, defined as an increase in the share of older people in the population, is a typical phenomenon of developed countries. According to demographic forecasts, in the case of European countries, the process of populations ageing will deepen in time [Coleman, 2001]. Such a process has a profound influence on the whole economy and society. In particular, many of the concerns involve projected increase of age-related expenditures including pensions, health care, and long-term care [Boersch-Supan, 2008].

To counteract the effects of an ageing population various strategies are suggested, among which the policy of active ageing appears to be the most crucial [Walker, Maltby, 2012]. Information and communication technology (ICT) is a critical component of the contemporary world offering a wide range of potential benefits for states, organizations, and individuals. Appropriate use of ICT can not only mitigate the effects of ageing, but also it may help transforming the demographic crisis into an opportunity for the whole economy and society [e.g. Adjacent Government, 2016; Soja, Soja, 2015].

In this paper we present an assessment of current activities on active ageing and we investigate possibilities for better use of ICT to promote this strategy. The research questions that guided our study might be formulated as follows: How ICT can better support active and healthy ageing? What are the key challenges for ICT in the context of ageing population in Poland?

This paper starts with the discussion of the demographic changes in the past and their consequences for economy and society. Then, it examines the policy of active ageing and in so doing it uses indicators of the Active Ageing Index for European countries. The next section includes discussion of the role of ICT in active and healthy ageing and the possibilities of transforming ageing into an opportunity for Europe. Finally, the article ends with concluding remarks. This research has been financed by the funds

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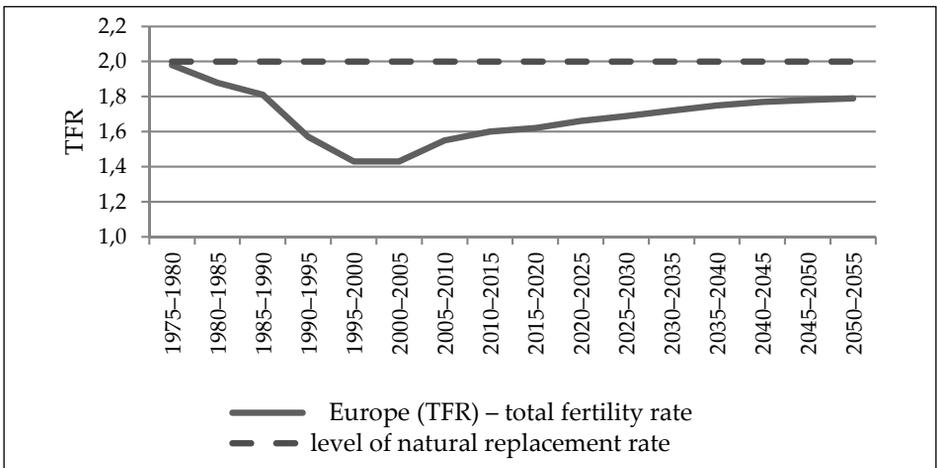
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granted to the Faculty of Management, Cracow University of Economics, Poland, within the subsidy for maintaining research potential.

## 1. Research background – ageing and its consequences

The ageing of the population affects all developed countries. This phenomenon is inevitable and will deepen in the future. This is due to change of basic demographic phenomena (fertility and mortality) in the past and the continuance of their course in the future [Basten et al., 2013]. This is illustrated in Figures 1 and 2, which show changes in fertility and mortality in Europe in the period since 1975 to 2055. Future trends are based on demographic projections of the United Nations 2017 [United Nations, 2017]<sup>1</sup>.

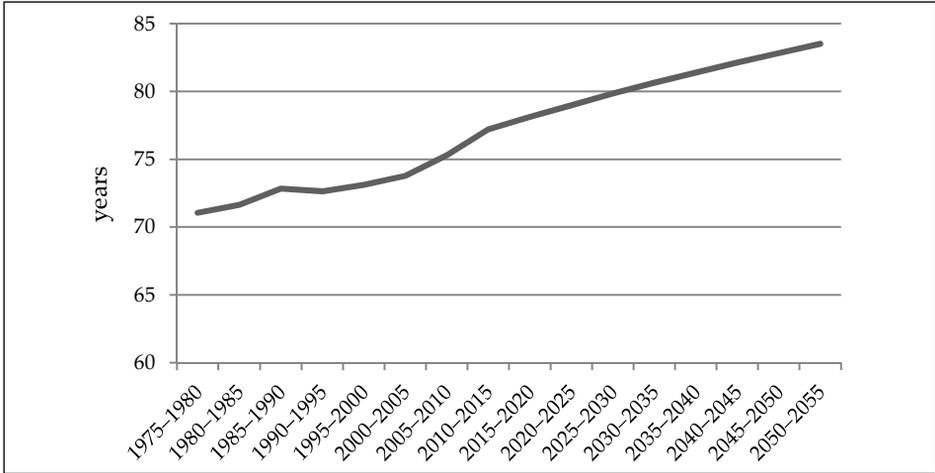
**Figure 1. Total fertility rate in Europe since 1975 to 2055**



Source: Own elaboration based on [United Nations, 2017].

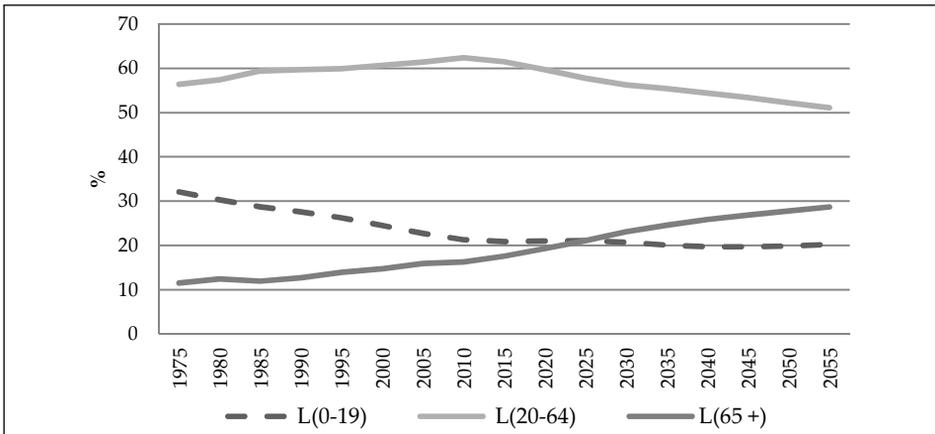
In the case of fertility we observed a downward trend until 2000, and then a gradual increase, which is expected in the future. However, throughout the whole period, fertility level is expected to remain at the low level, which does not allow for the replacement of generations of parents by the generation of children [Soja, 2011]. The changes of mortality result in a sustained increase in life expectancy, which is predicted in the future [Soja, 2013].

<sup>1</sup> The 2017 Revision of World Population Prospects is the twenty-fifth round of official United Nations population estimates and projections that have been prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. The main results are presented in a series of Excel files displaying key demographic indicators for each development group, income group, region, subregion and country or area for selected periods or dates within 1950–2100.

**Figure 2. Life expectancy  $e_0$  in Europe since 1975 to 2055**

Source: Own elaboration based on [United Nations, 2017].

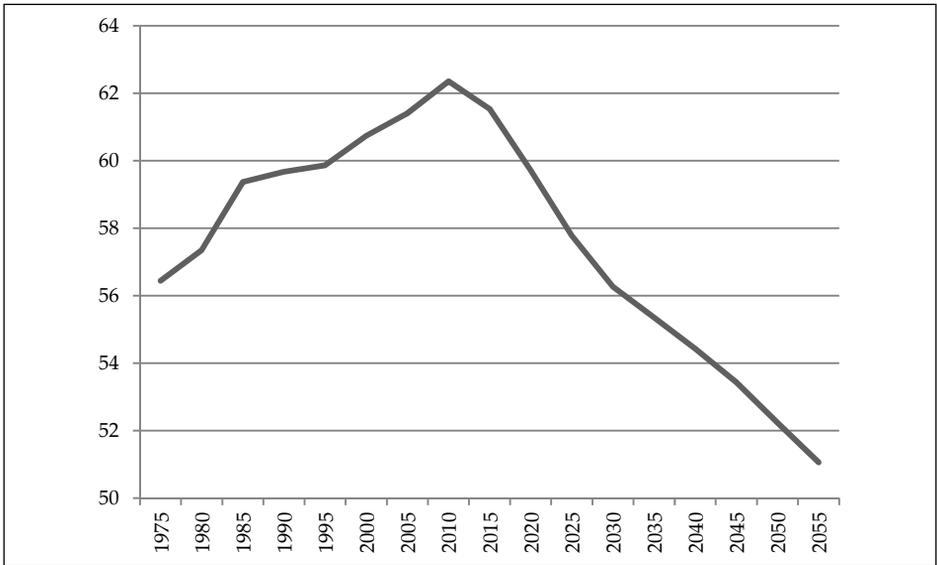
Changes in fertility and mortality shape the age structure of the population (Figure 3). The share of the population aged 0–19 was gradually reduced in the past and in the future its level will be stabilized. Simultaneously, the share of people aged 65 years and more has been increasing during the entire period which will result in an ageing population. In the period from 2015 till 2055 the percentage of this age group will increase by about 11.1 percentage points. The middle group in age 20–64 is of special importance as it defines the potential labour force. This group slightly increased until 2015 but in the subsequent period it will strongly decrease (10.4 percentage points in 2015–2055).

**Figure 3. Age structure of the European population since 1975 to 2055**

Source: Own elaboration based on [United Nations, 2017].

Projected changes in the structure of the population by age adversely affect the relationship between groups of producers and consumers. The number of producers may be roughly estimated as the number of people in working age (20–64), which will be shrinking and ageing in the future. Consumers represent the whole population. The relationship of producers to consumers describes the so-called demographic support ratio, which is presented in Figure 4. In the future, unfavourable decrease in the number of producers per 100 consumers is predicted (decrease of approximately 10.5 p.p. in the years 2015–2055).

**Figure 4. Support ratio in Europe since 1975 to 2055**



Source: Own elaboration based on [United Nations, 2017].

Researchers point to different consequences resulting from demographic changes in the coming decades. The most frequently mentioned are [e.g. Boersch-Supan, 2008; McMorrow, Roeger, 2004]:

- changing balance between capital and labour and between labour supply and demand for consumption,
- increase in age-related expenditures including pensions, health care, long-term care,
- problems with social protection,
- problems with maintaining the standard of life at the current level.

## **2. Policy of active ageing – evaluation and future actions**

An adaptation to new conditions of ageing population will be the main challenge for various stakeholders (institutions, organizations, individuals).

The most commonly used adaptive solutions include increase in employees' productivity, increase in activity rate, extending the period of professional work, and extending retiring age [e.g. Prskawetz et al., 2008; Soja, Stonawski, 2012]. These actions are part of a so-called active ageing. Walker and Maltby claim, however, that active ageing should cover a wider range of activities at various levels. They define active ageing as "...a comprehensive strategy to maximize participation and well-being as people age. It should operate simultaneously at the individual (lifestyle), organizational (management) and societal (policy) levels and at all stages of the life course" [Walker, Maltby, 2012, p. 7]. In general, researchers summarizing the evaluation of adaptive measures taken in the last 10 years in the context of demographic change state that an active social and public policy is required to maintain active ageing as the leading paradigm for ageing policy across the European Union [Walker, Maltby, 2012].

Zaidi and Stanton provide a definition of active ageing which is more focused on areas of activity and indicates the necessary environment for these actions: "...the situation where people are able to live healthy, independent and secure lives as they age and thus continue to participate in the formal labour market as well as engage in other unpaid productive activities (such as volunteering and care provision to family members)" [Zaidi, Stanton, 2015, p. 12]. According to them, the policy related to an ageing population should be widened in scope to ensure not only that public pensions and healthcare systems are sustainable, but also that such sustainability is achieved by an active contribution from older people themselves. This should be achieved by fostering lifestyles throughout the life course that will support healthy and fulfilling old age. It should be emphasized that the basis of active ageing is an age-integrated concept of life phases according to which different activities have to be reconciled over the whole life course [e.g. Szukalski, 2016; Walker, Maltby, 2012].

Taking into account the importance of the strategy of active ageing in the light of the challenges posed by an ageing population, a measure (Active Ageing Index)<sup>2</sup> was constructed to evaluate current activities and to set targets and monitor progress towards this policy in future. Active Ageing Index (AAI) was calculated as the weighted average of the four AAI domains: Employment (35%), Social Participation (35%), Independent Living (10%), and Capacity for Active Ageing (20%). AAI is constructed from 22 individual indicators grouped in these four domains. For each domain, individual indexes were calculated and were estimated as the weighted

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<sup>2</sup> Active Ageing Index was designed by Zaidi and Stanton and the first time it was estimated in 2012 that was called European Year on Active Ageing and Solidarity between Generations [Zaidi, Stanton, 2015].

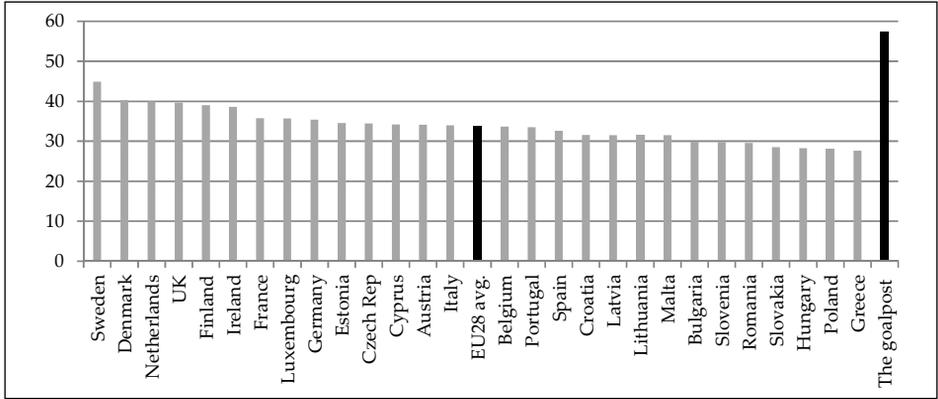
average of individual indicators<sup>3</sup> [Zaidi, Stanton, 2015]. The first three domains together measure the 'actual experiences' of active ageing. The fourth domain (Capacity for Active Ageing) measures the starting conditions for achieving positive active ageing outcomes.

The general AAI index and domain-specific indexes are defined in such a way that they can obtain values from 0 to 100. These values bear information about an individual's participation in particular domains. Since the theoretical maximum of 100 is of little practical value (the 100% participation is not real), therefore, a more realistic benchmark was calculated (the goalpost). The goalpost value for a given index was calculated using maximum observed values of all indicators included in the index among 28 EU countries, both for men and women. Therefore, for instance in the case the general AAI index, the goalpost value represents a fictitious country which achieved the maximum possible values of all 22 indicators defining the AAI index. The gap between the index value and the goalpost indicates the untapped potential of older people for active ageing and shows areas for improvement.

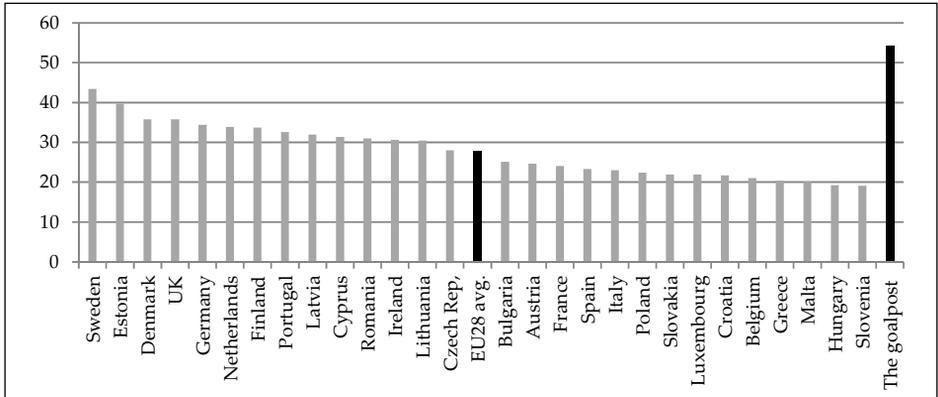
Figures 5–9 present the values of AAI indexes estimated for the 28 European countries in 2014. In general, the calculated numbers indicate that a healthy and active ageing is a reality for many older adults and elders in the more advanced age. This concerns mainly the wealthy member states in the Nordic countries and Western Europe. However, even in these countries there is room for improvement in some individual dimensions of active ageing and particularly in Social Participation. The situation in Poland appears rather unfavourably compared to other countries. All AAI values (overall and for particular domains) are lower than the average (EU 28), which indicates that active ageing in Poland needs to be developed across the board.

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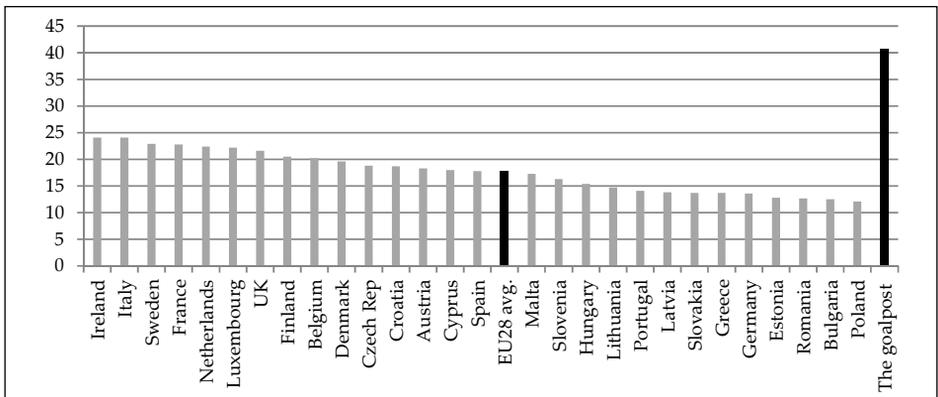
<sup>3</sup> A domain Employment includes employment rates for ages 55–59, 60–64, 65–69, 70–74. Social Participation refers to voluntary activities, care to children and older adults, and political participation. Independent Living relates to access to health services, independent living, financial security, physical safety, and lifelong learning. Capacity for Active Ageing refers to healthy life expectancy, mental well-being, use of ICT, social connectedness, and education. For each domain, indexes were estimated as the weighted average of individual indicators.

**Figure 5. Active Ageing Index (AAI) – Overall (EU 28, 2014)**

Source: Own elaboration based on [Zaidi, Stanton, 2015].

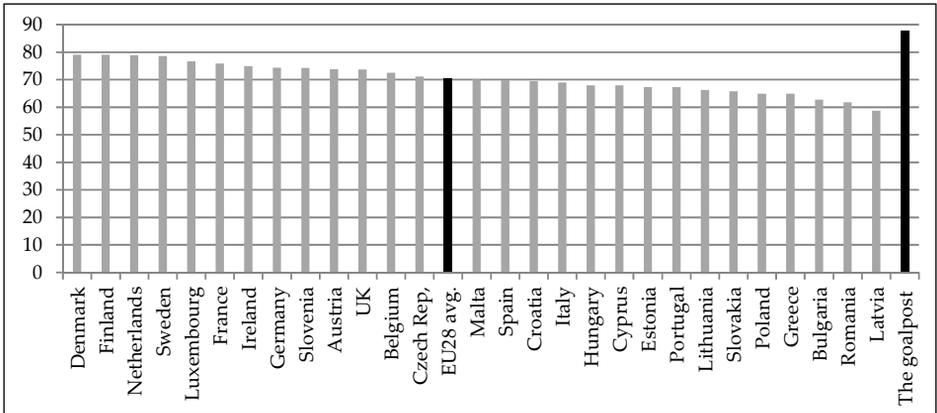
**Figure 6. Domains of AAI – Employment (EU 28, 2014)**

Source: Own elaboration based on [Zaidi, Stanton, 2015].

**Figure 7. Domains of AAI – Participation in society (EU 28, 2014)**

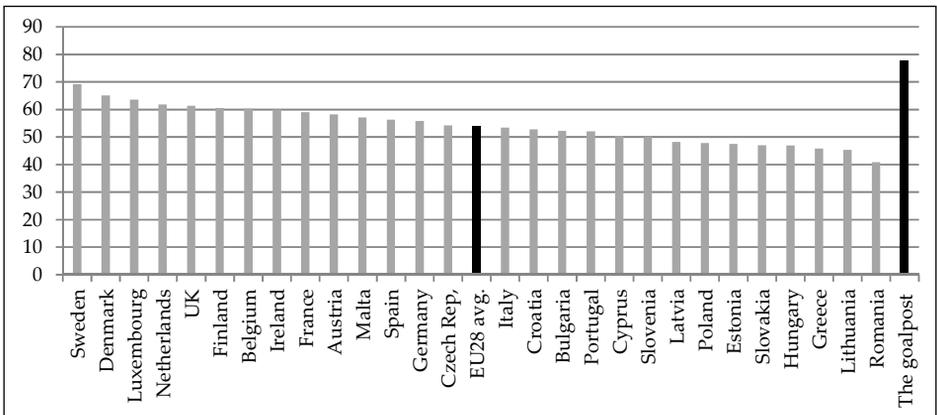
Source: Own elaboration based on [Zaidi, Stanton, 2015].

**Figure 8. Domains of AAI – Independent living (EU 28, 2014)**



Source: Own elaboration based on [Zaidi, Stanton, 2015].

**Figure 9. Domains of AAI – Capacity for active ageing (EU 28, 2014)**



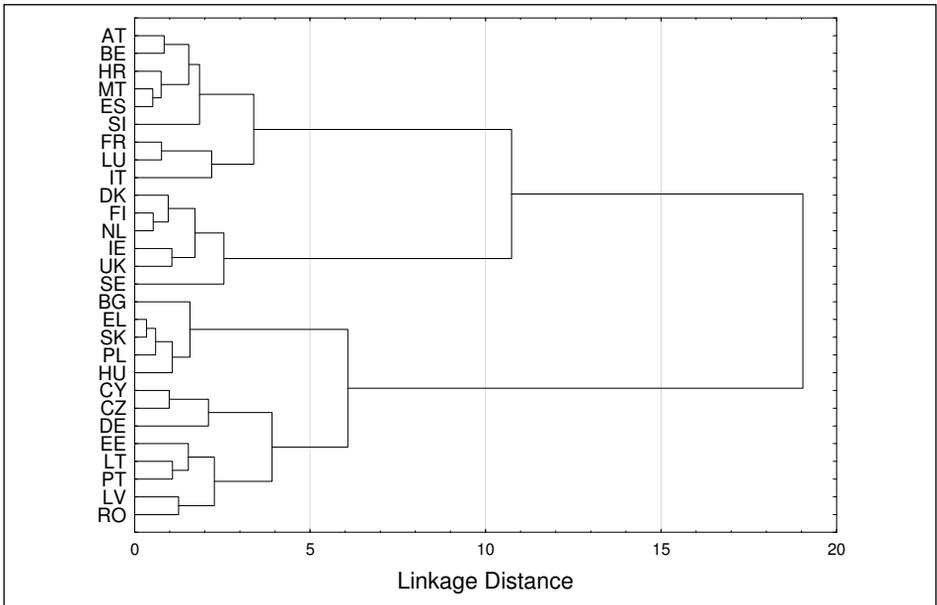
Source: Own elaboration based on [Zaidi, Stanton, 2015].

In order to evaluate the groups of countries similar to each other with respect to the values of four domains of AAI index, two agglomeration methods have been used: the hierarchical Ward's method and non-hierarchical k-means method. In the first stage, the hierarchical method was applied in order to determine a preliminary number of clusters (i.e. Ward's method). In the second step, the actual classification of objects using the k-means method was performed. Such a two-phase approach seems common in cluster analysis and is caused by the fact that in the k-means method a researcher has to arbitrarily provide the number of clusters [e.g. Everitt et al., 2001].

On the basis of an analysis of the distance diagram (Figure 10), achieved by application of the Ward's method, three countries groups have been

distinguished. The calculations performed with the use of the k-means method yielded almost identical categorization of countries. Only Czech Republic was assigned to the third group, instead of the first group according to the Ward's method. Table 1 presents countries groups with distances from the cluster centre for each country.

**Figure 10. Tree diagram for countries obtained with the use of Ward's method for four domain-specific AAI indexes**



Source: Own elaboration.

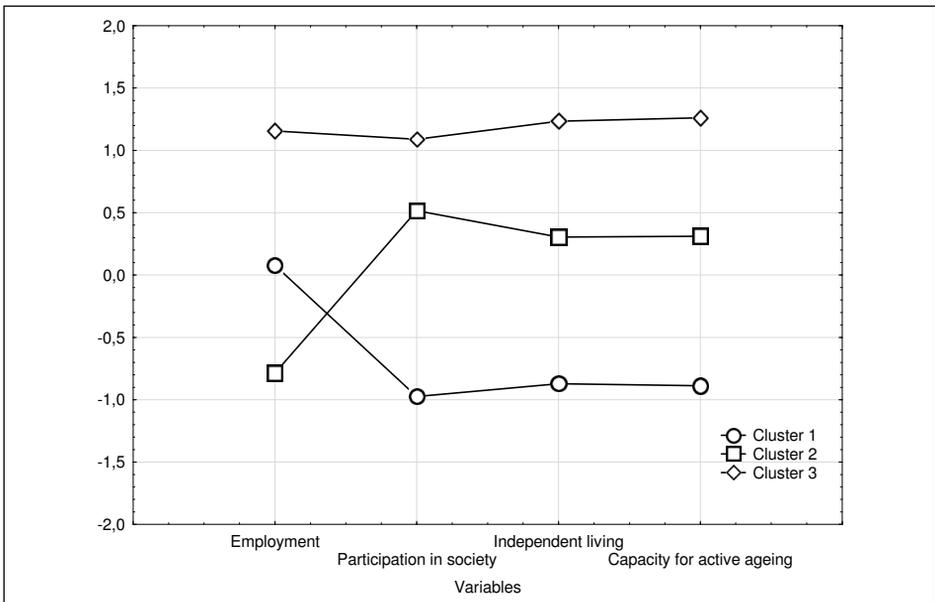
**Table 1. Clusters of countries obtained with the use of the k-means method**

Cluster 1		Cluster 2		Cluster 3	
Bulgaria BG	(0.508)	Austria AT	(0.298)	Denmark DK	(0.365)
Cyprus CY	(0.628)	Belgium BE	(0.315)	Finland FI	(0.326)
Estonia EE	(0.880)	Croatia HR	(0.399)	Ireland IE	(0.568)
Germany DE	(1.059)	Czech Rep. CZ	(0.457)	Netherlands NL	(0.219)
Greece EL	(0.639)	France FR	(0.571)	Sweden SE	(0.770)
Hungary HU	(0.748)	Italy IT	(0.691)	United Kingdom UK	(0.358)
Latvia LV	(0.707)	Luxembourg LU	(0.741)		
Lithuania LT	(0.294)	Malta MT	(0.416)		
Poland PL	(0.519)	Slovenia SI	(0.723)		
Portugal PT	(0.442)	Spain ES	(0.334)		
Romania RO	(0.706)				
Slovakia SK	(0.500)				

Source: Own elaboration.

The analysis of the mean values of standardized domain-specific AAI indexes calculated for each cluster, displayed in Figure 11, allowed us to identify the nature of the countries groups. The first group is characterized by the lowest values of Social Participation, Independent Living, and Capacity for Active Ageing. However, Employment remains at the average level for the first group. The second group includes countries which achieve average levels of Social Participation, Independent Living, and Capacity for Active Ageing. Nevertheless, these countries obtained a relatively low index Employment. The third group is comprised of countries which achieved the highest values of all domain-specific indexes. In addition, on the basis of the F-values (and significance levels) we can observe that the domains Social Participation, Independent Living, and Capacity for Active Ageing were the major criteria for assigning countries to clusters.

**Figure 11. Mean values for each cluster for four domain-specific AAI indexes**



Source: Own elaboration.

### 3. Transforming population ageing into an opportunity – the role of ICT in active and healthy ageing

As indicated above, all countries need to support areas of active and healthy ageing (Employment, Social Participation, Independent Living, and Capacity for AA). Only in the case of the area Capacity for Active Ageing the indicator of ICT use by the older has been included directly to measure active ageing. However, we demonstrate that all domains of active

and healthy ageing may be fostered by ICT through the development of the information society. This possibility might be clearly pointed out by the relationship between the Active Ageing Index (AAI) and the Digital Economy and Society Index (DESI). In order to investigate this relationship we use Spearman rank correlation coefficient and linear regression.

The DESI Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness. It is calculated as the weighted average of the five main DESI dimensions [European Commission, 2017]:

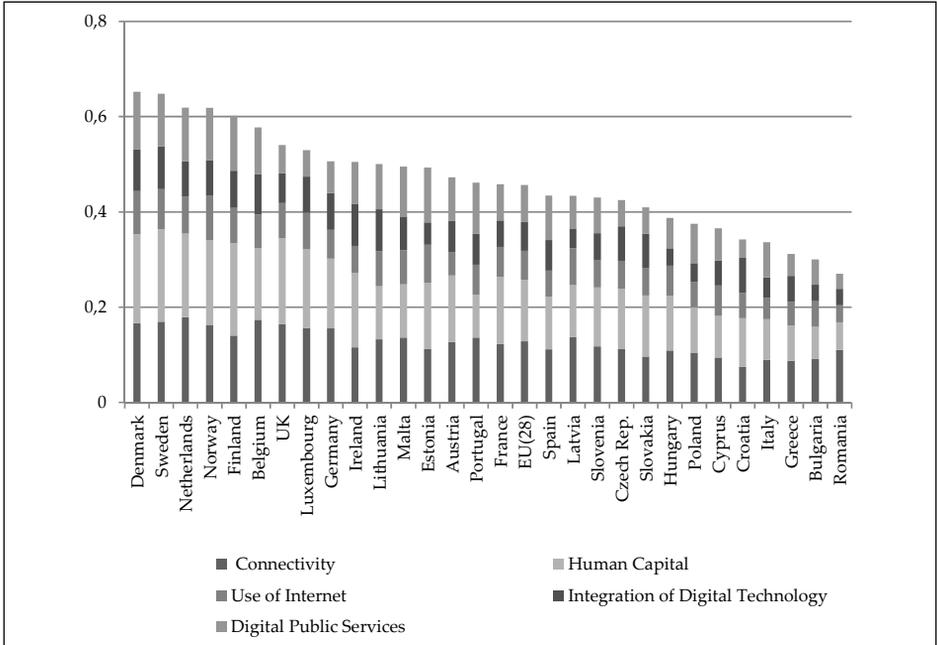
1. Connectivity (25%) – measures the deployment of broadband infrastructure and its quality.
2. Human Capital (25%) – measures the skills needed to use the possibilities offered by the digital society.
3. Use of Internet (15%) – measures the variety of activities performed by citizens already online.
4. Integration of Digital Technology (20%) – measures the digitization of businesses and their exploitation of the online sales channel.
5. Digital Public Services (15%) – measures the digitization of public services, focusing on eGovernment.

Figure 12 presents the results of the Index for the 28 EU member states in 2014<sup>4</sup>. The highest level of development of the information society was reached by the countries of Northern Europe and Western Europe. Poland, together with the majority of transition economies, received DESI index lower than the average. This result is very similar to the outcome of the evaluation of the level of active ageing. This similarity is confirmed by the value of Spearman rank correlation coefficient ( $r_s = 0.76$ ) for the AAI and DESI. Rankings of countries by the level of DESI and AAI are largely consistent. A similar consistency occurs in the case of domains Independent Living ( $r_s = 0.76$ ) and Capacity for Active Ageing ( $r_s = 0.75$ ). A somewhat lower similarities of rankings take place for Employment ( $r_s = 0.49$ ) and Social Participation ( $r_s = 0.51$ ).

In addition, we calculated the regression between the values of DESI and AAI (both measures expressed as percentages) to roughly determine the possible causal relationship between the development of digitalization and active ageing (Figure 13). The results show that 10 percentage points higher level of DESI index can on average translate into 3.3 percentage points increase in level of AAI index. These findings indicate that increasing the level of development of different areas including economy and the digital society should expand the possibilities of active and healthy ageing.

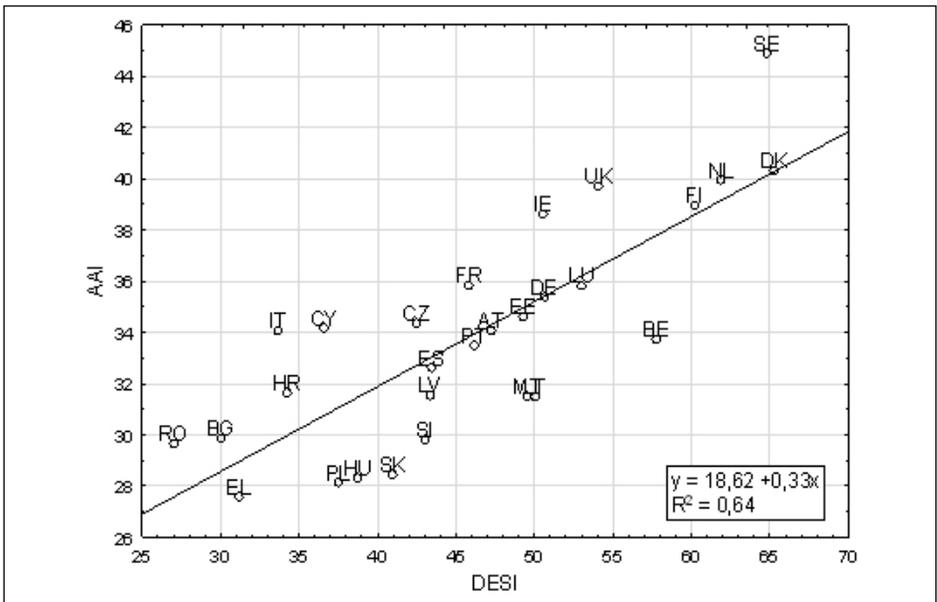
<sup>4</sup> DESI is constructed in such a way that its values are within the range from 0 to 1.

Figure 12. The Digital Economy and Society Index (EU 28, 2014)



Source: Own elaboration based on [European Commission, 2017].

Figure 13. DESI index regressed on AAI index (EU28, 2014)



Source: Own elaboration.

Permanent development of advanced ICT used in business imposes on employees the need to acquire or complete the new skills and knowledge in this field. Acquiring skills needed to reap the benefits from technological progress increases the competitiveness of workers in the labor market and may support their long professional activity [Wiktorowicz, 2014]. The development of digitalization of public and health services as well as the increasing popularity of a wide range of online activities (e.g. eShopping, eBanking, online communication) may facilitate people's everyday life. These considerations will support the reconciliation of work and private and social life. An increasing number of older adults, due to population ageing, will have enough ICT skills to use new products and services (based largely on innovation and new ICT) to promote healthy and active lifestyles and to foster independent life in later years.

The presented vision illustrates the possibility of the transforming demographic crisis into an opportunity for society and economy. An ageing society opens up new areas for economic growth and employment as technological innovation in ICT enters the market place. The specific needs of Europe's older adults will lead to increased public and consumer expenditure. This will have a significant pull-effect on many existing or emerging markets – benefiting the ageing population and the economy at large. This situation creates an idea called "The Silver Economy". In other words, The Silver Economy covers the existing and emerging economic opportunities associated with the growing public and consumer expenditure related to population ageing and the specific needs of the population aged over 50 [European Commission, 2015].

The Silver Economy, for which the driving force is technological and service innovation in ICT, will create a so called win-win-win situation, where:

- older people are supported in active and healthy ageing and a better quality of life,
- sustainability of healthcare and social systems is improved, and
- economic growth and new jobs are developed.

The concept and the framework for the Silver Economy are currently being developed. Iakovidis and Alves explain the possibility of implementing this vision and present the projected estimates associated with the Silver Economy and ICT [Adjacent Government, 2016]:

- the increase of smart connected homes which can support active ageing and independent living solutions will reach 29.7 million homes in the EU by 2020. This represents an annual market worth of €15.4 billion,

- technology-based long-term care and home healthcare are forecasted to grow by 18.8% between 2015 and 2020, representing a global market value of \$10.3 billion,
- the sales of service robots for domestic tasks could reach 15.5 million units in 2016, with an estimated value of \$5.6 billion,
- the global spending power of the elderly generation will reach €15 trillion by 2020.

Taking into account the potential of senior citizens in Poland as consumers, Badowska suggested that many senior consumers reveal positive attitudes towards innovative new technology products. In the near future, such a perspective should be included in the marketing strategies of innovative enterprises what will help them to expand the market [Badowska, 2016]. Such positive changes in the attitudes of older people to new ICT and the need to adapt the emerging ICT market for the elderly is essential for the development of the Silver Economy in Poland.

To illustrate the currently conducted projects using ICT to promote healthy and active ageing we present examples within the EU Horizon 2020 being part of the program Societal Challenge – Health, Wellbeing and Active Ageing [European Commission, 2015]:

1. Advancing active and healthy ageing (e.g. Service robotics within assisted living environments, ICT solutions for independent living with cognitive impairment).
2. Integrated, sustainable, citizen-centered care (e.g. Advanced ICT systems and services for Integrated Care, Self-management of health and disease: citizen engagement and health, Public procurement of innovative eHealth services).
3. Improving health information, data exploitation and providing an evidence base for health policies and regulation (e.g. Digital representation of health data to improve disease diagnosis and treatment, eHealth interoperability).

These three areas of activities using ICT for healthy and active ageing (market products, integration and centralization of health services, consolidation of data) were also mentioned as important for public health and population policy in the context of demographic changes in Poland [e.g. Szymborski, 2016].

A large number of products in the field of ICT for an ageing society have already been designed. However, only few of them are on the market and are used by the elderly, their caregivers or doctors. Practitioners indicate different barriers to market deployment of these products [Porcari et al., 2015]. We suggest that these barriers can be divided into two groups. The first group includes the classical barriers such as costs, complexity

for implementation, and lack of fit. The second group consists of barriers associated with the development of the digital society. These are, among other things, limited awareness and skepticism about the potential benefits of the products, resistance to accept changes in caring for the elderly (e.g. the use of human-machine interaction as robotics), and ethical concerns (e.g. monitoring of the user lifestyle through “sensing systems”).

The issues presented above, related to the use of ICT for active ageing, demonstrate the need for interdisciplinary research and cooperation between practitioners and researchers. At the same time, the findings illustrate the range of challenges for ICT in promoting active ageing.

## Conclusion

In this article we investigate the way in which the new ICT may participate in the transformation of the risks associated with an inevitable ageing population into opportunities for the development of economy and society. For this purpose, it is necessary to implement active ageing strategy, which aims at enhancing the capacity of older adults in the labor market and supporting their social participation and independent living.

This involves the age-integrated concept of lifestyles suggesting that different life activities have to reconcile over the whole life course. Such a lifestyle requires a specific market of products and services and may create a massive pull-effect on existing or emerging markets – a so-called “Silver Economy”. The development of new products and services is based on technological and service innovation in ICT.

We point out that all European countries need to improve active and healthy ageing. This might be strengthened by increasing the level of development of digital economy and society (e.g. broadband infrastructure, digitization of businesses and public services, use of ICT by people).

In Poland it seems particularly necessary to foster the implementation of active ageing and the development of the information society. Ageing is still perceived rather as a burden – a challenge, not as an opportunity. Using the experience of the leaders in the field of active ageing and the information society, we have to take into consideration socio-demographic situation associated with a family-based model of elderly care, lower level of social benefits, and relatively low incomes of Poles.

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## **Supporting Active Ageing: Challenges and Opportunities for Information and Communication Technology (Summary)**

Contemporary demographic changes associated with population ageing involve a number of consequences for the economy and society, such as a significant increase in spending on pensions, health and social care. To counteract the effects of an ageing population, a policy of active and healthy ageing is proposed. Information and Communication Technology (ICT) can mitigate the effects of ageing and help transforming the demographic crisis into an opportunity for the whole society. In this paper we assess current activities on active ageing in European countries and we present possibilities for use of ICT to support this policy. In particular, using indicators of Active Ageing Index (AAI) and Digital Economy and Society Index (DESI), we investigate the relationship between the level of active ageing and the level of development of the digital economy and society. Using statistical agglomeration methods, we also categorize European Union countries into groups with respect to various domains of AAI index. The main findings illustrate that countries from Northern Europe comprise the group of EU states revealing the best values of AAI index. Nevertheless, the results also demonstrate that all European countries need to improve their approaches to active ageing. The findings also suggest that development of such areas of digital economy and society as broadband infrastructure, digitization of businesses and public services, and people's ICT skills should better foster active ageing. The need for new products and services for this lifestyle may create economic growth called Silver Economy, whose critical components are innovation and ICT.

### **Keywords**

Information and Communication Technology (ICT), Active Ageing Index (AAI), Digital Economy and Society Index (DESI), active ageing, Europe

