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A Knowledge Map for ICT Integration in the Silver Economy

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Abstract

In the European Union, the silver economy is focused on developing strategies to facilitate the elderly population, mainly in terms of creating services based on innovations and technology. The paper encompasses a detailed overview of the silver economy in Estonia and the introduction of ICT solutions for the elderly population through knowledge management techniques. A knowledge map has been created using the Ontology model in Protégé to demonstrate the key knowledge resources for ICT integration in the silver economy. The results and information displayed in the knowledge map have been gathered from two detailed workshops which were further validated through questionnaires and interviews from the professionals in the field. The purpose of this paper is to discuss the different knowledge resources and competencies relevant to the integration of ICT in the silver economy which will serve as a basis for the development of a knowledge management model in the future.

Keywords: Smart Specialization Strategy; ICT; Silver Economy; Knowledge Map; Ontology; Digital Competency

1. Introduction

The aging population of the European countries is an emerging challenge in terms of its financial and communal repercussions but on the other hand, it is also a huge potential for market development. The Baltic Sea Region (BSR) countries are experiencing a change in demographic dynamics that will have a monumental impact on the economic and social fabric of these countries in the future [1]. According to an estimate by the European Commission, by 2060 one in three Europeans will be over 60 years of age, with the ratio of working to inactive citizens to 2 to 1 as compared to 4 to 1 today [2]. Some estimates suggest that by 2025, the percentage of citizens over 60 in the Baltic Sea countries will increase from 25% to 50% of the total population which implies a huge effect on the health and social care

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sectors as well as the overall productivity and job markets of the future [4]. With the rise in members of the population that will be more dependant on their families, the BSR will be faced with overwhelming challenges [7]. Therefore, this research focuses on creating an understanding of the existing knowledge resources with particular emphasis on investigating the potential of ICT solutions to facilitate the elderly population. It aims to highlight the competencies and cardinal resources for ICT usage amongst the elderly people. The findings are then visually represented on a knowledge map which will serve as a basis for the Knowledge Management Model in the future and also for building requirements for the Digital Silver Hub (see Sect. 6).

The European Commission has outlined research and innovation strategies for smart specialization at regional levels to spearhead progress in the future. According to the Commission: *"Smart specialisation is an innovative approach that aims to boost growth and jobs in Europe, by enabling each region to identify and develop its own competitive advantages. Through its partnership and bottom-up approach, smart specialisation brings together local authorities, academia, business spheres and the civil society, working for the implementation of long-term growth strategies supported by EU funds."*[5] This study is a part of a larger research initiative: OSIRIS - 'Supporting the Smart Specialization Approach in the Silver Economy to Increase Regional Innovation Capacity and Sustainable Growth'[1]. The project aims to create an innovation ecosystem where private sector, public sector, education sector and the end user can collaborate and co-create innovative solutions to help elderly people live a comfortable independent life.

The first phase of the research undertook to understand the demographic characteristics of those who benefit from digital services. Estonia has a dynamic and efficient digital infrastructure which means that its citizens enjoy a paper-free and hassle-free system where they can file their taxes, register their businesses, sign documents, get prescriptions and even vote online [11]. It was found out that the elder generation was not very motivated to utilize digital services. 90% of people above the age of 85 years did not want to learn new IT skills whereas those in the 65-85 age group did want to adopt new technologies to some extent. Most of the elderly were satisfied with the medical services they received online but a clear hesitation to adapt to technological innovations was observed.

Estonia is an impactful and energetic member of the European Union (EU), with a thriving digital economy fuelled by its technologically advanced infrastructure [16]. Estonia has expended tremendous efforts to build an information system that allows data exchange between public and private entities in order to build synergies. With respect to this, X-Road is considered to be a backbone of Estonia's e-government in the organization of interoperability [14]. As a Smart Specialization priority(RIS3) of Estonia, ICT encompasses a wide array of realms including e-health, e-governance, data analytics, cybersecurity, and many more [5].

In order to identify the key knowledge resources for ICT integration in the silver economy, two extensive workshops have been conducted and the results have been represented as a knowledge map using the ontology model on Protégé. The knowledge map serves as the primary source of information which then has been further validated from questionnaires and expert interviews. You can view the ontology based knowledge map on WebProtégé [2].

In Sect. 2, we provide a brief theoretical background of the silver economy in Estonia and knowledge management. In Sect. 3, we propose a knowledge map for ICT integration using the ontology model in Protégé. In Sect. 4, the research methodology is described which is used to validate the knowledge map from Sect. 3. In Sect. 5, we provide the results. We proceed with a discussion of possible future directions in Sect. 6 and finish the paper with a conclusion in Sect. 7.

2. Theoretical Background

2.1. Silver Economy in Estonia

The silver economy encompasses a broad term that pertains to the considerations of the elderly population. It deals with the economic activity related to the direct and indirect purchasing and spending patterns of people above

[1] https://www.osiris-smartsilvereconomy.eu/
[2] https://webprotege.stanford.edu/#projects/175753ab-fdcf-48f2-a28f-15f9053626d1/edit/Classes

50 years of age. According to the European Commission: *"Silver economy encompasses a unique cross-section of economic activities related to production, consumption, and trade of goods and services relevant for older people, both public and private, and including direct and indirect effects."*[16] The term silver economy also represents the challenges and opportunities that catering to the aging population entails [17]. Despite being ranked third in the index of Economic Freedom in the EU and second in Internet Freedom, with internet access declared as a human right, highly developed telecommunications and fastest broadband networks all across the country and digital public services a part of everyday life, Estonia or "e-Estonia" as some call it, has a lot of challenges pertaining to its older population using the available ICT services. [15]

2.2. Knowledge Management and Transfer

Knowledge management and transfer, both refer to the interdisciplinary concept of achieving a predetermined set of objectives through the optimal use of knowledge in professional settings. It's a complex process because knowledge embedded in any organization's processes, members, resources and networks includes both its explicit and tacit forms that are sometimes hard to define [9]. It is especially relevant to the innovation process and its tactical and strategic manifestations to create value by utilizing the knowledge assets of any entity [12]. The Knowledge Management Model(KMM) provides a practical framework to:

- identify needs,
- recognize the knowledge resources,
- acquire, create or eliminate knowledge related tools, processes or scenarios,
- recover, apply and share knowledge,
- store knowledge [3]

For this study, to understand the process of knowledge management and transfer in the silver economy in Estonia, a knowledge map has been created which will be utilized to develop the Knowledge Management Model in the future. The goal is to apply the smart specialization strategies (RIS3) to the Baltic Sea Region countries through this model. In this case, the RIS3 includes the implementation of ICT resources and strategies to the silver economy in Estonia.

2.3. Knowledge Map

For knowledge management and transfer to be effective, knowledge maps serve as beneficial tools and methods that capitalize on the explicit and tacit knowledge resources for problem-solving through visual representation. They identify the knowledge sources, the actors involved in knowledge creation and dissemination, how knowledge flows through various networks and reaches the target audiences and the hindrances that may stifle the process [3]. Through knowledge maps, we can have a practical representation of how information travels through a system amidst the innovation actors and recognize the imminent threats and weaknesses within the process. Consequently, pockets of opportunity and improvement can be pinpointed and adjustments can be recommended to make sure that the relevant knowledge reaches the concerned people at the right time [13]. For the purpose of this study based on the silver economy, the knowledge map is a fundamental outcome to serve as a base for open dialogue and knowledge management model for long term purposes.

3. Proposed Knowledge Map for ICT Integration in the Silver Economy

The integration of ICT in the silver economy is particularly challenging, because the elderly citizens are usually the last one to accept and implement change [1]. However, they are most vulnerable to be dependent on others due to their restricted mobility, lack of digital competencies, social, emotional and financial needs [8]. Two workshops were conducted to comprehend the important issues involved in the implementation of smart environments for the elderly. The needs of this segment of the population are distinctively different from those aged between 20-40 years in terms of acceptance of innovative technologies. The participants of workshops were mainly professionals from the fields of IT, science, business and government bringing together their extensive experience and knowledge to apply ICT in the silver economy of Estonia.

3.1. Workshop Results

The workshops sought to explore the following concerns regarding the digital environment for the silver generation which were based on strategy and direction from the EU strategy on the silver economy [6]. :

- The need to reform the existing digital environment or "smart environment".
- Key components in the development of such environments.
- Ways to find information on various factors.
- Kinds of information required to create a smart environment.
- Challenges and constraints in finding information.

The focus areas of workshops included the following:

- **Smart living**: Smart living includes solutions that enable digital environments that require minimum effort from the users so that the elderly people do not have to learn complex procedures to accomplish simple tasks.
- **Digital competencies for the elderly/digital e-government forms**: There is a need for the silver generation to acquire basic digital competencies such as navigating the internet, as the digital environment is inevitable. The digital e-government forms, however, need to be simpler and more user friendly with one time data input and pop-up windows to be effectively maneuvered by the elderly. The issue of the lack of experts to train the elderly in digital skills is also pertinent and needs to be addressed.
- **Medical help**: One of the most important and frequent services that the elderly require is medical help. Although the need to see a medical expert in person cannot be eliminated yet the medical resources can be managed effectively by providing digital platforms that are user friendly.
- **Information technology/Internet penetration**: Although Estonia has extremely high internet penetration rates, there is still a likely chance that the silver generation may not have it at their premises. It's important that they have infrastructural means to access to the information technology such as electricity, internet connection etc.
- **Active lifestyle and sociability**: If a person has a healthy lifestyle and an active interest, with adequate social support he is more likely to adjust to changes. There is a need to develop unified information centers by the government so that if the elderly does not have any social support, they can still learn to navigate the digital environment and feel secure.
- **One size doesn't fit all**: It was suggested that customized smart solutions, according to relevant age brackets, should be developed. In order to create a need-based approach to information flows, a matrix should be created for different elderly age groups(60+, 70+, 80+, 90+), as each age bracket presents a different set of challenges and demands.

It's imperative to understand that the elderly population does not have the necessary IT skills that the younger digital generation enjoys. Moreover, a retired person today may possess a different set of skills than a pensioner twenty years later. So the ICT implementation would have to take into account all these factors to facilitate the silver generation. Estonia being a second home to the internet, a vast number of organizations here are already working for smart solutions, for instance, virtual assistants. In order to improve e-governance and social welfare services, proactive approaches need to be incorporated in the ICT system such as one-time data input that may be cross-referenced. The workshops, with participants from various expertise, contributed towards developing a holistic knowledge map that took into consideration the following aspects of ICT implementation:

- Legal
- Infrastructure
- Service Design
- Actors
- Promotion
- Knowledge Management

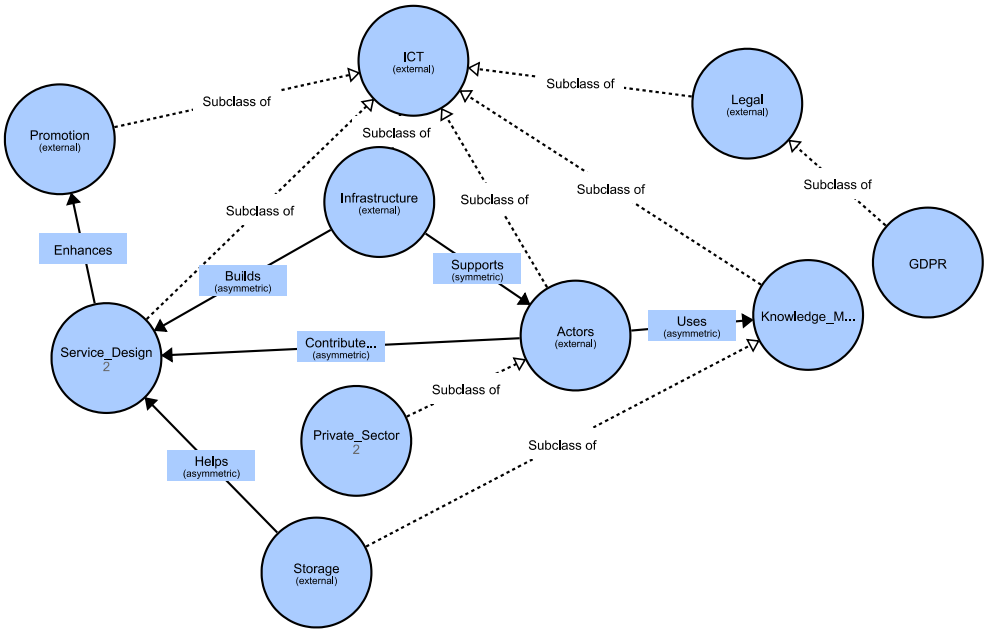

Fig. 1. Knowledge map (created from workshop results)

A comprehensive model of the necessary components of the knowledge map coupled with the capacity to navigate through different levels of abstraction across the related factors and actors was needed. For this reason, we constructed our ontology model defined in Figure 1. In the ontology, we defined a glossary of classes that serves as a central repository for the silver generation. More precisely, we defined a set of classes, sub-classes and instances for specifying the main concepts regarding the contextual characteristic of the ICT. In order to make more informed decisions, we represent the relationships between different classes. Relationships are represented by properties in OWL.

4. Methodology

For the purpose of developing a knowledge map, two dedicated workshops have been conducted, that ensured that the collected data was participant-centric. This allowed us to ground the data within the framework of the inter-regional Baltic Sea Program project ”OSIRIS” while making sure that the participants of both the workshops were assisted well to frame their experiences and opinions. One of the most important uses of the derived knowledge map is the visual representation of all the gathered knowledge and information. It is through knowledge maps, that the researchers can gain valuable insight into the topic under discussion through an easy to navigate visual knowledge map.

4.1. Expert Interviews and Questionnaires

The proposed knowledge map has been created through the information gathered from the participants of the two workshops which was dedicated to understanding the knowledge resources and competencies for ICT integration in the silver economy. However, it is essential to make sure that the map is validated and supported through other primary methods of data collection and research. For this purpose, the study aimed to conduct detailed interviews and questionnaire surveys to gather information that further related and supported the results of the knowledge map. Questionnaires were sent out to numerous influential professionals from different fields of IT, social sciences and healthcare and we received a total of 19 responses. In addition to this, six structured expert interviews were also

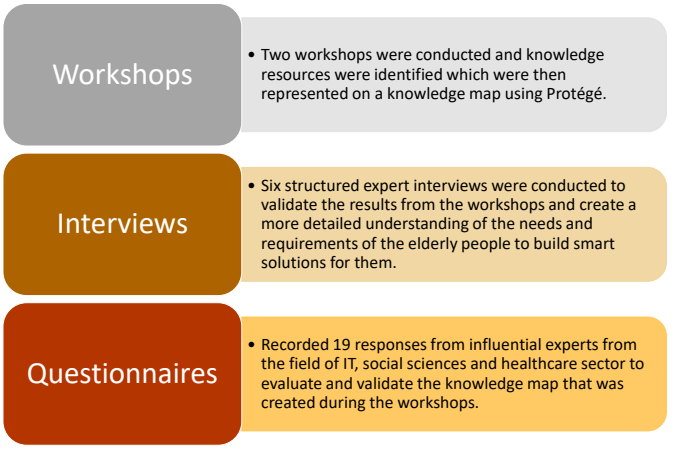

Fig. 2. Methodology Summary

conducted. The purpose of these interviews was to develop a better understanding of the needs and requirements of the silver economy while exploring the options that can assist in formulating detailed ICT solutions. Moreover, the objective behind the interviews was to ensure that the knowledge gathered through the workshops and the knowledge map was further validated and supported by expert opinions. The experts were chosen carefully while the questions were well-articulated and interviews were 30 min long on average which provided the research with a deeper insight to the topic at hand. Experts were from the following organizations:

- Tallinn University of Technology
- Tallinn University
- Ministry of Social Affairs (Sotsiaalministeerium)
- Estonian Association of Pensioners' Societies (Eesti Pensionäride Ühenduste Liit)
- NGO Estonian Village Movement Kodukant

Hence, the methodology applied for this research is mainly qualitative where the primary source of data collection includes workshops as well as expert interviews and questionnaires (see Fig 2). Here the purpose of the interviews and questionnaires is to support and further validate the knowledge map drawn in conclusion of workshops carried out to identify the key knowledge resources for ICT integration in the silver economy.

5. Results and Discussion

5.1. Results from Questionnaires:

All of the respondents agreed that there was no redundant information displayed in the knowledge map. All of the information was unique and essential for the study. 63.2% of the respondents agreed that the knowledge presented in the map covered all of the details related to ICT. Whereas 36.8% felt that there was some information left out. They believed that concepts such as interoperability and integration should also be discussed. One of the most essential factors that were discussed throughout the research is the readability of the elderly to adapt to new and dynamic technological changes. It has been analyzed that learning new skills and coping with new mechanisms at an elderly age may not be ideal and often requires extensive assistance and guidance.

When asked the most effective way of training the elderly, 73.7% of the respondents opted for "Training workshops". These workshops can allow them to come together with their age fellows and start learning at the basic level.

It is also important to create awareness amongst the elderly population about the benefits of integrating ICT solutions in their daily routines. Communication mediums easily accessible to them should be used for this purpose such as TV advertising, print advertising, radio advertising, informative sessions, activity clubs, enforced online services, and word of mouth. Out of which the most effective ones are print (63.2%), TV (52.6%), and radio (52.6%) advertising.

Smart living is a concept that we often see extensively advertised. However, the target audience that is still not very much catered to the concept is the elderly population which can, in fact, reap maximum benefits out of the new ideology. As per the respondents, one of the most common advantages for Smart living for the elderly will be the monitoring of health and medication reminders. 94.7% respondents believe that the elderly will get timely medication reminders, whereas 89.5% think that the caretaker of an elderly individual can be notified on time in case of any sort of emergency. However, the major obstacle that may arise while introducing smart living concept is the unwillingness of the elderly population to adapt to new changes (68.4%). Moreover, there is a likely chance that elderly population may not be able to keep the cyber hygiene and may fall for a scam (see Fig 3). The majority of the elderly population as per the results of the questionnaires are connected to technology through smartphones (94.7%). This factor needs to be kept into careful consideration while developing technology and related applications targeted for the smart living concept amongst the elderly population.

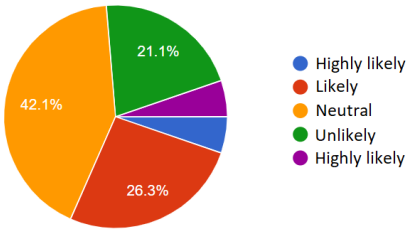

Fig. 3. Likeliness of elderly population to keep cyber hygiene.

Concluding the results from the questionnaires, it can be said that the results gathered from the survey concede with the ideas and information, as represented in the knowledge map.

5.2. *Results from Interviews:*

Interviews were conducted to explore expert insight on the issues pertaining to the integration of ICT solutions for the elderly population. One of the integral ideas discussed is the need to create a consolidated platform or a portal that can host an information bank for the elderly. The portal can serve as a means of creating a reliable environment for providing varying services and information to the elderly population. The platform can be further customized to provide user support which is age-appropriate and personalized. *"Information should be available in one place that is familiar and already in use"*. The information bank can include all the related medical history of a user, including the communication with the family doctor, the previous health conditions, and so forth. In order to ensure that the elderly population becomes acquainted with the e-environments, it is imperative to provide them with *"accessibility to services as a pre-requisite to motivate them to use, personal support, and automation of forms and/or critical reviews that may otherwise overwhelm them"*. However, the challenge remains to ensure that all of the information on the consolidated platform is reliable and authentic.

One of the most significant issues while creating ICT solutions for the elderly is their ability to use them appropriately and with ease. As discussed earlier, the elderly population is most of the time unaware as to how to utilize e-services such as e-Health. It is, therefore, essential to make sure services are easily accessible and personal support is available. For example, often a plethora of different online forms can be overwhelming, one solution can be to create forms that are not redundant and are easier to fill out. It is also essential to introduce training programs for the elderly population. The training should especially include information related to cyber hygiene to protect the elderly from falling at the hands of fraudulent activity. It was further advised that their systems should have warning messages displayed consistently to remind them and make them acknowledge the importance of cybersecurity. Moreover, different promotional campaigns should be organized to create ICT awareness amongst the elderly. These should include dedicated videos, TV programs, and face-to-face training by the professionals.

It is agreed upon, without any doubt, that IT solutions support a healthy lifestyle. It enables the elderly to ensure that their daily routines and health is carefully monitored while maintaining an independent lifestyle. However, all of this depends significantly upon the type of applications being developed, the ease of use, and the training programs.
The collection of personal data through a unified portal will also allow IT professionals to develop pre-filled forms for the elderly. Governments and even private companies go to great lengths to support the younger population in the society [10]. It is high time we also understand the importance of the role of the elderly population and provide support to help them lead a more independent life. This can be achieved by creating more proactive services for them. As one of the interviewees suggested: *"Event-based approach (e.g retirement course), public services should all be pre-filled, support-system for the healthy and active years supported by the state through local government, preparing people with the right information at an early stage, and the introduction of many more ideas that may support the elderly population maintain a healthy lifestyle"*.
Hence, it can be concluded that the interviewees mainly conceded with the competencies and knowledge resources gathered through the workshops and subsequently validating the knowledge map. The need here, now, is to define and create a consolidated approach that will help better integrate ICT solutions in the lives of the elderly population.

6. Future Work

As mentioned earlier, this research is part of a project called OSIRIS which is focused on the development of the silver economy through innovative solutions and ICT services that can help them live a comfortable independent life. The results from the current as well as future research will be compared to the findings from the other countries in the BSR so that outcomes can be discussed and generalizations can be made in order to build requirements to create an innovation ecosystem model in the future.

6.1. Knowledge Management Model

The purpose of creating detailed knowledge map by conducting dedicated workshops is to set the foundation of a Knowledge Management Model. The primary outcome of the complete process is the "Knowledge Management Model"; where it helps in defining processes that are best customized in accordance to the unique requirements of the project at hand. Furthermore, it also helps in retrieving and displaying relevant information in the most valuable and presentable form. Therefore, it can be said that the formulation of a Knowledge Management Model on the basis of the created knowledge map helps achieve the long-term goals and targets of the research. This model not only allows researchers to develop a better understanding of the needs and solutions for the silver economy but also helps the local authorities and policy makers find a deeper insight [13]. The knowledge management model which will be created on the basis of the knowledge map does not only take into account factors that are dependent but works on a system where all of the listed factors are interdependent. This means that the model is applicable at a wider scale and caters to different regions and is not limited to Estonia; providing relevant insight for both regional and inter-regional research purposes.

6.2. Digital Silver Hub

The research will set the cornerstone for future study and development of the digital silver hub in the BSR. The idea is to introduce a virtual collaborative platform referred to as 'Digital Silver Hub' which will connect *"researchers, product developers, financers and user organizations into a network and enable all innovation actors to screen and accelerate the uptake of innovative products and services enabling older adults to continue living a comfortable, independent and active life"*.[1] The introduction of technology specifically designed to help the elderly population will help in their care-taking and wellbeing.

7. Conclusion

The expected demographic change highlights the importance of the silver generation and their role in the economy. With the increase in the elderly population, it seems to be a high time to turn population aging into entrepreneurial

opportunities. Integrating ICT solutions to aid the elderly population to live a healthy lifestyle can be challenging due to their resistance to change and digital incompetency. However, if proper training and guidance programs are in place and e-services are designed with convenient user-interface, there is a likely chance that the elderly population would be keen to adapt. Private, public, and academic sectors need to build synergies to develop ICT solutions for the silver economy. Expertise and knowledge from the different actors can result in innovations that are designed to help the elderly population to maintain their cyber hygiene while availing e-services independently from the comforts of their homes. The need here is to amalgamate the requirements of the elderly and develop ICT solutions. The best way to promote these services is by introducing them to their activity clubs or using TV and radio commercials. When the silver generation is aware that their data is protected under GDPR and the service is easy-to-use and readily accessible, they might be more convinced to become technologically equipped.

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