The transformative power of technology to turn the silver economy into a gold society: a systematic literature review

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Abstract

***Purpose of the paper**: To analyze the intellectual and cognitive structures of silver economy research in the business and management literature, systematize current studies on technological innovations in the field, and propose future research directions to advance the debate on the role and impacts of technologies, better address the challenges and maximize the opportunities of an aging population.*

***Methodology**: A systematic literature review and science map analysis were conducted by applying bibliometric techniques to represent the current status of the research field.*

***Findings**: The results revealed three main research periods: the formation phase (1985-2007), the transition phase (2008-2014), and the early development phase (2015-2022), where the focus of scholars' interest shifts from welfare expenditures (1985-2007) to health policy, services (2008-2014), and technological change (2015-2022). The study reveals fragmented literature on the relationship between the silver economy and technology, which points out the lack of a holistic perspective of technological innovation for older people.*

***Research limitations**: The study has some limitations typical of most studies of a similar nature, such as the possible exclusion of research papers in the gray literature or the subjectivity bias of the researcher. These limitations were mitigated by the coordinated efforts of four researchers who, after working independently on each phase of the study, reached common agreements through discussion and improved the rigor and objectivity of the results.*

***Practical implications**: The paper provides relevant implications to a wide range of service ecosystem stakeholders, including business managers and policy makers, regarding the social challenges and business opportunities associated with the links between technological innovation and the silver economy.*

***Originality of the paper**: This paper presents a comprehensive systematic literature review of the silver economy in the business and management literature, with a particular focus on technological innovation.*

Key words: silver economy; bibliometric analysis; older people; technology; technological solutions; social innovation service ecosystem innovation

1. Introduction

"Closing our eyes will not make the demographic challenge disappear (…)" (Ahtonen, 2012). Ten years later, the challenges and opportunities of an aging population are high on the agenda of policy makers at the EU and national levels and continue to attract the interest of researchers and practitioners alike (Aceros *et al.*, 2015).

The 2021 Aging Report (European Commission, 2021) declares aging pressures to be a global priority. The ratio of people aged 65 and older to people aged 20-64 will continue to increase to 59% by 2070; since this ratio is increasing, the labor force and productivity growth in Europe are declining. This trend likely has two opposing effects: i) increasing social and economic pressures, which will have profound implications for the entire social system (i.e., the health and welfare system, the labor market, public finances, etc.); ii) a new market promise of the "silver economy".

The silver economy refers to existing and emerging economic opportunities related to the production, consumption, and trade of goods and services relevant to an aging population (European Commission, 2018). Older people provide an impetus for the development of new goods and services because they engage in a wide range of activities (sports, cultural events, tourism, higher education, volunteering, etc.) to stay active and connected with family and friends and society at large.

With an aging population recognized as driving consumer megatrends (Euromonitor International, 2020), the silver economy is relevant and attractive to any business. Indeed, the silver economy can be a source of competitive advantage for companies that offer innovative technological solutions capable of meeting the growing demand for goods and services from the silver market (Laperche *et al.*, 2019; McGuirk *et al.*, 2022). Surprisingly, while technology is now part of the silver culture (i.e., seniors use it daily to maintain social networks, intellectual growth and participation, and physical well-being: Loe, 2015) and the silver market is widely viewed as an excellent application area for technological innovations and solutions (Kohlbacher and Hang, 2011), some authors note that older people are not fully prepared to adopt technological innovations (Bowles and Baugh, 2007). This finding requires attention to the in-depth use of technology of seniors (Heart and Kalderon, 2013) to better understand the factors that hinder their adoption of innovative technological tools (Mostaghel, 2016).

Despite the clear relevance of this area of research, the established strands of the silver economy in the business and management literature offer only a partial understanding of the role and impact of technology on the lives of older adults and the development of this market promise (Oget, 2021). This is consistent with Mostaghel's (2016) call for further research for a deeper understanding and systematization of current knowledge on the relationship between technological innovation and the silver economy.

Accordingly, this paper aims to a) map the knowledge base of the silver economy in the business and management literature, b) discuss the hot topics and state of technological innovation in the field, and c) propose future research directions to turn the silver economy into a golden society.

To this end, a systematic literature review and a bibliometric analysis were conducted following the protocol proposed by Turzo *et al.* (2022). Bibliometric methods are widely used in different research areas, such as knowledge management (Gaviria-Marin *et al.*, 2019; Manesh *et al.*, 2020), innovation (Casprini, 2015; Klarin, 2019; van Oorschot *et al.*, 2018) and entrepreneurship (Rey-Martí *et al.*, 2016), to describe the status, trends and potential future research of a particular area.

Thus, this study contributes to a better understanding of the research field of the silver economy, presents the conceptual structure of the subject and traces its evolution over time through a funnel approach based on three levels of analysis.

Specifically, a general overview of the silver economy is first provided from the broad perspective of "Business&Economics" and "Operation Research and Management Science" - Web of Science (WoS) Research Areas. Second, the analysis is restricted to the WoS category of "Business and Management". Third, the focus is on technological innovation studies within "Business and Management".

The funnel approach allows embedding the topic within the broader stream of the business and economics literature and taking a detailed look at the studies that examine the relationship between technological innovation and the silver economy in the business and management literature.

Compared to previous systematic literature reviews, the current study provides a wider perspective on technological innovation related to the silver economy instead of focusing on a specific type of technology (e.g., Barakovic *et al.*, 2020) or specific countries (e.g., Mostaghel, 2016).

In addition, the study proposes a broad and transdisciplinary paradigm that combines the perspectives of service ecosystem innovation (Storbacka *et al.*, 2016; Storbacka 2019) and social innovation (Caulier-Grice *et al.*, 2012; Rubalcaba, 2016; van Wijk *et al.*, 2019) to better inform research, policy, and practice and improve coherence with current trends of aging populations in the real world.

The article is organized as follows. In Section 2, the methodology is reported. In Section 3, the results of the study are presented, organized by the three levels of analysis. In Section 4, the findings are discussed. Finally, in Sections 5, 6, and 7, indications for future research, implications, and limitations of the study are reported.

2. Methodology

A systematic literature review (Tranfield *et al.*, 2003; Denyer and Tranfield, 2009) and a science mapping analysis were conducted following the protocol proposed by Turzo *et al.* (2022) to represent the knowledge base of the silver economy, highlight the state of technological innovation in the field and track possible research directions that would turn the silver economy into a golden society.

Science mapping is one of the main procedures used in bibliometrics; it is useful to depict the cognitive structure of a research field (Cobo *et al.*, 2011). Often, bibliometric analysis suffers from limited transparency

and reproducibility caused by the discretion of the process. The approach followed here ensures transparency and replicability of the process (Turzo *et al.* 2022).

The Bibliometrix package (Aria and Cuccurullo, 2017) in R-Studio was used to create strategic maps of the research field, as shown in Cobo *et al.* (2011). Strategic diagrams cluster publications and plot them in a bidimensional diagram according to their Callon's centrality and Callon's density; this representation helps to better understand structural (cognitive structure) and dynamic aspects (evolution) of the research field (Cobo *et al.*, 2011).

Following the protocol proposed by Turzo *et al.* (2022), the process of data collection and analysis was organized into ten steps.

First, the literature on what is currently known as the "silver economy" was analyzed to obtain an overview of the topic, fill a list of the most popular keywords in the field, and determine how the most popular keywords have changed over time, according to the evolution of the topic.

Second, the research query was defined based on the results of step one and the authors' experience. In January 2022, the following query in WoS was defined using the operator TS: OR "silver economy" OR "elderly economy" OR "longevity economy" OR "senior economy" OR "aging economy" OR "silver market" OR "elderly market" OR "longevity market" OR "aging market" OR "senior market" OR "silver society" OR "elderly society" OR "longevity society" OR "aging society" OR "senior society" OR "aging economy" OR "aging market" OR "aging society" OR "population aging" OR "population aeging" OR "active aging" OR "active aging" OR "healthy aging" OR "healthy aging" OR "older people".

Third, the same query was run on Scopus using the operator TITLE-ABS-KEY, and no significant differences were found in the results; thus, WoS was used as the main database. The choice of WoS as a data source is consistent with its reputation as one of the most important bibliographic databases (Aria *et al.*, 2020; Cobo *et al.*, 2011).

Fourth, the analysis was limited to documents classified as "article" or "proceedings" (Glänzel *et al.*, 2006), written in English, within the "Business & economics" and "Operations research and management science" research areas over the entire timespan (1985 to 2022). The decision to include proceedings is consistent with the emerging nature of the topic, whose production has doubled since 2015: the keyword "silver economy" appears very few times in articles but is widely used in proceedings. This result confirms that the silver economy is a new topic, as also shown by the analysis of strategic diagrams (Fig. 3 and followings). We obtained 1,511 documents during 1985-2022: 1,157 articles and 354 proceedings.

Fifth, an automatic cleanup of the keywords was performed using OpenRefine (https://openrefine.org/). An additional cleanup of the keywords was also manually performed to standardize them (i.e., spelling between British and American English was uniformized, for example, using "aging" instead of both "aging" and "aging", wrote out the acronyms, and reworded all numbers).

Sixth, a bibliometric analysis was performed of the 1,511 documents using the Bibliometrix package in R-Studio (Aria and Cuccurullo, 2017). To

trace the evolution of different research topics and areas, the main sources and keywords were analyzed using a three-field plot (Sankey Diagram) where each field corresponds to one time slice. Then, the conceptual structure of the dataset was examined by analyzing the thematic or strategic maps (Cobo *et al.*, 2011). In this method, a clustering algorithm was applied to the keyword network; each cluster in the thematic map corresponded to a topic (Aria and Cuccurullo, 2017). The author's keywords were selected to label the clusters. Since this method does not allow direct categorization of documents by topic, four researchers independently read the text, discussed, compared, and categorized the documents. Then, the researchers' categorizations were compared with the thematic map and thematic network to combine them.

Seventh, new boundaries for the analysis were set: only documents belonging to the Business and Management WoS categories were eligible. We excluded 972 documents because they did not belong to the Business and Management WoS category; thus, a subset of 539[1] articles was obtained. A bibliometric analysis was performed, as in the sixth step.

Eighth, a further restriction was made by selecting only documents that focused on technology, which yielded 126 documents.

Ninth, manual cleaning of documents was performed by reading the full text of the 126 documents from step 8. We excluded 70 documents because they only mentioned *technology* but did not focus on it. At the end of the cleaning process, a dataset of 56 documents was obtained.

Tenth, a thematic map analysis of the 56 documents was performed, and documents were clustered according to the topics identified in the network map and related thematic diagrams (Cobo *et al.*, 2011). The network map shows the descriptors (e.g., keywords) of each cluster and their connections (Pinto, *et al.*, 2014). Table 1 shows the three levels of our research and the related steps according to the funnel approach.

Tab. 1: Levels or research aims and related steps

Research level	Research boundaries WoS Research Areas/ Categories	Records	Aim	Steps #
1	Silver economy in business & economics" and "operations research and management science"	1,511 records	To get a general overview of the academic research on silver economy	4, 5, 6
2	Silver economy in business & management	539 records	To outline the current state of the silver economy in the business and management literature	7
3	Silver economy and technology in business & management	56 records	To trace the relationship between the topics of technological innovation and silver economy in business and management literature	8, 9, 10

Source: Authors' elaboration

[1] Software automatically excluded 5 documents from clustering because they were not linked to any other document. Thus, the thematic and cluster analysis are based on 534 documents (see Section 3.2).

3. Results of bibliometric analysis and literature review

According to the aim of the study, our results present the conceptual structure and evolution of the research field of the silver economy over time. To this end, they are divided into three complementary sections, which correspond to three levels of research that were followed in the systematic literature review. Each section is characterized by a different focus and level of analysis (Table 1).

The first section (3.1.) provides a comprehensive overview of silver economy research in Business & Economics and Operation Research and Management Science (WoS Research Areas).

The second section (3.2.) outlines the current state of the silver economy in the Business and Management literature (WoS categories) by analyzing thematic maps.

The third section (3.3.) combines thematic and cluster analysis and provides detailed insight into the relationship between the topics of technological innovation and the silver economy in business and management (WoS categories).

3.1 Silver economy: A general perspective

This section provides a general overview of research on the silver economy from 1985 to 2022[2]. During these 37 years, scientific production on the broad phenomenon of the aging population has steadily increased (McGuirk, *et al.*, 2022; Mostaghel, 2016), reaching an annual maximum of 158 articles and proceedings in 2018. During this period, the most productive journals on this topic were the Journal of Nursing Management (43 articles), Health Economics (38 articles), Journal of Economics of Ageing (35 articles), Journal of Transport Geography (31 articles), and European Journal of Health Economics (23 articles). Evidence suggests that most of the debate has developed in the health management, economics/labor, and social policy literature.

Analysis of the annual production series reveals two breaks in 2008 and 2015 that delineate three subperiods (Fig. 1), which we refer to as the formation phase (1985-2007), transition phase (2008-2014), and early development phase (2015-2022). To analyze each period and how different themes were interlinked and evolved across periods, a three-field plot was used (Sankey Diagram) (Fig. 1). Thus, the links among the three time slices and their flows (from left to right) show the evolution of themes (Morante-Carballo *et al.*, 2022).

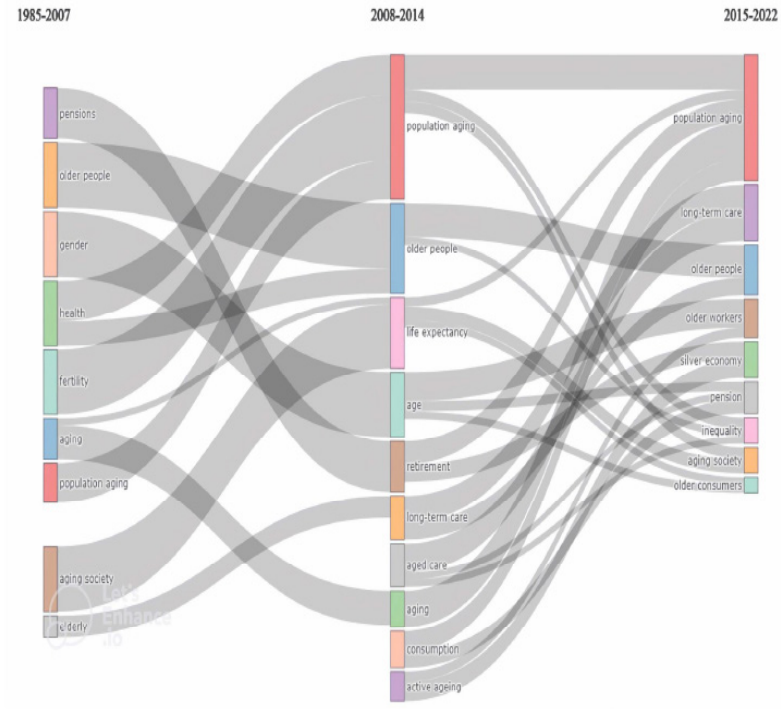
Scientific production in the formation phase (1985-2007) includes relatively few publications (an average of 12 per year), which mainly address the demographic change and the economy from a policy perspective.

[2] Our dataset dates back to the late 1980s; it reflects the use of a wide range of keywords (see step in Section 2) to directly and indirectly intercept the silver economy theme, where many authors refer to the broader phenomenon of aging populations. Most studies in the 1985-2015 period were intercepted by other keywords (e.g., aging society, population aging), while the emergence of the silver economy keyword only began in 2015, which suggests that the use of the term silver economy is relatively recent.

The focus is on the drivers and broader implications of economic life for aging and society's treatment of older people. The occurrence of author keywords (Kws) during this period suggests that the research topics have a very specific and narrowed focus, such as social welfare expenditures (i.e., pensions and health care spending) and the links between gender and age difference in the labor context.

Fig. 1: Top five sources in the three subperiods and Sankey diagram

1985-2007 167 documents 168 sources Top 5 sources cover 45% of production	**2008-2014** 405 documents 210 sources Top 5 sources cover 44% of production	**2015-2022** 939 documents 485 sources Top 5 sources cover 27% of production
Canadian Public Policy - Analyse de Politiques (8)	Journal of Nursing Management (27)	Journal of the Economics of Ageing (35)
Journal of Population Economics (6)	Health Economics (15)	Health Economies (20)
Journal of Macroeconomics (5)	Journal of Transport Geography (15)	Technological Forecasting and Social Change (18)
Japan and the World Economy (4)	Journal of Population Economics (10)	Journal of Nursing Management (16)
Journal of Macroeconomics (4)	European Journal of Health Economics (9)	Journal of Transport Geography (16)
National Tax Journal (4)	Transport Policy (9)	European Journal of Health Economics (14)
World Development (4)	Journal of Health Economics (8)	International Journal of Consumer Studies (14)
Health Economics (3)		
Journal of the Operational Research Society (3)		
Pharmacoeconomics (3)		
Public Finance - Finances Publiques (3)		
Review of Income and Wealth (3)		
Total Quality Management & Business Excellence (3)		



Source: Authors' elaboration

The transition phase (2008-2014) opens up new research directions on management, innovation and leadership in care and health, workforce aging and retirement, and the quality of transport policy, travel and mobility. Very specific themes (fertility and health) in the initial phase of the studies converge here with the general theme of research on the older and aging population. Meanwhile, some emerging themes (consumption, life expectancy, and active and healthy aging) shift the focus from the decline of older people's health and associated costs to the policies and practices to improve their independence, quality of life and society as a whole (savings in pension and health care costs).

Most of these emerging themes will be further developed in the early development phase (2015-2022).

The early development phase (2015-2022) covers many additional research interests and topics (the top five journals cover 27% of the total output for the period, compared with 45% and 44% in the first and second periods, respectively) by expanding, strengthening, and legitimizing earlier areas of study (population aging, long-term care, and older people). In addition, new research emerged in the areas of technology and technological change as the drivers and outcomes of complex interactions in social, economic, and political contexts; the role of national governments in identifying socially desirable technologies; health policy and services; labor and consumer research; and new market opportunities. These trends are evident in the assessment of new Kws such as "Older Consumers" and "silver economy", which address further studies in this area, particularly from the perspectives of business and management.

3.2 Silver economy in the business and management literature

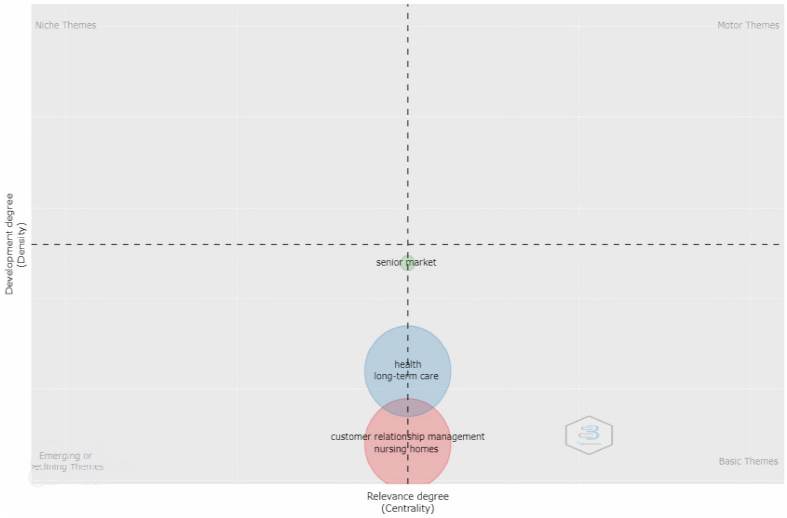
In the business and management literature, the most productive journals are the Journal of Nursing Management (43 articles), which confirms itself as the most important source (Section 3.1), Technological Forecasting and Social Change (21 articles), which published a special issue on technology and elderly individuals, International Journal of Consumer Studies (20), International Journal of Manpower (11), Action Research (9), and Research on Transportation and Business Management (9). The debate follows the same pattern as that in the general overview (Section 3.1) but with a focus on consumer preferences and needs instead of policies to be implemented.

As shown in Section 3.1, the analysis of the annual production series shows the same two breaks in 2008 and 2015. To identify the main themes and their evolution in the business and management literature, a thematic analysis was performed (Figs. 2, 3, 4) for each subperiod: formation (1985-2007), transition (2008-2014), and early development (2015-2022). The thematic map helps identify the relevance and evolution of the discussed topics and highlights the most discussed and marginal topics that have contributed to the construction of the research field in a given period (Aria *et al.*, 2022).

The formation phase (1985-2007) (Fig. 2) includes 34 articles and three main themes: *Senior market, Health/long-term care* and *Customer relationship management/nursing homes.*

The position of these themes on the map - medium centrality (horizontal axis) and low depth (vertical axis) - indicates an initial and very general attention to the topic by scholars. A deeper look at the map shows the higher density of the senior market topic compared to the others. For us, this increased interest reflects the emergence of research on consumer behavior in the senior market.

Fig. 2: Formation phase (1985-2007): Thematic map



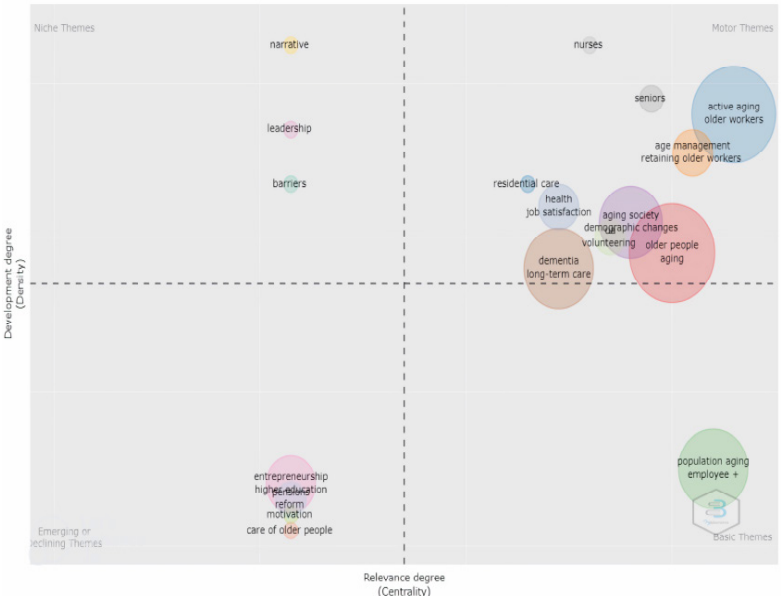
Source: Authors' elaboration

The transition phase (2008-2014) (Fig. 3) includes 136 articles and more topics than in the formation phase. This is consistent with the growing interest of scholars in the field.

The thematic map shows that active aging/older workers, aging society, and older people/aging and related issues are relevant motor themes of this subperiod. In particular, active aging/older workers is one of the motor themes with the most studies and high density and centrality. This trend follows the striking number of studies on how companies address the issues of work and retirement in the context of demographic change (Moulaert *et al.*, 2013; Bierwisch *et al.*, 2014).

To correctly define the themes in the lower left quadrant as emerging or declining, the thematic trends were analyzed across the three time periods (Figs. 2, 3, 4). For example, *entrepreneurship/higher education* is an emerging theme that shifts to the *seniors/age* theme in the third period, while *pension reform/motivation* and *care of older people* are declining themes, which neither survive nor cluster in the third period. Finally, in the last quadrant (upper left), the *narratives, leadership,* and *barrier* themes appear to be very specific to the subperiods.

Fig. 3: Transition phase (2008-2014): Thematic map



Source: Authors' elaboration

The early development phase (2015-2022) (Fig. 4) includes 364 articles and a steadily growing number of themes.

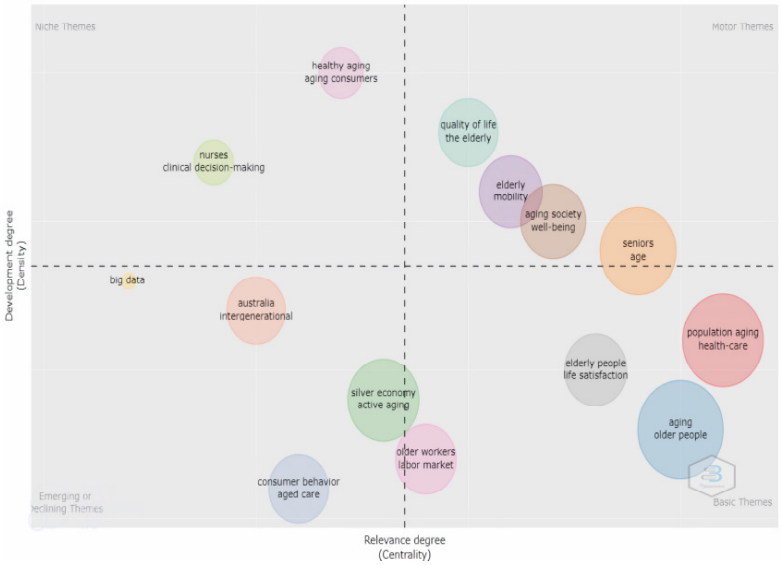
Consistent with the trend that emerged in the transition phase, the *aging society* and related aspects have confirmed their role as a motor topic in this phase. In addition, new themes have emerged as motor themes: *seniors/age, elderly/mobility, and quality of life.*

Among the basic themes, population aging has been confirmed as a relevant issue, while *elderly people/life satisfaction* and *older workers/labor market* appear as *new entries.* Interestingly, *aging/older people* are moving from a motor to a basic theme, i.e., it remains very central but has become less specific.

As described in Section 3.1, silver economy/active aging and consumer behavior appear as emerging themes (lower left quadrant) for the first time in this last phase (2015-2022). This result confirms the novelty of the topic, which has gained momentum since 2015 with the European Commission's first paper on the subject (Eatock, 2015). The strategic map confirms that it includes different but interconnected areas that relate to new and growing markets to meet the new needs of the growing number of older people.

Finally, the niche topics (upper left quadrant) include *nurses/clinical decision-making* and *healthy aging.* They are strongly developed but no longer central in this last phase. They follow the development of *health/long-term care* and *customer relationship management/nursing homes,* which were central and relevant topics in the formation phase (1985-2007). Most articles on these topics were published in the Journal of Nursing Management, which was the most fruitful source throughout the entire period and especially during the transition phase (2008-2014).

Fig. 4: Early development phase (2015-2022): Thematic map



Source: Authors' elaboration

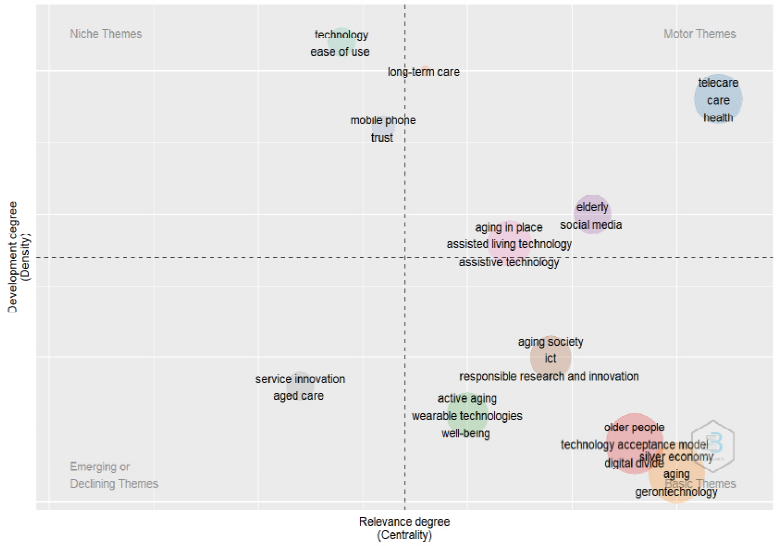
3.3 Silver economy in the business and management literature: focus on technology innovation

Although the silver market is widely recognized as a successful application area for technological innovation and solutions (Kohlbacher and Hang, 2011), our results (strategic map analysis in Section 3.2 - Figures 2, 3, 4) do not directly address this issue in the silver economy business and management literature. The results confirm our initial expectations (i.e., the number of articles and proceedings on technological innovation accounts for barely 10% of the total scientific output in the business and management literature - Figure 1). This result contrasts with the reality of technological development and its trends and impact on the social context, and it confirms a relevant gap in research on the silver economy in our area of interest. Accordingly, considering the purpose of our study, the following subsections show the results of the thematic map analysis (Fig. 5) and cluster analysis (Fig. 6). They are limited to the 56 articles and proceedings that address the topic of technological innovation in the silver economy literature (Fig. 1).

3.3.1 Thematic map analysis

The next lines present the most discussed topics (e.g., motor and basic) and the marginal topics (emerging/declining and niche) that determine the knowledge structure of studies on technological innovation in the silver economy (Fig. 5).

Fig. 5: Technological innovation in the silver economy domain: Thematic map



Source: Authors' elaboration

Motor theme: *Telecare/care/health, elderly/social media,* and *aging in place/assistive technology,* which are in the upper right quadrant, have high centrality and density, so they are the most important themes developed and critical to structuring the research field.

Basic themes: *Silver economy/gerontechnology, active aging/wearable technologies/well-being,* and *older people/technology acceptance model,* and *aging society/ICT,* which are in the lower right quadrant, are characterized by high centrality and low density. They are critical to the field, since they relate to general themes that cut across various research strands on technology and the silver economy.

Emerging/declining theme: *Service innovation/aged care* to implement and deliver health and social care innovation, which is in the lower left quadrant, has low centrality and low density, i.e., it is weakly developed and marginal. It can be classified as an emerging topic because publications on service innovation have appeared for the first time in a particular journal (e.g., Journal of Service Marketing) in the last ten years and fall into the third period.

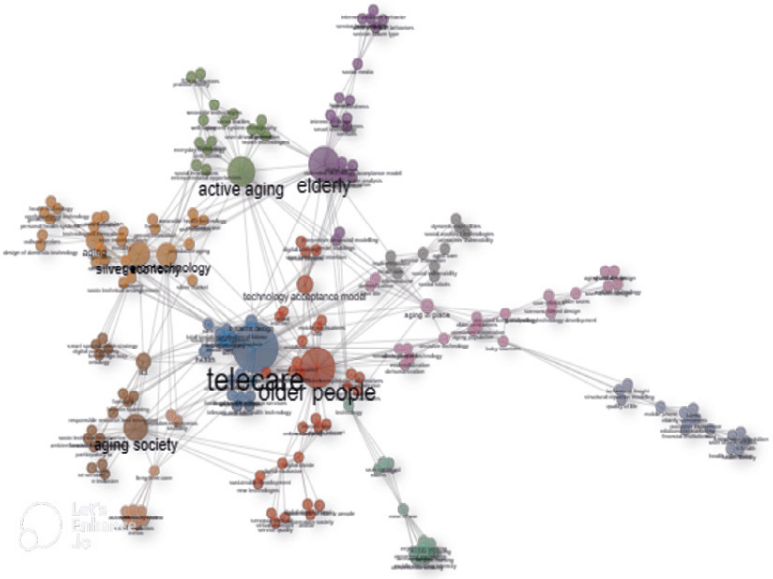
Niche themes: *Technology/ease of use and mobile phone/trust* appear in the upper left quadrant as very specialized and isolated topics. Their position on the map indicates that they have well-developed internal links (high density) but insignificant external links; thus, they have limited importance in the field (Aria *et al.*, 2020).

3.3.2 Cluster analysis

The network map (Fig. 6) shows eleven clusters that correspond to the themes in the thematic map (Fig. 5). Clusters were named according to their main descriptors (Appendix 1) and according to the themes that emerged

from the analysis and interpretation of the contributions. They are #Elderly and Social Media (purple); #Assistive technology for aging in place (pink); #Telecare implementation process (blue); #Technology acceptance and use of mobile devices (red); #Silver economy and gerontechnology (ochre); #ICTs for aging society (brown); #Wearable technologies for active aging (green); #Service innovation for aged care (gray); #Trust and senior online consumption (gray-blue); Human-Machine interaction in long-term care (salmon); #Age-friendly mobile devices (turquoise).

Fig. 6: Technological innovation in the silver economy domain: network and clusters



Source: Authors' elaboration

Below is a detailed description of each cluster based on the thematic map analysis (Fig. 5).

Motor themes

#Elderly and Social Media (purple): This cluster focuses on understanding the factors that influence the relationship between older people and social media as predictors of acceptance and use of different technologies. In particular, some scholars focused on the acceptance and intention to use smart technologies as a potential solution for their independence and safety at home (Tirziu *et al.*, 2020; Wong and Leung, 2016) or gaming technologies to improve their mental and physical health (Wang and Sun, 2016). Other researchers mainly refer to interactive/communication technologies (e.g., Facebook) to avoid social isolation by staying in touch with family and friends (Matilainen *et al.*, 2016). Within the cluster, Israeli *et al.* (2019) proposed a narrower focus on older people's intention to use social media to complain when a service failure occurs.

#Assistive technology for aging in place (pink): this topic relates to the use of and interaction with technology in their homes among older people. Some authors discuss the shortcomings and weaknesses associated with the use of assistive technologies, while others focus on solutions that enhance the use of technology to support the independence of older people. A first group of studies specifically addressed the negative effects of personal alarm systems. According to Pritchard and Brittain (2015), alarm pendants tend to be ineffective and increase feelings of dehumanization in older people. Similarly, Aceros *et al.* (2015) found that alarm systems tended to confine older people to aging in place and prevented them from engaging in outdoor activities, and telecare systems could exacerbate problems related to social isolation among older people. In the second group of studies, Compagna and Kohlbacher (2015) focused on the adoption of care robots for elderly individuals and emphasized the need to strengthen a bottom-up approach in participatory technology development to improve the development of ambient assisted living technologies that meet the real needs of older people. Additionally, according to Östlund *et al.* (2015), a better understanding of social and domestication processes (i.e., the integration of technologies into households) can make welfare technologies (a group of heterogeneous technologies that reduce social/welfare expenditures) more effective for older consumers. Meanwhile, Holliday *et al.* (2015) argued that greater development of the market for electronic assistance systems could help older consumers independently purchase products and services while maintaining their independence and lifestyle.

#Telecare implementation process (blue): The papers in this cluster focus on the successful acceptance and use of telecare. They take a user-centered perspective to adapt products and services to the needs and abilities of older people and make them user-friendly. Bjørkquist *et al.* (2015) referred to the involvement of seniors and other potential users (health and care professionals, relatives of seniors, etc.) in the process of defining their needs and selecting appropriate telecare solutions to meet them. Horton (2008) examined the experiences of users (older patients with chronic obstructive pulmonary disease and staff) with telecare to better understand the subjective definitions of patients regarding acceptability and usefulness (i.e., why patients liked or disliked a service) and identify areas of success, best practices, and problems in implementing telecare technology. Wilson *et al.* (2017) used the Total Social Organization of Labor (TSOL) framework to paint a broader picture of the impact of telecare systems from the diverse perspectives of project teams, clinicians, social workers, volunteers, and elderly individuals. They related to sociotechnical environments instead of on-site technologies/services. This broader perspective has strong implications for the design and implementation of telecare systems that are intended to create (social) value for all users (Wilson *et al.*, 2017).

Basic themes

#Seniors' acceptance and use of technology (red): The articles in this cluster focus on the factors of acceptance and use of different technologies

by older people depending on their specific applications and purposes. They reconceptualize and integrate the existing Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) model (Macedo, 2017) to demonstrate the positive impact of internet acceptance and use on active aging (Macedo, 2017) and examine the acceptance/use of mobile devices by older people from both technical and sociological perspectives (Klimova, 2018). According to Azuddin *et al.* (2018), the design and functions of the mobile device (technical factors - device context) and the social inspiration and awareness of the usefulness, communication, and economic benefits (sociological factors - social context) are critical to mobile device acceptance and use. Technology acceptance and use are closely related to the digital divide and digital exclusion of older people. On this topic, Huterska *et al.* (2018) noted hindering factors (i.e., soft factors primarily related to older people's lack of knowledge and skills) in online shopping use that lead to digital and social exclusion. Adamczyk and Betlej (2021) recalled the dimensions of digital exclusion and related social factors in an aging society (i.e., motivation to use new technologies, physical access, skills, and usage). They argued that people aged 60-75, 75-85, and over 85 had relevant differences in their needs and activities. Hwang and Nam (2017) compared computer-based technologies with mobile-based technologies and found that the latter helped reduce the "digital divide", especially for social relationship services (i.e., social media) and convenience services (i.e., administrative services). The issue of exclusion from smart public services is a central theme in studies of aging. Nowakowska-Grunt *et al.* (2021) explored the role of technological innovations (e.g., virtual assistants/avatars) in reducing the digital exclusion of seniors in the context of e-government, while Cirella *et al.* (2019) reflected on the possibilities of integrating mobile technology into transportation to promote seniors' mobility and their social inclusion through accessibility, affordability, availability, and acceptance of new services.

#Silver economy and gerontechnology (ocher): the articles in this cluster mainly refer to the links between the promising silver market and the development of innovation. Here, innovation, including technology, is considered a potential solution to the problems of aging and a driver of new market opportunities (Kohlbacher and Herstatt, 2011).

The focus of this group of studies is heterogeneous and includes several research directions and theoretical approaches. Cukanova (2015) identified digital consumption by seniors as the main stimulus for innovation and a prerequisite for the coming dynamization of businesses in the service sector (i.e., information technology services, online sales, transportation services, medical and nursing services and assistance, sports, culture, recreation, etc.). Laperche *et al.* (2019) examined the supply side of the silver market and assessed the role of demographic aging on innovation development. More specifically, the authors went beyond the established concept of gerontechnology and introduced the concept of geront'innovation as a solution that combined multiple forms of innovation (i.e., product, process, organizational, and marketing innovations), including but not limited to technology. Similarly, Oget (2021) stated that

the most innovative part of this new market was its organizational and marketing innovations. Technological innovations are not a milestone for the silver economy and currently play only a minor role; instead, they reinforce and enable marketing and organizational innovations. Due to the complex nature of such innovations, both open innovation (Laperche *et al.*, 2019) and networks (Laperche *et al.*, 2019; Oget, 2021) are critical to their effective development. Another relevant research direction calls for a holistic interpretation of technology according to the science and technological studies (STS) approach. The new role of technology as an obstacle or enabler of new practices and roles in seniors' lives replaces the traditional view of technology as an instrumental and passive object that only acquires meaning through the way people use it. Some studies in this subgroup focused on the area of complex telecare systems (Leonardi *et al.*, 2009; Gòmez, 2015), while others focused on the assisted living environment as an enabler of autonomy and independent living for older people (Neven, 2015). Leonardi *et al.* (2009) broadened the focus from the needs of older people to the complex web of emotions and practices (daily routines) of independently living seniors to design and develop acceptable and useful advanced home technologies. In the same vein, Gòmez (2015) noted the ontological status of autonomy-enabled innovations for later life and asserted that such technologies must interact with the social and cultural context of older people and evolve accordingly to be concretely and meaningfully integrated into their lives. Against the backdrop of actor-network theory and other theories of user representation, Neven (2015) noted that representations of users (i.e., people who want to live independently at home for as long as possible) formed the basis for the design of technologies; thus, they have a wider influence on usage and practices so that particular views of aging are written into the technology. This paper draws attention to the changes at the physical, virtual, and emotional levels that technologies introduce in the home, focusing on two main effects. On one hand, technology enables older people to have greater and lasting autonomy, especially at home. On the other hand, technology can undermine the emotional experience of being at home.

More broadly, the latter contributions focus on the role and linkage between seniors' lives (practice and daily routines), science, and the design and use of technology in shaping new practices and patterns of aging.

The positioning of this cluster opens the door to links between two other relevant groups of studies: #ICTs for an aging society (brown) and #wearable technologies for active aging (green).

#ICTs for aging society (brown): the contributions of this cluster focus on the role and importance of silver generation in business, which is considered an entrepreneurial opportunity but has strong ethical and social consequences. Indeed, an increase in aging population represents a remarkable societal change that requires the diffusion of a new and more inclusive culture of aging (Bechtold *et al.*, 2017). Therefore, companies, academics and policy-makers are called upon to design and develop ICT solutions for the social inclusion of older people (Butt *et al.* 2021; Flick *et al.*, 2020). Thus, future technologies should be easy to use, accessible, inclusive, and able to overcome the older population's resistance to change

due to their inherent digital incompetence (Butt *et al.*, 2021). Depaoli *et al.* (2010) noted that according to the "e-Inclusion Strategy" developed by the European Union, ICT for older people is becoming an enabler to achieve inclusion goals. ICT technologies can help include people who are not readily able or willing to use them, including for basic services (Bechtold *et al.*, 2017; Frau *et al.*, 2019).

#Wereable technologies for active aging (green): publications in this cluster see older people as an economic opportunity due to their longevity and vitality. Older people are not considered a threat but a challenge that requires rethinking the impact of aging on the economy and society as a whole (Bojanic and Erceg, 2017). Consistent with this approach, technology is becoming a tool to shape the lives of older people while promising better quality of life and reduced public spending. These technologies help senior people who are younger, more independent, and self-motivated (Lassen *et al.* 2015) to become truly savvy tech operators (Loe, 2015). They are active agents who, for example, make conscious decisions about whether to use biomedical devices (Loe, 2015) or adopt wearables such as smartwatches and fitness trackers (Morozova and Gurova 2021). Thus, they do not like uncomfortable devices that are considered something for sick people. In doing so, they collaborate and participate in the development of textile-based clothing, such as high-performance sportswear, to improve their daily lifestyle and well-being.

In summary, active aging technology enables older people to take responsibility for their own bodies instead of treating them as patients (Flick *et al.*, 2020). This is confirmed by the cluster's position on the map, which is quite isolated and on the opposite side of the assistive technology for the aging-in-place cluster, which focuses on telecare.

Emerging themes

#Service innovation for aged care (gray): the studies in this cluster focus on the implementation and delivery of innovations in health and social care. Barlow *et al.* (2006) referred to telecare as a set of services (i.e., safety and personal monitoring and care-related information delivery) that directly brought care to the end user. Because telecare involves a combination of technological and organizational innovation in a multiactor context, the authors emphasized the need to align the value systems of different stakeholders to meaningfully integrate telecare services into the overall system of care: "The higher the level of dependency of a patient, the greater the need for integration of the telecare service they receive into the care system as a whole" (p. 399). Drawing on research on innovation in other service sectors, the authors identified factors that affected the adoption of telecare (i.e., organizational context, user needs and demand, project complexity, and a local framework for support). Although not directly, they introduced the concept of resource integration and service ecosystems. Khaksar *et al.* (2016) explored and evaluated the factors that enabled social robots (a new generation of assistive technologies) to provide innovative services to reduce social vulnerability and improve the well-being of older people in elder care facilities. The authors referred to social robots as service innovators and catalysts for service innovation in elder care "because they

not only seek the best solutions to the problems of aging, but also play a preventive role for any other problems they might encounter in the future" (p.442). For example, social robots can entertain and engage the elderly in social activities such as group games (bingo), detect mental impairments during games, and help caregivers monitor the elderly's performance. Thus, it is not only a "talking machine or pet" but an actor that offers new opportunities to personalize services, improve the social interaction and independence of older people, and improve the quality of social services by supporting caregivers. From an organizational perspective, Khaksar *et al.* (2017) referred to providers of services to older people and described social robots as a means to transform and improve their existing business models, increase the quality of their services, and develop innovative service offerings. The authors noted that service delivery through social assistive technologies supported the process of value co-creation between service providers, caregivers, and people in need of assistance and improved well-being through transformative services (Ostrom *et al.*, 2015).

Niche themes

#Trust and senior online consumption (gray blue): The trust levels in mobile shopping vary across age groups. Studies in this cluster show the relationship between older people's willingness and trust to use information and services in an online context. Rajaobelina *et al.* (2020) confirmed the relationship among the cognitive, positive affective/sensory, negative affective, and social dimensions of mobile banking experience and trust. They found that the social dimension, which refers to the opportunity to interact with staff, was particularly relevant for individuals over 65 years of age in the context of mobile services, overall when the complexity of the transaction increased and trust in the online service or in oneself decreased. Therefore, social support is crucial and closely related to trust (Bae *et al.*, 2021). Heldal *et al.* (2020) found that older people lacked trust in eHealth information, especially when the symptoms or concerns were severe. In this case, dialog and social support from physicians, peers, and family could be very helpful for older adults, as they partially compensated for the lack of trust, which affects the eHealth literacy of the senior people and their ability to recognize, understand, evaluate, and critically apply eHealth information to solve health problems.

#Human-Machine interaction in long-term care (salmon). The papers in this cluster identify a strong connection between the topic of telecare and long-term care. For example, Grzybowski *et al.* (2017) identified a model to assess the utility of smartphones for the elderly as a proxy for the benefits of mobile telecare, while Tan *et al.* (2021) identified technological risks and five ethical issues in the use of robotics and autonomous systems in long-term care.

#Age-friendly design for mobile devices (turquoise). This cluster includes two very specific studies on mobile device usability and online mobile shopping. The first study, proposed by Iancu and Iancu (2020), discusses the role of design in the technology adoption process. They provided a specific theoretical overview of the main features that should be built into mobile devices to meet the needs of older people. In particular,

the authors argued that more user-friendly features were needed in terms of device design and menu and applications to improve the usability of mobile technology for older people. The second paper by Hou and Elliott (2021) addresses how consumer demographic characteristics and motivations may influence the mobile shopping intensity. In this context, the authors noted that ease of use was among the most important drivers of online and mobile shopping.

4. Discussion

This paper offers interesting new perspectives on innovation for the well-being of older people by tracing the current state and evolution of research on the silver economy and particularly the state of technological innovation in this area. To our knowledge, this is the first study to combine a systematic literature review and a quantitative bibliometric approach for the silver economy in the business and management literature. The study was developed through a funnel approach based on three levels of analysis, each characterized by a different focus.

The first level of analysis provides a broad overview of the field of the silver economy domain within Business & Economics and Operation Research and Management Science (WoS research areas). It covers topics (e.g., elderly, longevity, aging society, active aging, etc.) with a well-defined literature that was intentionally included because they are closely related to the silver economy, which is the focus of this paper. Three main research periods were identified: the formation (1985-2007), the transition phase (2008-2014), and the early development phase (2015-2022), where the focus of scholars' interest shifts from welfare expenditures due to the declining health of the elderly (1985-2007) to health policy, services (2008-2014), and technological change (2015-2022) to use opportunities of population aging to develop a growing and diverse market.

The second level of analysis addresses the thematic analysis of the field of the silver economy in the business and management literature. It shows the evolution of the themes - motor, basic, emerging, and niche - that characterize the research field in each of three subperiods: formation (i.e., 1985-2007), transition phase (i.e., 2008-2014), and early development phase (i.e., 2015-2022). The silver economy, active aging, and consumer behavior themes emerged for the first time in the early development period (2015-2022). These themes mark a relevant shift in perspective; they underscore the need for a new research agenda that moves from issues of age-related decline to new market opportunities that arise from positive and active aging.

The third level of analysis addresses the issue of technological innovation and the silver economy in the business and management literature. A quantitative and qualitative approach combines both thematic and cluster analysis to clarify the role and impact of technological change on the lives of older adults and evolution of the silver market.

Although the clusters focus on specific technological solutions for frail seniors in need of care and/or healthy and active seniors, some

general themes run through various research strands. For example, a basic theme in most clusters explains the critical factors that influence seniors' attitudes and behavioral intentions when using technology. The authors define and evaluate these factors considering existing models of technology acceptance, such as TAM (Davis, 1989) or UTAUT (Venkatesh *et al.*, 2003), or newer models such as STAM (Chan and Chen, 2014) and UTAUT2 (Macedo, 2017), which incorporate age-related health and ability characteristics of older people. Interestingly, certain determinants (e.g., the user-driven approach) of technology adoption and intention to use are piquing researchers' interest by raising new questions about the new role of seniors and their entire environment (i.e., active vs. passive recipients of technology), even in well-established topics, such as those related to telecare. Bjørkquist *et al.* (2015), Horton (2008), and Wilson *et al.* (2017) recognized the importance for service providers to view telecare as a complex system, where adaptability to the needs, expectations, knowledge, and skills of seniors and other users of the care system (i.e., professional caregivers, family, friends, etc.) has implications for its functioning. This highlights the importance of involving users in the process of designing, selecting, and implementing technological solutions (Gòmez, 2015; Leonardi *et al.*, 2009; Neven, 2015) to improve their usability (i.e., ease of use) and acceptance among older people. Recognizing the active role of older people requires a new, socially inclusive mindset to overcome ageist stereotypes. To this end, the changing role of the older technology user as a resource integrator should be considered (Edvardsson *et al.*, 2014; Vargo and Lusch, 2008). Technology for older users should be considered an actor in the service ecosystem (Storbacka *et al.*, 2016; Storbacka 2019), which can act on potential resources to co-create and/or destroy value (Caridà *et al.*, 2019a).

A similar approach is found in clusters #service innovation for elder care (gray) and #silver economy and gerontechnology (ocher). Some recent studies (Compagna and Kohlbacher, 2015) in these clusters go beyond the traditional view of technology as an instrumental and passive object; they emphasize the new role of technological solutions (e.g., social robots) as service innovators and catalysts for service innovation in elder care (Khaksar *et al.*, 2016) and as enablers of new practices and roles in the lives of seniors (Khaksar *et al.*, 2017).

In short, technological solutions must interact and evolve with the social and cultural context of older people (Gòmez, 2015) to accurately reflect their life experiences and enable them to actively participate in their own care. This approach reflects the general perspective of welfare technologies (Östlund *et al.*, 2015) and the emerging pillars of transformative social innovation (Pel *et al.*, 2020). It addresses the use of technologies for social purposes (Caridà *et al.*, 2019b) and leads to the development of new practices, patterns of aging that meet the needs of a more inclusive society, and new market opportunities, particularly in the area of active aging.

To harness the transformative power of technology in terms of social interaction, independence, social inclusion, and improved well-being, older people must become empowered users who control technology. Although older people actively use technology in many ways and for many

purposes (e.g., active aging, aging in place, etc.), this is not a given. As many scholars have noted, the digital divide and its associated consequences (social exclusion of older people) are high on policy-makers' agendas. To avoid this issue, policy initiatives (e-Inclusion Strategy) should align technologies with the values, needs, expectations and skills of older society as a whole and promote digital literacy at both national and European levels. They must include tailored support and education programs (Bechtold *et al.* 2017; De Paoli *et al.*, 2010) that enable seniors to handle everyday services that move online, such as e-government, e-banking, e-commerce, and e-health services. The success of the e-Inclusion strategy requires a shift in perspective from the aging individual (i.e., the micro level) to the aging society (i.e., the macro level). Thus, the question of how to provide new, meaningful opportunities for people in their third age is not a matter for a single organization or service provider but implies the responsibility (Caridà *et al.*, 2019b) of the entire society. Governments and other organizations must promote a social inclusion (dominant) logic to inspire and drive the development of new economic, social, and cultural contexts aimed at the well-being of society.

5. Further research

These findings have shown the lack of a comprehensive theoretical framework that combines the expectations of policy makers, businesses, and silver people in a win-win logic. This is likely due to the recent and highly fragmented debate on the role and impact of technological innovation on the silver economy in the business and management literature. In this regard, further studies should adopt a broad and transdisciplinary perspective to better inform research, policy, and practice and improve their coherence with current trends of aging populations in the real world.

To this end, scholars should combine the perspectives of social innovation (Caulier-Grice *et al.*, 2012; Rubalcaba, 2016; van Wijk *et al.*, 2019) and service ecosystem innovation (Storbacka *et al.*, 2016; Storbacka, 2019).

The service ecosystem innovation perspective (Storbacka *et al.*, 2016; Storbacka 2019) fosters interactions and resource integration among silver market network actors and facilitates the co-creation of technological solutions for social innovation purposes.

On one hand, this research perspective challenges many conventional foundations regarding older people's abilities, expectations, and behaviors, and the social context, where they seek to live longer and healthier. Moreover, it catalyzes several patterns of aging that stem from the emerging theme #service innovation for aged care (gray) and intersects established research strands of the silver economy (i.e., motor and basic themes).

Thus, to view the silver economy through the lens of social innovation and the service ecosystem, scholars should examine the following in depth:

- The role of local and central governments (i.e., policy makers) in orchestrating resource integration processes to holistically address aging opportunities and promote the silver economy at the national

and European levels. To truly transform the silver economy into a golden opportunity for society as a whole, governments must take on the novel role of service orchestrators (Breidbach *et al.*, 2016) to integrate technological innovation, business opportunities, and the social dimension of sustainable development. Accordingly, they must define, develop, and share common institutional arrangements (principles, rules, and social norms) that provide normative guidance for a social innovation culture (Bechtold *et al.*, 2017) at each level of the ecosystem (Edvardsson *et al.*, 2014) and incorporate the role of business in driving the next wave of innovation by focusing on social domains (Caulier-Grice *et al.*, 2012), such as demographic change and aging populations. Therefore, this line of research can make an important contribution to policy-relevant issues (e.g., the development of ICT solutions for the social inclusion of older people, (Butt *et al.* 2021; Flick *et al.*, 2020)), which are included in several clusters such as #ICTs for an aging society (brown) and #wearable technologies for active aging (green).

- The role of both silver people and technology in the broader context of aging society As we discussed, older people become resource integrators (Edvardsson *et al.*, 2014; Vargo and Lusch, 2008), especially when they are empowered to act in social and participatory ways through ad hoc training programs and activities that enhance their digital literacy. This finding is consistent with the United Nations Roadmap for Digital Cooperation (2020), which emphasizes the importance of linking digital inclusion and capacity building to human rights. In addition, technology is no longer just an instrumental and passive object but has become autonomy-enabling innovations for later life, which interact with the social and cultural context of older people (Gòmez, 2015; Khaksar *et al.*, 2016). Future studies in this research area can contribute to clusters such as #Service innovation for aged care (gray), #Wereable technologies for active aging (green), and #Human-Machine interaction in long-term care (salmon), which focus on the active role of older people and technology (e.g., Flick *et al.*, 2020).
- The models, processes (i.e., resource integration: Caridà *et al.*, 2019a; Kleinaltenkamp *et al.*, 2012) and activities to co-create social value and long-term and sustainable value for all ecosystem actors. In this context, researchers should focus on how seniors can be involved in the entire technology design process (Iancu and Iancu 2020). In this context, one should examine how seniors can be involved in all stages of the process, from needs assessment to testing, implementation, and adoption of technological solutions (Gòmez, 2015; Leonardi *et al.*, 2009; Neven, 2015). Therefore, further research in this area will significantly contribute to several clusters such as #Age-friendly design for mobile devices (turquoise) or #Telecare implementation process (blue), #ICTs for aging society (brown), and #Seniors' acceptance and use of technology (red).
- The different beneficiaries and types of value (i.e., economic, cultural, social) that result from the digital inclusion of older people. This direction will allow one to better harness the opportunities of the

silver economy and address the social challenges to transform the silver economy into a golden society.

This approach is not new but still challenging when the heterogeneous characteristics and demands of an aging society are considered. Moreover, as mentioned above, this perspective in the business and management literature provides a basis for further research and development in this area.

6. Theoretical contribution and managerial and policy implications

Discussions about the role and impact of technological innovation for older people have a common denominator based on the social impact of technological innovation and improving the well-being of older people. Although social issues are an important theme in research on the silver economy, different theoretical and practical perspectives of the studies show the lack of a comprehensive theoretical framework that links both social and business logics. Accordingly, this study opens up new research directions by calling for a broad and transdisciplinary paradigm that combines service ecosystem innovation and social innovation perspectives. It identifies several cornerstones (i.e., actors' roles, models of co-creation, processes and activities, codesign of technology for social purposes, and value) that require joint analysis to make the shift from the "silver economy," which is mainly about businesses and older individuals, to a golden opportunity for society of all ages. In summary, orchestrating and developing a meaningful service ecosystem for social innovation can address the challenges of current aging population trends and capitalize on opportunities.

From a managerial perspective, the study provides comprehensive insight into the opportunities and challenges of technology for the silver market. Identifying key problem groups through the systematic literature enables managers to better understand how to respond to stakeholder expectations and reap the benefits of technological innovation. In this sense, the analysis captures the economic opportunities of the silver market and social challenges that managers should consider when formulating business strategies and designing products for older people. Indeed, the current study shows how the interactions between technological innovation and older people can help companies achieve economic benefits. For example, when discussing the level of acceptance of technology by older people from different theoretical and practical perspectives, the analysis shows how innovation can increase the level of usability of technology by older people. This can help managers undertake product development initiatives that stimulate seniors' interest in purchasing products and services. In addition, our findings discuss the advantages and disadvantages that different types of technology design and applications have for older people. From this perspective, the current study enables product developers and managers to better understand which product features satisfy the needs of older people. In addition, our study provides insights for managers on integrating social aspects into business strategies and new product offerings.

From a policy perspective, our study recommends that policy-makers rethink their role and promote effective public policies for aging (i.e., social learning, senior entrepreneurship, etc.) to harness the potential of digital technologies and improve the social relationships and independence of older people in their living environment to enable active and healthy aging. Although the European Commission's program to promote the development of a fully inclusive digital society (European Commission, 2021) partially recognizes this goal, a general strategy is needed to drive changes in the social and cultural context beyond stereotypes and rethink the valuable role of older people in society.

7. Limitations of the study

This study has some limitations typical of most studies of a similar nature, such as the possible exclusion of research papers in the gray literature or the subjectivity bias of the researcher. Indeed, the classification and discussion of the study directions identified by the systematic literature review are inevitably influenced by the researcher's subjectivity bias (Boell and Cecez-Kecmanovic, 2015). To mitigate this problem, the discussion of the topic groups and associated relationships results from the coordinated analysis of four researchers. In particular, the initial and independent examination of various study strands, which was performed by each researcher, was jointly discussed to reach common agreements and increase the degree of objectivity.

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Appendix 1: Cluster themes and author's keywords

	Custer label	Keywords
Motor themes	#Elderly and Social Media (purple)	aging in place; connectedness; digital games; elderly; extended technology acceptance model; game narrative; gameplay intention; hierarchical regression analysis; hotel industry; internet addiction behavior; internet of things; interpretive structural modelling; isolation; sensors; service failure type; service recovery type; smart buildings; smart homes; smart technology; social media; systems design; technology; technology acceptance model; word-of-mouth behaviors
	#Assistive technology for aging in place (pink)	active aging; aging and design; aging population; aging in place; alarm pendant; assisted living technology; assistive technology; baby boomers; care robotics; consumer information; dehumanization; domestication; later life; mcdonaldization; older consumers; older people; older users; participatory; echnology development; scenario-based design; social shaping of technology; sts-driven design; telecare; user-driven design; welfare technology
	#Telecare implementation process (blue)	Care; case study; chronic obstructive pulmonary disease; community care; coordination; focus group interviews; health; information infrastructure; local health and care services; social care; socio-technical systems; systems design; tele-accompany; telecare; telecare and telehealth technology; total social organization of labour; work
Basic themes	#Seniors' acceptance and use of technology (red)	active aging; aging society; digital development; digital divide; digital learning; digital exclusion; households of elderly people; ict; influenced factors; information society; internet; internet use; mobile applications; mobile design; mobile devices; mobile internet; mobility narratives; new technologies; older people; online shopping; senior citizens; service quality; servqual method; smart environment; smartphones; social inspiration; sustainable development; technology acceptance model; transport innovation; transport service; transportation alternatives; use; user behavioral intention; utaut; virtual assistant - avatar
	#Silver economy and gerontechnology (ocher)	Aging; autonomy; care; configurational technology; consumers; continued use; cultural probes; design of domestic technology; elderly; france; gazelles; generification; gerontechnology; geront'innovation; health technology; innovation; morality; personal health systems; population aging; sectoral system; senior; silver economy; silver market; socio-technical arrangements; systemic approach; technological innovations; technology; telecare; use intention; user representation; wearable health technology
	#ICTs for aging society (brown)	aging society; ambient assistive technologies; digital competency; e-inclusion; foresight; forward-looking methods; health; horizon scanning; ict; ict services; knowledge map; ontology; participatory ta; responsible research and innovation; rri; silver economy; smart specialization strategy; smes; socio-technical imaginaries
	#Wearable technologies for active aging (green)	50+ consumers; active aging; alignment; biomedicine; birth cohort; elderly; entrepreneurial opportunities; ethnography; everyday technology; garment system; gerontechnology; health technologies; practice theory; silver economy; smart textiles; social innovations; user-driven innovation; wearable technologies; well-being
Emerging themes	#Service innovation for aged care (gray)	aged care; consumer vulnerability; dynamic capabilities; healthcare; implementation; older people; service innovation; social assistive technologies; social robots; social vulnerability; telecare; telemedicine
Niche themes	#Trust and senior online consumption (gray-blue)	baby boomers; banks; behavioral insight; customer experience; e-health; elderly consumers; financial institutions; health information; health literacy; knowledge acquisition; mobile phone; quality of life; relationship marketing; structural equation modeling; trust; user characteristics
	#Human-Machine interaction in long-term care (salmon)	aging society; autonomous system; ethics; gerontechnology; heuristics ergonomics; long-term care; long-term care; risk; robotics; smartphones; social robot; systematic review; telecare; usability
	#Age-friendly design for mobile devices (turquoise)	bargain hunting; convenience seeking; demographics; design; ease of use; elders; enjoyment seeking; innovativeness; mobile shopping; mobile shopping intensity; perceived usefulness; technology; user-centered

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