

A Bibliometric Analysis of the Emerging Trends in Silver Economy

G. Marcucci*, F. Ciarapica*, R. Poler**, R. Sanchis**

*Department of Industrial Engineering and Mathematical Science, Università Politecnica Delle Marche, Via Breccie Bianche, Ancona, 60131, Ancona, Italy; (e-mail: g.marcucci@staff.univpm.it, f.ciarapica@univpm.it).

**Research Centre on Production Management and Engineering (CIGIP). Universitat Politècnica de València. Calle Alarcón, nº1, Alcoy, 03801 Alicante, Spain (e-mail: rpoler@cigip.upv.es, rsanchis@cigip.upv.es)

Abstract: The economy of the future is experiencing a fundamental change in its structure, determined mainly by demographic factors. To this regard, the silver economy concept has been coined, relative to the consumer segment of people aged 50 or over. The present study aims at providing a state-of-the-art literature review about this field of research, using VOSviewer software, a freely available tool to construct bibliometrics maps. The analysis of these maps is presented, providing useful insight on the main topics within the silver economy field of study.

Copyright © 2021 The Authors. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0>)

Keywords: Silver Economy, Literature Review, Bibliometric Analysis, Bibliometric Maps, VOSviewer.

1. INTRODUCTION

The progressive ageing of population is an accelerated and inevitable phenomenon. It represents one of the main challenges for modern countries economy all over the World, with important economic and social consequences (Podgórnjak-Krzykacz *et al.*, 2020).

"The silver economy" study, commissioned by the European Commission, took into consideration the European population over 50 years of age, up to the over 100s, and indicated that 199 million Europeans, 39% of the entire population, are already the protagonists of this new economy and will become 222 million in 2025, reaching 43% of the population (European Commission, 2018). Therefore, the increase in life expectancy of the population, combined with the decrease in the birth rate makes the Silver Economy sector very attractive to any business.

Opportunities for development arise in all parts of the world. At first, they covered more traditional sectors such as health, housing and services; now they also break into more innovative ones such as technology, communication and artificial intelligence (Berthelot-Guiet, 2018; Carra and Tabia, 2020; Kohlbacher and Herstatt, 2010; Sikos T and Kovács, 2019). Rogelj and Bogataj (2019), in their analysis, focus on the assisted living market. They conduct a literature review on the housing solution business targeted to the silver market, proposing a research agenda for future development in this sector.

The present analysis contributes to the Silver Economy research field by performing a bibliometric analysis of the Silver Economy literature. The term "bibliometrics" was firstly coined by Pritchard, (1969), as an evolution of the traditional concept of statistical bibliographies. Bibliometrics oversees the quantitative study of production, growth, maturation, and consumption of scientific publications (Moral-Muñoz *et al.*, 2020). In turn, Small (1999) defines bibliometric mapping as a spatial representation of how

disciplines, fields, specialities, and individual documents or authors are related to one another. This study is conducted using VOSviewer, a bibliometric mapping software, which will be shown in the next section. This tool, by offering a comprehensive point of view of the broader literature, brings a key added value to the literature research in this field: through VOSviewer, in fact, the most widely used keywords are identified and then analysed by enumerating the connections among them, in terms of occurrence in the same research paper. The research is organized as follows: after the introduction, the second section introduces the research procedure. The third section shows the bibliometric analysis along with the trends of silver economy identified in the results. Last section presents the conclusions, providing indication on how to use this tool to identify potential gaps in the literature and answer to new research questions.

2. RESEARCH PROCEDURE

Bibliometric analysis is a methodology widely used in many research fields, e.g., medicine (Panagopoulos *et al.*, 2020), information science (Wang *et al.*, 2021), circular economy (Geissdoerfer *et al.*, 2017) or industrial engineering (Bevilacqua *et al.*, 2019). Due to the large amount of publications in many research fields in fact, bibliometric networks are an optimal tool to generate, visualize and structure the taxonomic classification of a specific topic while maintaining an optimal trade-off between comprehensiveness and clarity of results (Guzman and Trujillo, 2014). Chen (2017) contributes to highlight the objectives of bibliometric mapping. He specifies that this methodology allows to detect intellectual milestones and key areas of research in numerous different specific knowledge domains. It has to be stressed, in fact, that when approaching bibliometric analysis, the first step consists in selecting the most appropriate tool. After analysing different software tools and based on the reviews performed by Moral-Muñoz *et al.* (2020), VOSviewer has been selected to perform the present analysis.

VOSviewer is a freely available software tool developed for constructing and visualizing bibliometric maps. VOSviewer pays particular attention to the graphical representation of these maps. VOSviewer is particularly useful for displaying large bibliometric maps due to its numerous functionalities: e.g., zoom options, labelling algorithms, and density metaphors. The software tool was developed by the Centre for Science and Technology Studies at Leiden University (van Eck and Waltman, 2010).

3. BIBLIOMETRIC ANALYSIS

Cobo et al. (2011) define that the general plan of a bibliometric analysis involves data retrieval, pre-processing, network extraction, normalization, mapping, analysis, and visualization. Finally, at the end of this process, the overall study has to be interpreted in order to obtain conclusions from the results. Figure 1 shows a scheme of the bibliometric analysis methodological process.

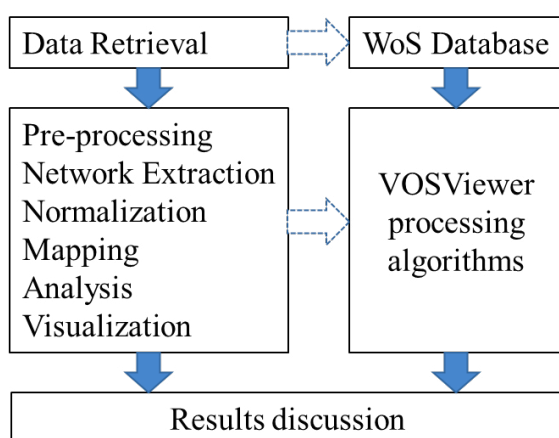


Fig.1: Bibliometric analysis methodology

The database to lay the basis for the bibliometric analysis has been built throughout a literature review. It has been carried out on the Web of Science database on the 2nd of November 2020. The search parameters were defined as follow (van Eck and Waltman, 2018):

- The keyword research parameters are summarized by the following Boolean expression: “Silver Economy” OR “Silver Generation” OR “Silver Market” OR “Silver Marketing” OR “Senior Economy” OR “Senior Generation” OR “Senior Market” OR “Senior Marketing”.
- To have a more comprehensive view of the evolution of the literature, the 1990-2020 timespan was selected.
- Only results classified in the following categories: Business, Engineering and Economics were chosen. The reason to focus on those categories lies on the fact that silver and senior issues are closely related to health and medicine issues. However, this research is out of the scope of such knowledge domains.

Through the application of these filters, 314 papers were identified. Subsequently, the dataset was exported and analysed through the software VOSviewer. This software provides different visualization methods. In this paper, the network visualization is used to exemplify the results in a clear manner. In the network visualization, the bibliometric maps contain items and links:

- Items: they are the object of interest. When interpreting the map, the higher the occurrence of an item, the larger the label and the circle of the item.
- Links: if two items are connected, i.e., they are found in the same research paper, they will be coupled by a link. Each link has a weight, represented by a positive numerical value, which shows how many times two items are connected. Moreover, when looking at the map, the closer two items are located to each other, the stronger their relatedness.
- Clusters: when visualizing the map, cluster of items related to each other are represented with the same colour. Items are clustered using a weighted and parameterized variant of modularity-based clustering (Newman and Girvan 2004).

3.1 Bibliographic Data Results

Firstly, a Co-Occurrence analysis based on bibliographic data is displayed in Figure 2. In this map, the items are represented by the keywords exemplified in each paper and the relatedness is determined based on the number of documents in which the keywords occur together. In order to find the optimal trade-off between comprehensiveness and clarity of results, a minimum number of 3 occurrence per keyword is chosen as threshold: 131 out of 1475 keywords meet this criterion. Analysing the map, the presence of some keywords captures the attention. For example, "senior tourism": the presence of this set of keywords indicates how the silver generation tourism sector is being studied and therefore represents a novel business frontier. It seems that recreation, especially regarding tourism and leisure time management, is one of the future avenues of research related to silver economy. One can also note the presence of "united states" as a relevant keyword: this shows that the trend of ageing and therefore the formation of this new market is also significantly crucial overseas. Moreover, as the market evolves, also the associated business strategies such as "Strategic management", "entrepreneurship", "product development" are some of the keywords representing this trend. Their presence testifies how the silver market is a real golden opportunity also for the long term, given the need for strategic planning. Another interesting keyword is, of course, "retirement": the retirement age, in fact, is a crucial input variable in the study of this subject and, since it differs from state to state, depending on the institutional laws, it has to be closely monitored in order to observe the trend in this market.

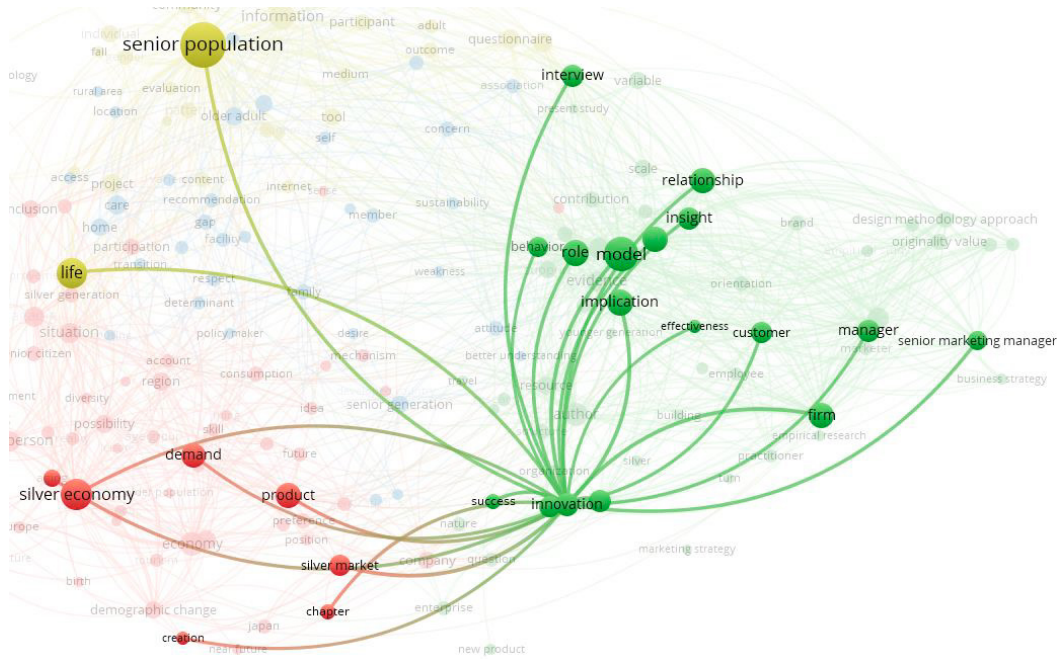


Fig.5: Co-Occurrence analysis based on text data.

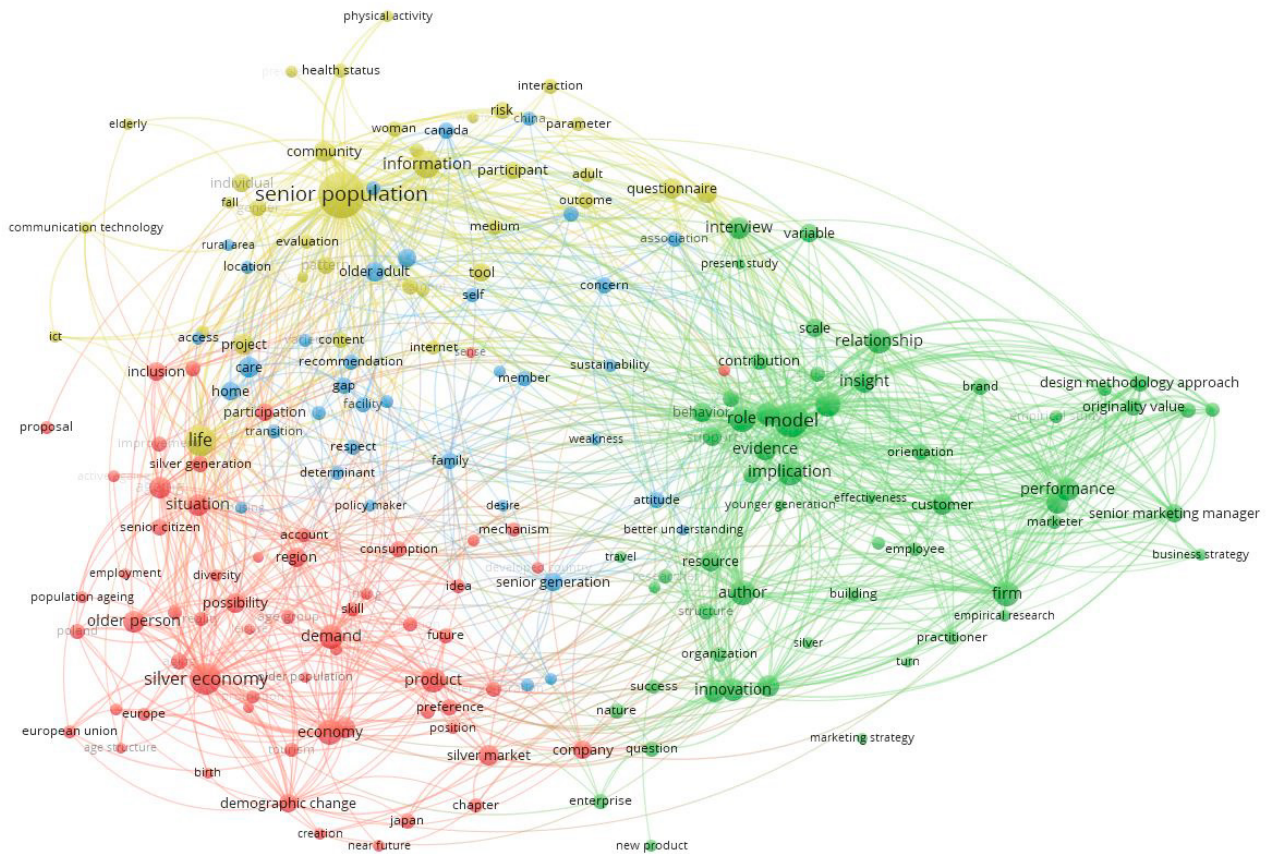


Fig.6: Co-Occurrence analysis based on text data: focus on “innovation” co-occurrence links.

3.2 Text data Results

The second study is a text-based Co-Occurrence analysis, displayed in Figure 5. In this map, the items symbolize the terms which occur in each paper and the relatedness is determined by the number of documents in which the terms occur together.

The terms are identified in the text data using natural language processing algorithms by the VOSviewer software. In order to find the optimal trade-off between comprehensiveness and clarity of results, a minimum number of 6 occurrences per term is chosen: 316 out of 7490 terms meet this threshold. For each of this 316, a relevance score is calculated by the software. Based on this score, the 60% most relevant terms are displayed in the map, equal to 160 items.

Analysing the text-data Co-Occurrence map, the presence of some keywords captures the attention. The red cluster comprehends, among others, the following items: “european union”, “europe”, “silver economy” and “demand”. The presence of this terms indicates that the silver economy is an important field of study among the present and future policies of European Union. Bran et al. study (2016) confirms such trend as they state that silver economy long-term repercussions are protagonists of several subject of active debate in European Union’s management, first of all in European Commission. One of the most crucial topics is the need of a long-term economic strategy focused on the division of work, welfare and care between the states of the EU, family and labour market, between and within generations. Research confirms that it is feasible to take advantage of the economic potential of all generations in Europe (European Commission, 2014).

Moreover, a focus on the keywords’ “innovation” and “inclusion” are shown respectively in Figure 6 and Figure 7.

In Figure 6 it is possible to observe how the term “innovation” is at the centre of three different clusters and directly connected to “senior population”, “silver economy” and “silver market”. These connections indicate that the expansion of this market is an important driver of innovation for new products and services, as shown also by the other linked terms, e.g., “product”, “success” or “creation”. In light of this, further efforts should be focused on new innovations to fulfil the demands of the silver economy such as technological developments (eHealth, telecare, integrated care or independent living).

Lastly, Figure 7 shows the connections of the term “inclusion”. This term can be interpreted as a mean to ensure that everyone can belong in a society, regardless of the presence of limiting elements, and terms such as “gap” and “community” can confirm this interpretation. The research is evidently focusing on how to facilitate the inclusion of older people: note, in fact, the presence of words such as “information” and “communication technology”, which may represent fundamental drivers to progress in this direction.

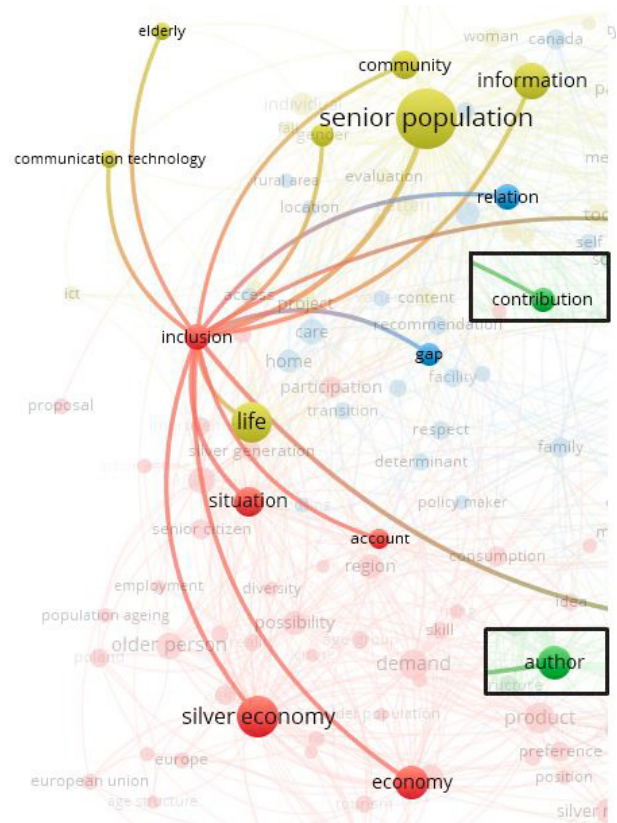


Fig.7: Co-Occurrence analysis based on text data: focus on “innovation” co-occurrence links.

5. CONCLUSIONS

This article provides an overview of the literature on the silver economy field of research, through the application of the VOSviewer software, a freely available tool which allows to create bibliometrics maps from a large amount of data. The methodology used in this research allows to have a complete picture of the state-of-the-art literature of a given topic. From this photograph one can then observe the presence of the most relevant keywords or terms and how they are linked. Nevertheless, in order to maintain an optimal trade-off between comprehensiveness and clarity of the results, bibliometric map do not go in-depth in the outcome analysis: indeed, if further research is required, a two-step literature review is needed, adding a more thorough study of the most relevant scientific papers.

This methodology has been applied in the field of the silver economy, i.e., the sum of all economic activities aimed at the population aged 50 and over, which is attracting considerable political attention from policy and decision makers around the world. Several key words have been found, so that current trends in literature can be more easily identified. On the other hand, this type of information can also make possible to observe any gaps in research, and thus direct scholars and researchers towards fields of study that are still partially unexplored.

For future developments, it is planned to use this methodology to investigate the topic more accurately: comparing sub-sectors and investigating which are the most active authors and countries, as well as which journals and conferences are most focusing on this topics.

ACKNOWLEDGEMENTS

This research has been supported by the “Programme to support the academic career of the faculty of the Universitat Politècnica de València 2019/2020” in the project ‘Enterprise and Supply Chain Resilience Enhancement’ granted to Dr. Raquel Sanchis who wish to thank Università Politecnica delle Marche, particularly the Department of Industrial Engineering and Mathematical Science for the support, during her stay, in the development of the present research.

REFERENCES

- Berthelot-Guiet, K. (2018), New media, new commodification, new consumption for older people, *International Conference on Human Aspects of IT for the Aged Population*, Springer, pp. 435–445.
- Bevilacqua, M., Ciarapica, F.E. and Marcucci, G. (2019), Supply Chain Resilience research trends: a literature overview, *IFAC-PapersOnLine*, Elsevier, Vol. 52 No. 13, pp. 2821–2826.
- Bran, F., Popescu, M.-L. and Stanciu, P. (2016), Perspectives of silver economy in European Union, *Revista de Management Comparat International*, Revista de Management Comparat International, Vol. 17 No. 2, p. 130.
- Carra, C. and Tabia, K. (2020), Smart home for seniors: Opportunities and challenges for AI, Vol. 2, presented at the ICAART 2020 - Proceedings of the 12th International Conference on Agents and Artificial Intelligence, pp. 967–973.
- Chen, C. (2017), Science mapping: a systematic review of the literature, *Journal of Data and Information Science*, Sciendo, Vol. 2 No. 2, pp. 1–40.
- Cobo, M.J., López-Herrera, A.G., Herrera-Viedma, E. and Herrera, F. (2011), Science mapping software tools: Review, analysis, and cooperative study among tools, *Journal of the American Society for Information Science and Technology*, Wiley Online Library, Vol. 62 No. 7, pp. 1382–1402.
- European Commission. (2014). Population Aging in Europe. Facts, implications and policies, available at: https://ec.europa.eu/research/social-sciences/pdf/policy_reviews/kina26426enc.pdf (accessed 7 December 2020).
- European Commission. (2018), The silver economy, available at: <https://op.europa.eu/en/publication-detail/-/publication/a9efa929-3ec7-11e8-b5fe-01aa75ed71a1> (accessed 28 November 2020).
- Geissdoerfer, M., Savaget, P., Bocken, N.M. and Hultink, E.J. (2017), The Circular Economy—A new sustainability paradigm?, *Journal of Cleaner Production*, Elsevier, Vol. 143, pp. 757–768.
- Guzmán Sánchez, M.V. and Trujillo Cancino, J.L. (2014), Los mapas bibliométricos o mapas de la ciencia: una herramienta útil para desarrollar estudios métricos de información, *Biblioteca Universitaria*, Vol. 16 No. 2, pp. 95–108.
- Kohlbacher, F. and Herstatt, C. (2010), *The Silver Market Phenomenon: Marketing and Innovation in the Aging Society*, Springer Science & Business Media.
- Moral-Muñoz, J.A., Herrera-Viedma, E., Santisteban-Espejo, A. and Cobo, M.J. (2020), Software tools for conducting bibliometric analysis in science: An up-to-date review, *EPI SCP*.
- Newman, M. E., & Girvan, M. (2004). Finding and evaluating community structure in networks. *Physical review E*, 69(2), 026113.
- Panagopoulos, D., Karydakis, P., Markogiannakis, G. and Themistocleous, M. (2020), Pediatric arterial ischemic stroke: Overview of the literature and of the most cited relevant articles, *Interdisciplinary Neurosurgery*, Elsevier, p. 100924.
- Podgórnjak-Krzykacz, A., Przywojska, J. and Warwas, I. (2020), Silver economy as a response to demographic challenges in polish regions: realistic strategy or Utopia?, *Innovation: The European Journal of Social Science Research*, Taylor & Francis, pp. 1–28.
- Pritchard, A. (1969), Statistical bibliography or bibliometrics, *Journal of Documentation*, New York, Vol. 25 No. 4, pp. 348–349.
- Rogelj, V. and Bogataj, D. (2019), Social infrastructure of Silver Economy: Literature review and Research agenda, *IFAC-PapersOnLine*, Elsevier, Vol. 52 No. 13, pp. 2680–2685.
- Sikos T, T. and Kovács, C.J. (2019), The Silver Generation as Potential Purchasing Power in Budapest: a Case Study, *Theory Methodology Practice: Club of Economics in Miskolc*, Vol. 15 No. 02, pp. 53–63.
- Small, H. (1999), Visualizing science by citation mapping, *Journal of the American Society for Information Science*, Wiley Online Library, Vol. 50 No. 9, pp. 799–813.
- van Eck, N.J. and Waltman, L. (2010), Software survey: VOSviewer, a computer program for bibliometric mapping, *Scientometrics*, Vol. 84 No. 2, pp. 523–538.
- van Eck, N.J. and Waltman, L. (2018), *VOSviewer Manual*, p. 51.
- Wang, X., Xu, Z., Su, S.-F. and Zhou, W. (2021). A comprehensive bibliometric analysis of uncertain group decision making from 1980 to 2019, *Information Sciences*, Elsevier, Vol. 547, pp. 328–353.