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Innovating for elderly people: the development of geront'innovations in the French silver economy

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ABSTRACT

The objective of this paper is to study the supply side of the silver market, which is usually neglected by research on this topic. Adopting a systemic approach to innovation, our main goals are to identify the nature of the innovations developed, the way innovations are created, and the issues related to their emergence and diffusion. Our research is based on an empirical study of the French silver economy, which consists in an enquiry carried out in Silver Valley. The results of our study lead us to suggest a new term 'geront'innovation' to qualify the various forms of innovations developed to cater for the needs of elderly people. We also put forward the importance of networking and open innovation strategies. Finally, the identified barriers to emergence and diffusion as perceived by the supply side of the market lead us to suggest recommendations to support the diffusion of geront'innovations.

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1. Introduction

Demographic evolutions generate significant risks for the increase in diseases, invalidity and dependence situations for older people. They also stimulate demand for new technological devices and services aimed at reducing these risks (Lorenzi and Xuan 2013). On the other hand, on the supply side, new scientific and technological developments (in robotics, domotics, the Internet of Things, NBIC) offer new perspectives in terms of the creation of businesses and the supply of new goods and services adapted to older people. In this sense, demographic change is considered to be one of the megatrends affecting science, technology and innovation (OECD 2016).

Elderly people constitute a potentially important market (due to their purchasing power and the growth of this population). To describe this, researchers have defined the 'silver economy' not as a separate sector, but as a set of productive and commercial activities transversal to existing sectors (health, leisure activities, housing, insurance, caring sector, ...) (Enste, Nagele, and Leve 2008). In France, in 2013, the French government proposed to build an economic *filière*: 'the silver economy', aiming not only to meet the needs of elderly people, but also to boost innovation, competitiveness and economic growth (Bernard, Hallal, and Nicolai 2013; MASS 2013).

While we can assume that people's ageing may have a positive impact on innovations, it is necessary to accurately study their economic potential. Research on the relation between demographic ageing and innovation has gained ground in recent years, focusing mainly on the use of technology

and on the characteristics of the demand side of the silver market. To assess the economic potential of innovations dedicated to the elderly, we propose to explore the supply side of this market: we seek to put forward the types of innovations, the categories of actors involved in their development, and the difficulties and constraints that may hinder their widespread diffusion. The objectives of this paper are to fill this gap identified in the literature, since research at the intersection of entrepreneurship, innovation management and people's ageing remains largely unexplored (Kohlbacher, Herstatt, and Levsen 2015).

This paper is based on an empirical study of the French case. We rely upon the open literature on the French silver economy and upon the results of an enquiry conducted in the French Silver Valley¹ from 15 December 2014 to 15 February 2015. It is organised as follows: Section 2 presents the literature review on the topics of the silver economy, silver markets, and innovation dedicated to elderly people. The theoretical framework is based on the systemic approach to innovation according to which new products, firms or markets emerge via a co-evolution of technological, social, economic and institutional systems (Freeman and Perez 1988) and on the economic mechanisms that contribute to the emergence and diffusion of innovation (RRI 2014). Section 3 presents the methodology of our empirical study on the French case, achieved through an enquiry in the French Silver Valley. Section 4 analyses the results and the economic potential of innovations dedicated to the elderly. It particularly focuses on the definition of geront'innovation, a term which according to us, increases understanding of the various forms of innovations dedicated to older people. The analysis also provides some insights on the identified constraints on the emergence and diffusion of geront'innovations. To conclude, section 5 and 6 discuss the results and present implications and future research.

2. Silver economy, technology and innovation: literature review

2.1. Demographic ageing and technology: the relationship reviewed

Demographic ageing is considered to be a major challenge for the twenty-first century (Lorenzi and Xuan 2013; Peine et al. 2015; OECD 2016). Research in this field mostly deals with the impacts of ageing on growth and productivity, the management of health and retirement systems, and the issue of wellbeing in old age.

In this context, technology tends to be considered as a kind of 'solution' to all the problems raised by population ageing. Technology can offer new solutions to older persons' needs, such as recovery, independence, lengthening of healthy life. Moreover, thanks to technological solutions, older people will be able to stay at home, thus alleviating the burden that weighs on health insurance systems. Finally, demographic change, generating a silver market, can be an opportunity for innovation and growth, as already stated by Drucker in 1985 (see also Kohlbacher and Herstatt 2011). Neven (2015) refers in that sense to a 'triple-win narrative', where policy makers, innovators and older people will equally benefit from the development and diffusion of technologies.

However, a major part of the literature analysing the relation between technology and population ageing focuses on the use of technologies by elderly persons. Many works have set out their potential or existing resistance and the conditions of acceptance of these technologies (Holden and Karsh 2010; Fischer et al. 2014; Peek, Wouters, and van Hoof 2014). In all cases, they have long been considered to be passive recipients of technology. A more recent perspective developed by Science and Technology Studies (STS) (see Peine et al. 2015) moves beyond the view of technology as a 'mere' solution, or beyond the separate analysis of users on the one hand (who may accept or reject technology), and technology on the other hand. Authors in this field argue the complex relation between science, technology and ageing, notably focusing on the transformative effect of science and technology on older people. In other words, they show 'how material culture and materiality have shaped the constitution of later life' (Peine et al. 2015, 3), and how this particular relation has to be taken into account when developing new products and services, when studying the impacts of technology on older people, and the characteristics of the silver market.

In the field of management and business studies, the analysis of the 'graying market' or the 'silver market' focuses mainly on the demand side (Kohlbacher and Herstatt 2011), especially market conditions (is it a homogenous market or a segmented one?), the characteristics of this particular kind of users, and their needs. Recent research sets out the heterogeneity of these particular consumers who may, for example, be healthy and active or may suffer from chronic disease, dementia or cognitive impairment. For example, Sixsmith (2013) studies the roles that ICT devices and services play in each of these cases. It is thus crucial to know the needs and desires of older people in order to develop products and services that are more marketable because they are adapted to their needs.

One aspect that makes the link between the demand and the supply side of the silver market is the issue of design. Scholars mainly analyse the type of design needed for elderly users. Is it a specific design or a universal one? According to Gassmann and Reepmeyer (2011), products should be attractive for both younger and older consumers; such a universal design is the key to success. Another issue is why and how to integrate users in the design of new products and services? Many recent papers deal with the need, but also the difficulties to develop user-driven perspectives (Sixsmith and Gutman 2013; Compagna and Kohlbacher 2015).

Research focused on the supply side of the market has received much less attention in the literature. As stated by Kohlbacher, Herstatt, and Levsen (2015, 82), 'research at the intersection of entrepreneurship, innovation management, and demographic change is still in its infancy'. The authors argue that demographic change can give rise to entrepreneurial opportunities to meet the needs of older people. Studying entrepreneurial action as a two-stage process involving opportunity recognition and opportunity exploitation, they make the link between the supply side (origin of the innovation) and the demand side (exploitation of the opportunity and thus diffusion on the market). Adopting a systemic perspective, which particularity implies taking account of the historical, social and institutional context of innovation development (Witt 2008; Lazaric 2010), our aim is to study some of the issues that remain unexplored regarding the characteristics of the supply side of the emerging silver market. What are the forms taken by innovations: are they technology-driven? Are there other types of innovations? What are the characteristics of the innovation process: is it an individual or a collective one? What are the difficulties encountered by entrepreneurs when they launch their business and innovate in the silver market?

Enhancing knowledge on this side of the market will not only help researchers, but also politicians and entrepreneurs, in understanding the newness of this market and its economic potential. It will thus complement studies more focused on the demand side of the silver market. To develop these ideas, we need to come back to the economic theory of innovation, highlighting the contributions of the systemic approach which provides some grounds for analysis of the emergence and the diffusion of innovation.

2.2. Emergence and diffusion of innovation: a systemic approach

As mentioned, our three main issues are related to the nature of innovation, the characteristics of the innovation process (individual or collective), and the difficulties (lock-in factors) faced by the innovators.

On the first aspect, there is nowadays a consensus among economists to consider that technology, and more broadly innovation, is a powerful engine of economic growth. Pioneer authors interested in innovation were indeed largely focused on technology. In the Schumpeterian perspective, innovations, especially in their technological form, have a boosting effect on the supply as well as on the demand side of the market (Schumpeter 1934). The major role of technology is also present in the evolutionist neo-Schumpeterian approaches dealing, for example, with the formation and impacts of 'technological paradigms' (Dosi 1982) or the role of 'general purpose technologies' (Bresnahan and Trajtenberg 1995). However, innovation cannot be reduced to technological progress. Indeed, other forms and trajectories of innovation, namely organisational and service innovation, are gaining ground in our knowledge-based economies (Gallouj 2002). The current definition of

innovation by the OECD (2005) acknowledges this, since four types of innovation are identified: *product*, *process*, *marketing* and *organisational* innovation. Literature offers many terms and concepts to qualify innovation dedicated to the elderly. For instance, 'Gerontechnology' (Bouma and Graafmans 1992) was at first defined as a scientific field but is currently used to identify products and technology devices that cater to the needs of older people. It also appears as a 'multidisciplinary model that uses technology to innovate in the geriatric field' (Petermans and Piau 2017). 'Gerontechnological innovation' (Neven 2015), 'silver innovation' (Kohlbacher, Herstatt, and Levsen 2015), 'welfare technology' (Ostlund et al. 2015) are also used. In these expressions, the focus is mainly on technology or, more generally, neither the scope of the innovations nor their relation with scientific and technological fields have so far been accurately defined. We may consider that, like in other fields, innovation dedicated to older people is not restricted to technology (products, processes) but also involves new organisations and marketing innovations in a systemic combination.

Our first hypothesis (H1) thus concerns the *nature of innovations*:

H1: Innovations dedicated to elderly people are not only of a technological nature (product and process) but can also include other forms (organizational, marketing).

The second aspect deals with the origins of innovation. Entrepreneur is nowadays considered to be a central character of innovation and economic growth (Audretsch, Keilbach, and Lehmann 2006). The knowledge spillover approach (Agarwal, Audretsch, and Sarkar 2013) puts forward the diffusion of knowledge promoted by entrepreneurs connected to companies and other institutions like universities. These networks support a continuous phenomenon of 'creative construction'. Networks linking industry (entrepreneurs, larger companies), universities, and government are acknowledged to be the most efficient institutional arrangement for innovation (Etzkowitz and Leydesdorff 2000; Laperche and Uzunidis 2010). They are considered to be the best way to gather all the required competencies and to reduce the length and cost of the innovation process. They are a major illustration of the co-evolution of technological, social and institutional systems (Aalbers and Dolfsma 2015). In innovation studies, researchers refer to 'open innovation processes' to study the way networks are built, their functioning and the benefits, but also the difficulties in setting them up (Chesbrough 2003). In sociology, the social construction of technology approach (SCOT, Pinch and Bijker 1984) identifies the 'relevant social groups' (institutions, organisations, organised or unorganised groups of individuals) that contribute to the development of technological artefacts. Thus, the current approaches of the innovation process in economics, management, and sociology insist on the fact that technology (and innovation) is not a 'black box' but the result of systemic interactions generating co-construction by stakeholders involved in this process. Our second hypothesis (H2) thus relates to this systemic approach to the innovation process.

H2: As in other innovative sectors, networks and open innovation processes play a major role in the co-construction of innovations dedicated to elderly people.

The third aspect refers to the fact that many difficulties may arise all along the innovation process, from the supply or from the demand side of the market. This can result in the insufficient diffusion of new products and services, processes, organisations, and in the dominance of certain technologies on markets, despite potential inefficiencies. Researchers in the innovation economics field refer to these difficulties using the concepts of 'lock-in' or 'switching cost' and 'path dependence'. In lock-in situations, a technology becomes dominant because it benefits from increasing returns to adoption which ensue from network externalities, economies of scales in production, learning effects, infrastructure availability, etc. (Farell and Saloner 1985; Katz and Shapiro 1985, 1986, 1994; Cowan and Gunby 1996). Applying the notion of lock-in to companies in the context of eco-innovation, Cecere et al. (2014) insist on the role of routines as a source of lock-in or unlocking. Being 'successful solutions to particular problems' (Dosi, Teece, and Winter 1990) and forming as such a firm's 'organizational memory' (Nelson and Winter 1982), routines can boost the emergence of new technological

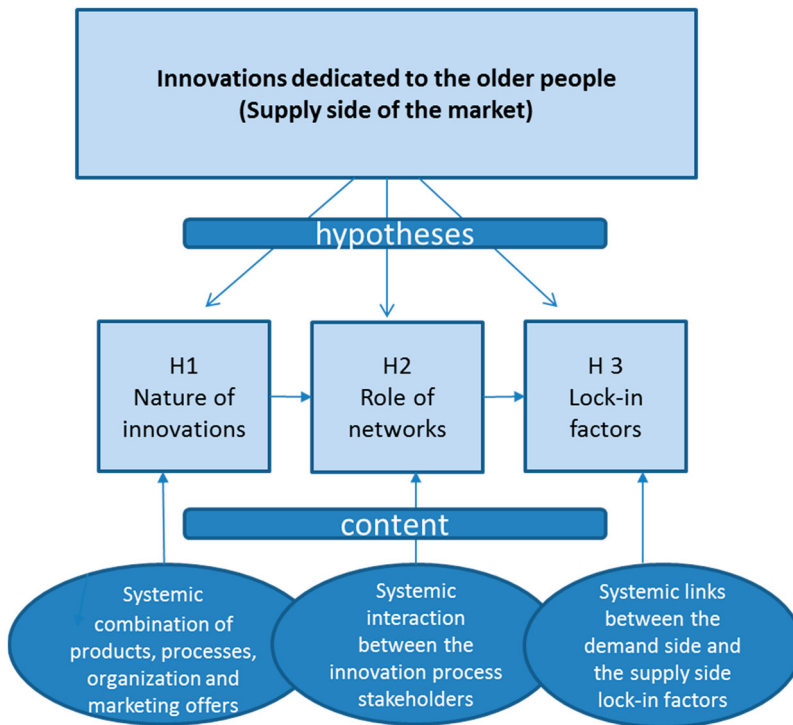


Figure 1. A systemic approach to the emergence and diffusion of innovations dedicated to the elderly. Source: Authors

trajectories, but the core competencies that comprise them can also be the source of ‘core rigidities’ (Leonard-Barton 1992) prejudicial to the emergence of new products, processes and organisations. The evolution of routines may be hindered by the lack of skills and competences, but also by the financial cost incurred in such adaptation of routines. From the demand side, users can be resistant to change and face switching costs when a completely new product or service appears on the market. These can refer to search costs, transaction costs, loyalty customer discounts, customer habits, emotional cost, and cognitive efforts, and be linked to financial, social and psychological risks on the part of the buyer (Fornell 1992; Schiavone, Simoni, and Tresca 2015). In the case of eco-innovation Lazaric and Oltra (2012) refer to ‘behavioural lock-in’ to study such resistance by the demand side of the market. All of these lock-in factors may cause path dependence which expresses the idea that the change in a technological trajectory (e.g. the acceptance of more or less radical innovations) is affected by decisions, investments and routines developed in the past (Nelson and Winter 1982). Our third hypothesis thus relates to the barriers that may hinder the development and diffusion innovations dedicated to older people. Most of the literature focuses on the demand side of the market, but some lock-in factors can emerge from the supply side, on which we mostly focus in this paper.

H3: In the case of innovations dedicated to older people, lock-in factors stem not only from the demand side of the market but also from the supply side.

Figure 1 presents our research model, and our three hypotheses.

3. Methodology: an analysis of the French silver economy

Our empirical study aims at applying this theoretical framework to the case of innovations developed to meet the needs of older people, especially focusing on the French case.

3.1. The emergent silver economy in France

In a systemic approach, the role of the economic context is determining in the explanation of the innovation process. In France, according to INSEE, people of more than 60 years old represent around a quarter of the population. On 1 January 2015, 18.4% of people were aged at least 65. In 2005 the share of people aged at least 75 was 8% and reached 9.1% in 2015. Longer life expectancy and the increasing age of the baby boomer generation are the main factors in this ageing. Life expectancy should rise from 81 years today to 86 years by 2050. In 2050, 22.3 million people will be aged 60 or over, against 12.6 million in 2005. This means an increase of 80% in 45 years. It is between 2006 and 2035 that this increase should be strongest (from 12.8 to 20.9 million), with the arrival at these ages of many baby boomers, born between 1946 and 1975.

To face this challenge and to try at the same time to transform a threat into an opportunity, in 2013 the French government proposed to build an economic *filière* – ‘the silver economy’. It is defined as a set of economic and industrial activities that benefit seniors, in terms of increased social participation, improved quality and comfort of life, reduced loss of autonomy, and increased life expectancy (Bernard, Hallal, and Nicolai 2013; MASS 2013). As in other older definitions (Enste, Nagele, and Leve 2008), the silver economy is not defined as a specific sector but as a set of activities that are transversal to the sectors that compose the productive system. This new *filière* is also intended to be an economic and industrial opportunity that should result in new businesses and jobs.

The Directory of the French silver economy presents 13 main categories of activities in which 1438 companies and institutions are active (Figure 2).²

3.2. Enquiry on the French silver economy

Our empirical study is based on an enquiry conducted in the French Silver Valley from 15 December 2014 to 15 February 2015. Silver Valley is a French Cluster that brings together silver economy private

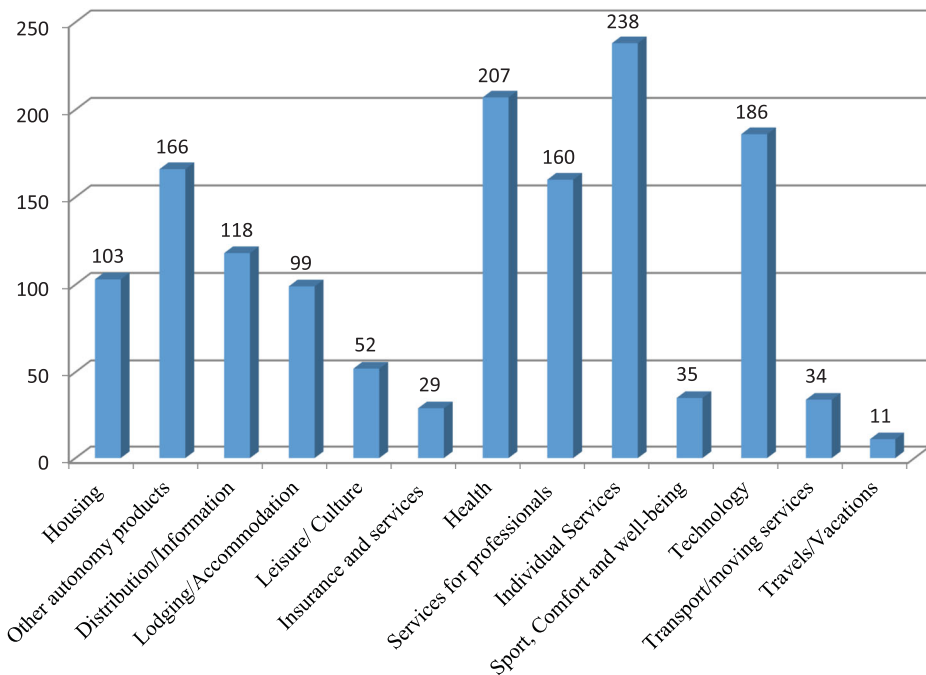


Figure 2. The French silver economy, distribution of companies and institutions according to their activities. Source: Authors' elaboration based on the data of the Ministère des Affaires Sociales de la Santé et des Droits des Femmes (2013).

and public actors in the Paris region. The cluster aims to foster the conditions favourable to the development of the senior market at a national and international level. The survey was administered by Silver Valley, via the Internet. The 180 members of Silver Valley at the date of contributions on 18 December 2014 were asked to respond through an internal release. The questionnaire includes the company's profile, the activity carried out, the type of innovation developed (nature of the supply-product/service), R&D activities, partnerships, the company's market and the strengths of, and barriers to, the dissemination of innovations dedicated to older people. The questionnaire was processed using XLSTAT software.

A total of 51 companies from Silver Valley (28.3% of total members) have responded. Among these, 31 are micro-enterprises, 11 are SMEs, 3 are medium companies, and 6 are large companies. 84% of the total of companies surveyed are concentrated in the service sector and of these approximately 38% are in business services, working in B2B.

4. Analysis of results

4.1. A definition of geront'innovations

The term *gerontechnology* was first used in 1989 and defined as 'the study of technology and aging for ensuring an optimal technological environment of all aging and old people up to a high age' (Bouma and Graafmans 1992). The term was then commonly used to refer to the innovations catering for the needs of older people (Gimbert 2009; Broussy 2013). However, these innovations cannot be reduced to technological products or processes, as revealed by our survey. When the companies of Silver Valley are asked to qualify the type of innovation they perform, 37 declare that they innovate in terms of services, 32 develop new products, 22 develop marketing innovations, and 19 carry out organisational innovations (several answers were possible). Ultimately, 36 respondents (out of 51 respondents, 70.6%) consider that their innovations consist of 'solutions' combining the previously mentioned forms of innovations (Figure 3).

To describe the kind of innovations dedicated to older people we thus propose the concept of geront'innovation, which is adapted from the OECD's definition of innovation presented in Section 2.2 (OECD 2005). Geront'innovation can then be defined as the implementation of a new or significantly improved product (a good or service or a combination of these) or process, a new marketing method, or a new organisational method to the benefit of fragile and dependent old people. In our results, the importance of 'solutions' (combinations of products, processes, organisational and marketing innovations) demonstrate the systemic links between the various forms of innovations (RRI 2016).

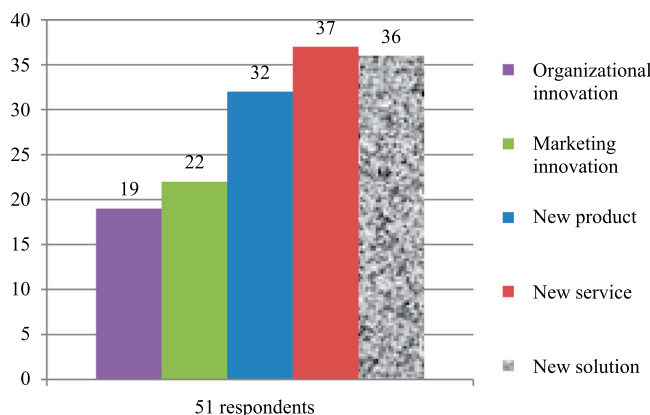
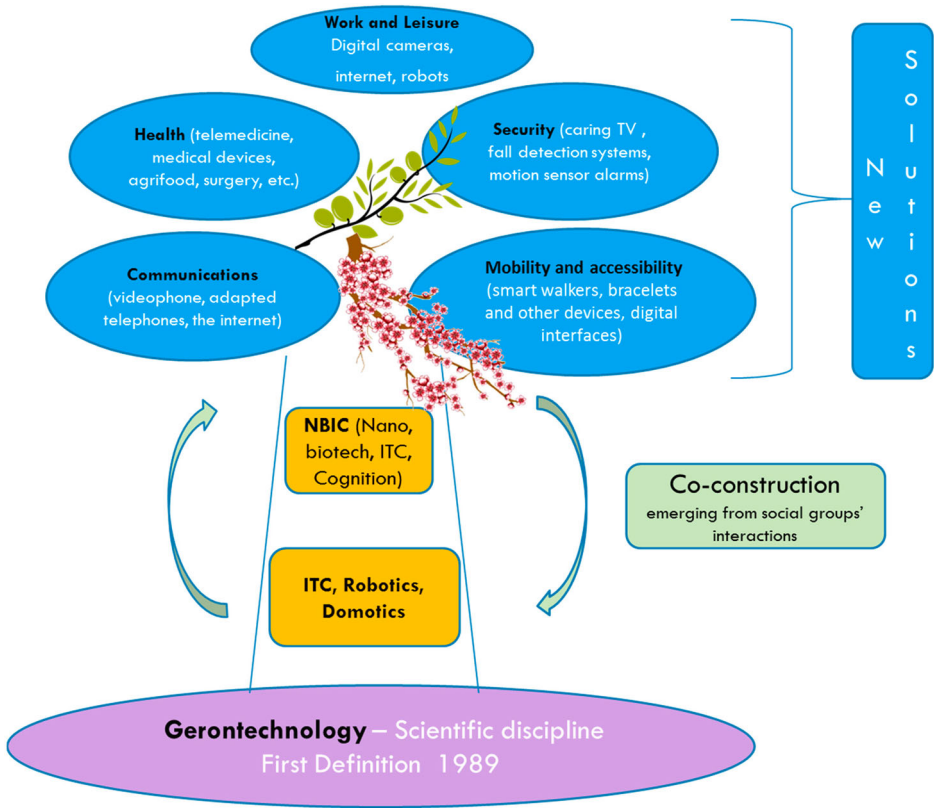


Figure 3. Type of innovation developed in the silver economy (number of answers). Source: Authors.



Scheme 1. From gerontechnology to geront'innovations. Source: Authors.

Geront'innovation integrates (a) gerontechnology defined as a scientific discipline (Bouma and Graafmans 1992); (b) the key technologies, which are ICT, NBIC, robotics and domotics; and (c) the various products, services, commercial and organisational methods developed for older people, and most often taking the form of solutions combining these. They can, for example, be related to communication and social links (videophone, adapted telephones, the Internet, robots), security (caring TV, fall detection systems, motion sensor alarms), health (telemedicine, medical devices etc.), mobility and accessibility (smart walkers, bracelets and other devices, digital interfaces), etc., as depicted in Scheme 1.

Using the term geront'innovations to describe the innovations developed in order to cater for the needs of the elderly has several advantages: it extends the issues associated with gerontechnology to other types of innovations (services, organisations, business models) and does not limit the debate only to the technological part of these innovations. It also paves the way to an analysis of the production process of these innovations and does not restrict the discussion on demand aspects (satisfaction, adaptation to end-users etc.) which is the subject of the literature in this field. Finally, it shows that it is not a linear process but that scientific and technological fields are connected to each other through the contribution of different social groups that will shape the final forms of the artefacts, organisations and services. In the next paragraph we identify - at the level of the enterprise - the social groups contributing to the development of geront'innovations.

4.2. The co-construction of geront'innovations: the role of networks

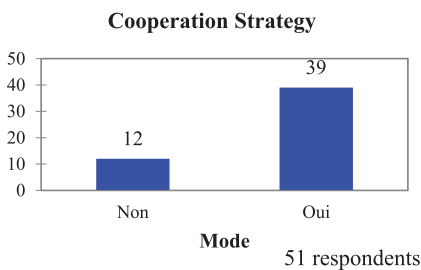
The offers of the French silver economy's companies (from the results of our survey in the French Silver Valley) are not developed individually but are the result of a collective and open innovation processes.

The majority of our respondents (76%) cooperate with partners to develop their offer. The strategy of open innovation (Chesbrough 2003) is widely used by businesses, which corresponds to a common practice in terms of innovation management, regardless of the sector (Laperche 2017).

Partnerships are multiple and involve several social groups: public research institutions, suppliers and customers, alongside other partners or competitors. These partnerships are primarily based in France. The main partners with which companies cooperate are first suppliers (cited 28 times) and then buyers through B2B relationships (cited 28 times). It is important to note, however, that companies also develop relationships with clients as part of B2C relationships (cited 21 times) or associations (mentioned 23 times). Partnerships with public research seem relatively less frequent (quoted 19 times) (Figure 4).

Our survey thus clearly shows the role of 'open innovation' in the silver market. As a matter of fact, entrepreneurs cannot develop innovations alone due to the related costs and various competences required by the 'solutions' proposed. Big companies also need the spur of ideas coming from entrepreneurship and startups. Open innovation and networking strategies are indeed a strong tendency, whatever the sector studied. Cooperating with partners is a way to reduce the cost and length of the innovation process, as well as to gather the competences and skills needed. Taking part in a cluster (in France labelled a 'pole de compétitivité') thus gives access to a wide range of advantages: social networks, improved image, access to knowledge, complementary resources and new markets.

All these partners are social groups that are holders of specific motivations or views on the functions of these innovations (e.g. simplicity of use, cost, image of solutions in the fields of health, communications, mobility). The analysis of these various and sometimes conflicting motivations goes beyond the scope of our enquiry and is not studied in this paper. However, it is important to note that they will shape the final form of the artefacts, services, organisations and marketing methods developed and diffused on the markets. This is in line with the contribution of the social constructivist approach of technology evoked in section 2.



| Type of partnership | Number of answers |
|----------------------|-------------------|
| Suppliers | 28 |
| B2B client | 28 |
| Association client | 23 |
| B2C client | 21 |
| Public research | 19 |
| Startup | 18 |
| Business competitors | 14 |
| Other companies | 11 |

Figure 4. Cooperation strategies. Source: Authors.

4.3. Barriers to the emergence and diffusion of geront'innovations

We distinguished three categories barriers to the development and diffusion of the innovations: resource barriers (scientific and technical, human and financial), the existence of a demand (social need and effective demand), institutional and regulatory support.

Regarding resource barriers, the financial constraints appear to be the first obstacle (56.9% of the respondents consider it to be a very significant obstacle and 27.5% as a quite significant one). The availability of other resources (like skills and competences) is not considered to be an important obstacle for more than half of our population. This is the same for technical progress, which is not seen as a barrier by over 66% of respondents.

Ethical and psychological barriers (resistance to change, social acceptance of innovations dedicated to the elderly) are the second most important obstacle after financial constraints. These behavioural lock-in factors are considered to be a moderate or very important obstacle by 72.5% of respondents. The solvency of the market (economic barrier) is the third most important obstacle highlighted by over 68% of responses (quite or very significant obstacle). Barriers in terms of communication and marketing (age stigma is considered as an inhibitor by nearly 65% of respondents).

Institutional and regulatory barriers have also been emphasised by the respondents. The most important barrier in this category is institutional barriers (e.g. inadequate public policy) which are considered to be quite or very significant by 60% of respondents, against about 53% of respondents who consider that legal barriers are a very or very significant obstacle (e.g. technical regulations in retirement homes) (Figure 5).

Our enquiry does not reveal lock-in factors in terms of switching costs from an 'old' to a 'new' technology, nor in terms of existing routines that would hinder the change in a technological trajectory. The lock-in factors that emerge from the supply side of the silver market are mainly related to financial aspects. These are linked to the financial resources needed to adapt existing technologies (namely digital ones) to the needs of older people and notably to develop other forms of innovations (solutions) than technological ones. Moreover, these lock-in factors from the supply side of the silver market supplement the more well-known ones that emerge from the demand side.

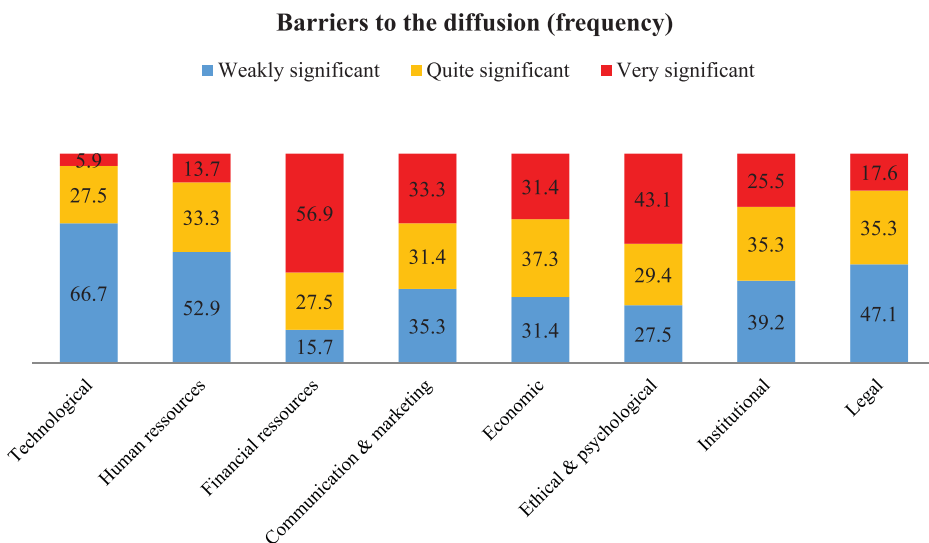


Figure 5. Barriers to the development and diffusion of geront'innovations. Source: Authors.

5. Discussion and conclusion

This article aimed to study the characteristics of the supply side of the silver market in order to assess the role of demographic ageing on innovative developments. Indeed, demographic change arouses the interest of entrepreneurs and large companies which try to seize this opportunity to develop new markets. To sum up our results, we can state that our first hypothesis (H1) on the nature of innovation is validated: innovations dedicated to elderly people are not only of a technological nature. They often take the shape of 'solutions' combining several forms of innovations. This is why we suggest a new term 'Geront'innovations' to name them. This result complements the existing literature on our subject which mostly highlights technological improvements.

Our second result is related to the importance of network and open innovation strategies. Hypothesis 2 is largely borne out by our empirical study: networks and open innovation processes play a major role in the development of geront'innovations, mainly due to the cost, but also the need for diversified skills and competencies to build the required 'solutions'. Our systemic approach stresses the role of networks and of open innovation strategies as well as the contribution of various social groups in the emergence of geront'innovations. It thus combines these current managerial and sociological concepts for a better understanding of the co-construction of innovation, usually studied in separate fields.

However, the diffusion of geront'innovations still faces lock-in situations. Our third hypothesis is also borne out by our empirical study: in the case of geront'innovations, lock-in factors not only stem from the demand side of the market but also from the supply side. These lock-in factors interact since the adaptation of innovations to the needs of older people and the financial resources dedicated to it implies co-construction and thus a reduction in the behavioural lock-in. On the demand side, apart from the ethical and psychological aspects, the solvency of the market is also an important aspect. Moreover, a third kind of lock-in factor, related to an insufficient institutional support, has also been identified. This result is original in the sense that it highlights the complexity of lock-in factors and the necessity to study them from both sides of the market.

6. Implications and future research

These results have important implications, in terms of public policies, managerial strategies and open up new path for future research. As a matter of fact, the emergence of a growth path based on the silver economy and geront'innovations remains dependent on removing these blocking factors. The consolidation of the silver economy certainly requires coordinated actions by public policies (industrial policy, institutional support through clusters & networks, social policy, distribution of income) and business strategies (implementation of new business models, a collaborative management of innovation processes).

In terms of public policy, the implementation of an incentive innovation policy (specific research programmes, tax incentives, and support for collaborations) to stimulate entrepreneurship and consolidate the industry remains central. The examples of public policies implemented in other countries like Japan, Germany and South Korea could be a source of inspiration in this field (Reboud and Tanguy 2016). At the same time, our results show that innovation has several forms and hence, public policies should not only focus on technological development but also on social innovation (Djellal and Gallouj 2012; Haga 2018).

The question of the business models facilitating the dissemination of geront'innovations seems to be essential, taking into account the issue of market solvency. On this point, the functional economy model (rental contracts with individuals or organisations) can appear to be an interesting solution. The functional economy includes the development of product-service systems and leads to the substitution of the sale of a product by selling a service (Laperche and Picard 2013; Boutillier, Laperche, and Picard 2014). The technical product is made available to the client (or user) through a leasing contract. The ownership of the property remains in the hands of the producer. The functional

economy model can be applied successfully to many geront'innovations. In this context, 'silver functionality' would become not only a sustainable growth factor but also an inclusive one (for older populations, fragile and dependent). Renting a service (e.g. the use of a strap connected robot or social assistance) is less expensive than purchasing it and its use is facilitated by the 'connection' to the product services' platform. This is the business model of some companies operating in the silver economy that are experiencing strong development (e.g. Bluelinea, specialising in health connected objects). However, other blocking factors exist in terms of the generalisation of this type of model. They are related to the insufficient development of platforms dedicated to the management and exchange of data and bringing together the actors of connected object communities in different areas. The increasing development of platforms in other industries (Porter and Heppelmann 2014, 2015) could foster their development in this 'filière' in the near future.

This study was based on quite a small population of companies identified through Silver Valley. Notwithstanding the fact that it is a limitation of this study, it is, however, according to our knowledge, the first one in France, and among the few that focus especially on the supply side of the silver market. Future research will try to study in more detail the final shape and characteristics of the innovations developed for older people. This means understanding the motivations and the relative strength of the partners (social groups) involved in the innovation process. This would give the possibility to assess the differences between innovations dedicated to older people (geront'innovations) and those developed for other target groups. Another research perspective is to increase the population of companies studied in France and to make some comparative analysis with other countries. Finally the digitisation of the industry and the development of platforms could be an interesting field to study as it could influence new business models in this silver industry.

Notes

1. Silver Valley is a French Cluster that gathers silver economy private and public actors in the Paris region. The organisation fosters conditions favourable to the development of the senior market at a national and international level, see more on <http://www.silvervalley.fr/English-version>.
2. Remarks: (1) The total number of companies and institutions is actually 655. The difference is due to the fact that some of them are present in several categories. (2) The Directory of the French silver economy not only includes companies but also nonprofit organisations.

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