

The Healthy Ageing Challenge: Defining Innovation and Shaping Support in a Hybrid Domain

Report prepared by:

Jen Nelles (Oxford Brookes University)

Lauren Tuckerman (Oxford Brookes University)

Nadeen Purna (Oxford Brookes University)

Tim Vorley (Oxford Brookes University)

www.innovationcaucus.co.uk

Authors

The core members of the research team for this project were:

Dr Jen Nelles (Innovation Caucus, Oxford Brookes University)

Dr Lauren Tuckerman (Innovation Caucus, Oxford Brookes University)

Nadeen Purna (Innovation Caucus, Oxford Brookes University)

Professor Tim Vorley (Innovation Caucus, Oxford Brookes University)

Acknowledgements

This research was commissioned by Professor Judith Phillips, Director of the Social, Behavioural and Design Research programme which is funded by the Healthy Ageing Challenge. UKRI's Healthy Ageing Challenge is delivered jointly by ESRC and Innovate UK. We are very grateful to the project sponsors at UKRI and advisors from the Social Behavioural and Design Research programme of the Healthy Ageing Challenge for their input into this research. The interpretations and opinions within this report are those of the authors and may not reflect the policy positions of UKRI. We would also like to acknowledge the contribution of [glass.ai](#).

About the Innovation Caucus

The Innovation Caucus supports sustainable innovation-led growth by promoting engagement between the social sciences and the innovation ecosystem. Our members are leading academics from across the social science community, who are engaged in different aspects of innovation research. We connect the social sciences, Innovate UK and the Economic and Social Research Council (ESRC), by providing research insights to inform policy and practice. Professor Tim Vorley is the Academic Lead. The initiative is funded and co-developed by the ESRC and Innovate UK, part of UK Research and Innovation (UKRI). The support of the funders is acknowledged. The views expressed in this piece are those of the authors and do not necessarily represent those of the funders.

About glass.ai

[glass.ai](#) has built a new AI capability that reads and understands the web's content at scale about businesses, people, and other areas. The [glass.ai](#) engine has already mapped and monitors a very large part of the UK economy based on its web presence. It regularly reads the websites and social media presence of 2M+ businesses in the UK across sectors and geographies. Government organisations, universities, trade associations, consultancies and corporates use the AI system to research and monitor companies, sectors and geographies. Learn more at: <https://www.glass.ai>

Contents

Foreword.....	i
Executive Summary.....	1
<i>Core Findings</i>	1
<i>Recommendations</i>	2
Evolving the impact of the Healthy Ageing Challenge.....	4
Supporting innovation in a hybrid domain.....	6
A “hybrid” domain.....	6
<i>Functional diversity</i>	7
<i>Ageing population diversity</i>	8
Methodology.....	10
<i>Phase 1: Domain mapping</i>	10
<i>Phase 2: Sense checking and scoping</i>	11
Mapping the healthy ageing economy.....	12
Geographies.....	14
<i>Implications for place-based innovation policy</i>	16
Exploring place and innovation: Greater Manchester case study.....	18
Business.....	18
<i>Participation in the healthy ageing domain</i>	18
<i>Interaction, networking, and local embeddedness</i>	18
<i>Defining innovation</i>	19
Governance.....	20
Research.....	21
Conclusions and recommendations.....	23
<i>Domain hybridity challenges traditional perceptions of critical mass for innovation</i>	23
<i>Creative interaction centred on governance and engagement, not market innovation</i>	24
<i>Innovation in a hybrid domain is just...different</i>	24
<i>Opportunities for place-based innovation</i>	25
Recommendations.....	25
References.....	28
Appendix A: Innovation and approach: glass.ai methodology.....	30

Foreword

Population ageing is set to transform all aspects of society, including how we live, work and relate to each other. With that is an opportunity for innovation with economic potential and a social purpose. While the value of the opportunity is huge, the market has been slow to respond.

That is why UK Research and Innovation's Healthy Ageing Challenge was established. Its aim is to support the development of services and products which support people as they age and enable them to remain active, productive, independent and socially connected across the generations for longer.

In a fresh approach, the Healthy Ageing Challenge is focused on intervening early in the lifecourse. That brings with it a broad scope - ranging from employment in later life, through to the communities and environments in which we live, and how we remain active participants in society while adapting to changing abilities as we age. In a sense, it is a domain covering a bit of everything, which means that it is not confined to established definitions of sectors or product categories, nor is it driven by the convergence of established sectors. This poses particular challenges when seeking to develop the market.

We commissioned this study to understand the landscape and assess the potential to stimulate innovation clusters as a mechanism to grow the healthy ageing domain. The investment in the Challenge is a start, and while the funding over a 5-year programme is a step change increase over previous programmes, it is at best just a catalyst. So we wanted to understand if a place-based clusters approach was the right next step.

The Innovation Caucus were invited to lead the study in recognition of their experience in understanding innovation in novel contexts with an ability to convene insight from a range of disciplines. This project called for a mixed methods approach to research and set out to identify potential clusters by combining an AI technique with deep dives into places where we thought there would be strong potential for a cluster. This approach to the study offered significant advantages as neither method alone would have identified both social and economic innovations.

We welcome the findings of the report, which have shed fresh light on the complexities we have faced in delivering the Challenge. In particular, in framing this as a hybrid domain, the study has found that the process of innovation is different than that found in typical innovation 'clusters' where factors such as networking behaviour, governance, anchor assets, shared knowledge bases, partnerships, or knowledge spillovers provide the key ingredients.

The report notes that industrial clustering is not the only place-based strategy available. Places can benefit from collocation and critical mass of related activities even if they are not specifically contributing to knowledge spillovers that enhance market innovation. Of note is the significance of a stable and enduring local policy as a key driver for place-based innovation in healthy ageing, further supported by access to the expertise provided by specialist centres. We have separately identified around 40 research centres specialising in aspects of 'healthy ageing' across the UK. If this market is to develop those specialist centres, covering design, behavioural sciences, technology, health and care will continue to play a key role in converting policy commitments into a thriving domain with social and economic benefits.

As the report concludes, further work is also needed to understand how such hybrid and complex healthy ageing domains can be stimulated, supported and sustained - particularly around place. Our thanks go to the authors and contributors for a fascinating insight into the world of ageing healthily.



George MacGinnis

Healthy Ageing Challenge Director
UK Research & Innovation

The Healthy Ageing Challenge: Defining Innovation and Shaping Support in a Hybrid Domain

Executive Summary

This research project situates innovation in the healthy ageing domain in the UK and develops insights about its sustainability and growth potential. The aim is to provide recommendations about how to contribute to evolving policy development and programme delivery under UKRI's Healthy Ageing Challenge, by connecting business, social sciences, and the arts and humanities.

According to ONS forecasts, the UK's over-85 population is expected to increase substantially by 2050. In response, the UKRI Healthy Ageing Challenge and linked initiatives have a mandate to support this ageing society and the economy through mobilising market innovations within the growing healthy ageing domain. However, this domain is highly fragmented and complex featuring diversity in financial sources, aims, and sources of legitimacy - something that we characterise as hybridity. We argue that this demands a more nuanced understanding of the economic structure of the domain, careful consideration of which activities should be included in the analysis, and an expanded conceptualisation of innovation and sources of innovative dynamics.

This report provides an evidence-based analysis of the healthy ageing domain and opportunities for innovation support by engaging with and leveraging the domain's hybridity. It does so by exploring three core areas:

- Outlining hypotheses about innovation in the healthy ageing domain with particular attention to whether there may be place-based advantages that the Healthy Ageing Challenge can leverage;
- Mapping activities in the sector to get a sense of emerging sectors of excellence, specialisms, and potential for clustering using AI-enabled analysis provided by project collaborator glass.ai;
- Understanding place-based dynamics and innovation processes through a case study of healthy ageing in the Greater Manchester area.

Core Findings

Domain hybridity challenges traditional perceptions of critical mass for innovation

Both the glass.ai data and the Manchester case study demonstrate the challenge that the highly diverse set of activities that are assembled under the healthy ageing umbrella pose for innovation and innovation policy. While diversity in the form of related activity can often stimulate innovation, such activities are perhaps too diverse and disconnected to create the synergies that underpin clustering and place-based market innovations. This is also partly because of functional diversity - firms recognise their connection and contribution to healthy ageing but, outside of social enterprises and non-profits, rarely see themselves as exclusively part of the sector. From a policy perspective, it may be more effective to encourage the recognition of the importance of designing, planning, and creating for an ageing population across all sectors than to specifically focus on stimulating innovation around ageing in specific areas.

Creative interaction centred on governance and engagement, not market innovation

Market innovations can flourish even in a diverse environment through a variety of mechanisms - knowledge spillovers between unexpected industries can create new paths of technological development, for example. Interactions and networks are at the heart of these effects. We did not find strong evidence of these kinds of dynamics *between firms* in the Greater Manchester area in the healthy ageing domain. However, researchers, social organisations, and governance actors were relatively well connected to each other. In this context, governance acts as a leader and nexus - provides support structures and connects these (primarily) social and socially focused actors. Networks disseminate and amplify the voices of ageing people in a wide variety of forums and help to create change and opportunity around healthy ageing. They were never characterised as vectors for market innovation. But this doesn't mean that they are not innovative.

Innovation in a hybrid domain is just...different

While we found little evidence that the collocation of healthy ageing activities was instrumental in creating conditions for market innovation it was clear that participants in the healthy ageing domain in Manchester conceptualised innovation differently. They did not see the creation of better products and services as key to creating positive change to healthy ageing outcomes. Rather, most participants reported that where innovation was required was in provoking behavioural changes (in older populations but also more broadly in social interactions and design); in increasing the ambition, reach, and scale of programmes; in connecting people better to ensure better feedback processes; and in socialising the idea that ageing should be embedded in all things instead of being confined to rigid categories and informed by stigmas. Only focusing on one end of the spectrum - e.g., economic or social - limits potential impact. Instead, to realise the twin goals of economic and social benefit, a broader understanding of innovation is needed.

Opportunities for place-based innovation

Supporting and enhancing these kinds of evolving place-based networks and initiatives that we have observed in the Greater Manchester case may have greater impact on achieving progress in the seven healthy ageing themes that underpin the UKRI Healthy Ageing Challenge than relying exclusively on targeted support for market innovations. Investing in clusters is thought to create multiplier effects for market innovation - enhancing local assets, shared knowledge bases, and labour pools, among many other expected benefits. We argue that similar effects may hold for investments in social innovation, but through very different mechanisms (Gerli et al. 2021). In these cases, rather than enhancing the pool of inputs to a localised market, investments in social innovations can multiply *outputs* as social changes reduce barriers for all, ease accessibility issues, support the broader dissemination of practices, and further strengthen governance networks. These, in turn, may open up more space for innovation (social and otherwise) as well as (ideally) generating actual social impact. The following recommendations build on opportunities identified in the course of this research and represent a beginning to balancing the roles of market and social innovation in supporting the growth of the healthy ageing domain and goals of healthy ageing.

Recommendations

A place-based model of public intervention in a hybrid domain should focus on supporting and strengthening ecosystems that enable both social and market innovations. This should involve supporting more than just firms and social enterprises but potentially expanding this to encompass

ideas, objectives, and initiatives that rely on innovation to generate impact defined more broadly to include social benefit.

- **Focus on connecting the commercial and social sectors**
In places that have emerging or developed governance networks, extending engagement with commercial entities may help to bridge gaps and stimulate innovation (directly or indirectly).
- **Create synergies with science**
One of the barriers to closer engagement between actors within the healthy ageing domain is a notable division between those that operate within and alongside the healthcare sector and those that are not formally considered part of that ecosystem. Recognising the frictions between social and scientific/technical approaches and seeking mechanisms to broker relationships and reduce bureaucratic and cultural barriers to collaboration and knowledge exchange can increase innovation potential.
- **Encourage age-inclusive everything**
Encouraging age-inclusiveness (as well as other kinds of inclusivity) as a part of all aspects of innovation - from urban or product design and development, and to be embedded in processes and practice - can have wide ranging social benefits.
- **Target skills and training gaps**
Localities can look to embed age-inclusivity into areas of skills with existing strengths but can also plan for future skills. This will go beyond just a demand for care workers but will impact everything from urban to industrial design, service provision, policy development, etc. Aligning the ambitions embedded in local ageing strategies (where they exist) with others, such as local industrial and skills strategies, can reveal opportunities to enhance existing strengths and spot potential gaps.
- **Focus on complementarity, not competition, in place-based support**
Encouraging place-based innovation can create internationally-recognised centres of excellence but the lessons generated within localised networks are transferable and local assets (such as research, support structures, and social networks) can be shared, plugged into, and extended to create benefits in other locations around the country (and internationally). No one loses out when more places become more age-friendly.
- **Recognise opportunities, and pitfalls, in future challenges**
In the absence of planning, sectoral and investment may not be optimised for public benefit. Preparing public actors, and linking them with networks around social innovation, can help to shape and leverage these emergent behaviours to ensure prosperity as well as diversity, inclusion, and equity.
- **Link age-friendly innovation to levelling up agendas**
Supporting social innovation in these places has the potential to create positive lifestyle benefits for ageing populations. Additionally, the emergence of strong networks around healthy ageing can help to connect and galvanise other social and particularly intergenerational networks, such as around opportunities and training for youth.

The Healthy Ageing Challenge: Defining Innovation and Shaping Support in a Hybrid Domain

Evolving the impact of the Healthy Ageing Challenge

This project explores activities in the healthy ageing domain as well as identifying strategic advice on how to connect business, social sciences, and the arts and humanities in the UKRI Healthy Ageing Challenge. The aim of the research is to develop insights about the sustainability and growth potential of the Healthy Ageing economy in order to provide recommendations about how to contribute to evolving policy development and programme delivery under the Healthy Ageing Challenge.

The over-85 population in the UK is expected to double by 2050 (ONS 2019) posing a series of present and future challenges for economic and social wellbeing (Bright 2019, Lodge et al. 2016, Murdock 2020). The UKRI Healthy Ageing Challenge and linked initiatives focus on supporting this ageing society and the economy through the delivery of market innovations within the growing healthy ageing domain, while also addressing inequalities in healthy life expectancy. UKRI is approaching this challenge through seven themes that aim to holistically address the breadth of issues involved in producing healthy ageing outcomes: Creating healthy active places; Design for age-friendly homes; Living well with cognitive impairment; Managing common complaints of ageing; Maintaining health at work; Supporting social connections; and Sustaining physical activity.

UKRI's remit puts research and innovation at the heart of all of its initiatives. In line with this, the UKRI Healthy Ageing Challenge aims to use innovation to achieve its broader social goals. But innovation in what and innovation where? While these questions seem straightforward, the breadth and complexity of the healthy ageing domain create challenges, particularly in defining innovation and channelling support to activities that generate positive social, economic, and behavioural outcomes in the seven theme areas.

This report provides an evidence-based analysis of the healthy ageing domain and opportunities for innovation support. The first step involved developing a clearer understanding of what kinds of activities and organisations participate in the healthy ageing domain. This called for an assessment of the challenges related to defining the boundaries of the healthy ageing economy - which are particularly acute given the hybrid nature of the domain (Section 2) - and designing a methodology sensitive to these difficulties (Section 3). We worked with partners glass.ai to adopt their innovative AI-driven approach to develop a map of both the sectors involved in the healthy ageing domain and the geographies of this activity. These results are presented in Section 4.

One of the central questions we were challenged to answer was whether the UK has any existing or emerging healthy ageing innovation clusters. Clusters play a central role in the UK Innovation Strategy, the Levelling Up white paper, and the Industrial Strategy, all of which link clustering to growth and innovation (HM Government 2017, BEIS 2021, HM Government 2022). If such clusters exist, or there was strong potential for their emergence, adopting this kind of place-based support strategy could multiply the impact of UKRI Healthy Ageing Challenge Fund investments, potentially creating spillovers beyond target firms that could benefit cluster growth and development.

While the geographical data in Section 4 can provide some clues as to the locations of potential clusters it cannot tell us anything about cluster structures, such as networking behaviour, governance, anchor assets, shared knowledge bases, partnerships, or knowledge spillovers. Exploring these dimensions requires deeper investigation of localised dynamics. To this end, we also designed a series of workshops in the Greater Manchester Area (Section 5) to explore the place-based dimensions of innovation in the healthy ageing domain. These workshops focused on understanding the importance and impact of localised networks and interactions, and the nature of innovation in the healthy ageing activities in the area.

The data and workshops both supported the conclusion that there is weak evidence for clustering as it is typically understood (discussed in more detail in the following section). Most places, including Manchester, appear to lack a critical mass of organisations involved in related activities and workshop participants reported minimal benefit from collocation with peers in the region. If clustering occurs, it is likely in subdomains of healthy ageing and as part of clusters - such as biotechnology or health informatics - that do not exclusively or even predominantly serve the goal of healthy ageing. As we report below, with further analysis it may be possible to identify these subdomain clusters and determine whether support through the UKRI Healthy Ageing Challenge would yield expected outcomes for the healthy ageing agenda.

These findings do not, however, mean that place-based approaches to supporting healthy ageing activities have no potential. In Manchester, we did find evidence of developed, evolving, and synergistic networks between different types of actors in support of commercial activities, social outreach, research projects, and public policy development and implementation. The actors in these networks considered themselves innovative, however only rarely were their efforts targeted uniquely at profit generation or market growth. Innovation in this space involved using technologies and new approaches to better understand, track, and reach older populations. This was equally likely to involve finding ways to influence behaviours in older people (e.g., to increase social engagement, mobility, cognitive longevity, etc.) to ensure that their voices could effectively feed back to stimulate changes in the environment that they inhabit, be that the spatial design and fabric of their communities, the tools that we all use to interact with urban space, or the character of social and civic interactions. While these sometimes had market implications, they were equally likely to enhance the effectiveness of government programmes, social services, or places - innovation outcomes that are much more difficult to track. Supporting and enhancing these kinds of evolving place-based networks and initiatives may have greater impact on achieving progress in the seven healthy ageing themes than existing strategies of targeted support for market innovations. However, it requires a different understanding of innovation and developing a clearer set of priorities for public support. This report develops this argument and concludes with a series of recommendations to contribute to evolving policy development and programme delivery under the UKRI Healthy Ageing Challenge.

Supporting innovation in a hybrid domain

Innovation can be defined as new practical knowledge - ideas that do not merely contribute to the store of human knowledge but that have impact and application.¹ Definitions focus on innovation outcomes – new products, new value, new forms of organisation, new practices, etc. However, innovation can also be described as a process. Innovation outcomes describe the typical end result of innovation – the ‘what’ – while innovation processes outline the stages through which those results can be achieved. While public policy typically prioritises innovation outcomes it also recognises the value of understanding and encouraging each element of the processes.

The UKRI Healthy Ageing Challenge places innovation front and centre. Its vision states that by investing in UK-wide innovation and research UKRI aims “to support both our ageing society and the economy through the delivery of market innovations within the growing healthy ageing domain, while also addressing inequalities in healthy life expectancy” (UKRI 2022). In this conceptualisation, market innovation is seen as the mechanism through which economic activities in the domain will grow and flourish with expectations that this growth and its outputs will yield positive benefits to the wellbeing and life expectancy of an ageing society. Enabling businesses, including social enterprises, to develop and deliver products, services and business models, adopted at scale, will support people as they age.

The difficult tasks of the UKRI Healthy Ageing Challenge are determining how to ensure that the innovations that it supports contribute to these twin social and economic goals, understanding where private provisions and market innovation may be falling short, and tailoring interventions to achieve these objectives in the context of a highly fragmented and complex socioeconomic environment.

Although the UKRI Healthy Ageing Challenge documentation stresses so called ‘market based’ innovation, if we consider the dual nature of the goals of the challenge, it could perhaps be said that it fits within the realm of social innovation, which is often described as “new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations” (Social Innovation Exchange, 2010, p.18). This definition encompasses both social processes and social outcomes. Social innovation can be achieved by leveraging market mechanisms towards social outcomes but can also emerge from the non-commercial pursuits of actors (such as government, research, or social sectors) to more effectively reach constituencies, generate insights, or provide services.

A “hybrid” domain

Because it is characterised by a high degree of fragmentation and complexity (which includes diversity in financial sources, aims, and sources of legitimacy), we refer to healthy ageing as a hybrid domain, borrowing a concept from an extensive and growing literature on organisations, such as social enterprise, that have both market and social (and sometimes other) missions (Battilana et al., 2017,

¹ The OECD definition adopted by Eurostat, and the UK Innovation Survey (BEIS 2022) lists all the following as instances of innovation:

- 1 The introduction of a new or significantly improved product (good or service) or process.
- 2 Engagement in innovation projects not yet complete, scaled back, or abandoned.
- 3 New and significantly improved forms of organisation, business structures or practices, and marketing concepts or strategies.
- 4 Investment activities in areas such as internal research and development, training, acquisition of external knowledge or machinery and equipment linked to innovation activities.

Pache & Santos, 2013). Here we extend the concept of hybridity to acknowledge not only the economic/social duality of the core Challenge objectives, but to describe the ecosystem and actors within it. For instance, defining the boundaries of the healthy ageing domain - that is, what we should consider an activity or actor that is part of the healthy ageing ecosystem - is very difficult because of both subdomain and functional diversity which is a broader application of hybridity in the organisational sense.

Subdomain diversity

Activities from a hugely diverse range of sectors contribute to wellbeing in later life. Those that most readily spring to mind relate to healthcare and health services, pharmaceuticals, care homes and services, medical technologies, and mobility aids. However, as the data in the mapping section (and common sense) shows, the domain can also include transportation, education, social services, financial services and counselling, housing and real estate, arts and cultural providers, and many others. While this diversity is ultimately a strength of the healthy ageing domain it can also complicate strategic development. The factors that support innovation in research into heart disease are unlikely to generate similar outcomes in estate and retirement planning or programmes designed to reduce isolation and loneliness. Although these activities can be grouped into subdomains (e.g., home care/care homes, housing, social programming, healthcare, financial and legal services, etc.) there are many overlaps between them and conceptualising them in silos also carries risks (Hamilton-West et al. 2020). For instance, healthcare and medical technologies are already treated differently and as more central than other sectors involved in healthy ageing, which has tended to privilege clinical solutions - a regime that has only begun to change relatively recently as the profession begins to more widely recognize the value of social prescription (Costa et al. 2021).

Functional diversity

Intervention in the domain is also complicated by the fact that many of the actors that contribute to the healthy ageing domain would not necessarily identify these contributions as central to their organisation. There is certainly a cadre of firms and organisations that focus exclusively on solving problems related to ageing across many sectors.

There are also lots of firms and organisations for whom their participation in the healthy ageing domain is one among several things that they do. For example, a legal firm may provide many types of services to its clients in addition to consulting on estate planning and transfer. A music therapy organisation may provide sessions to people of all ages with conditions that could benefit from this type of intervention. A software company might design digital solutions for third sector organisations, some of which might be healthy ageing focused.

This type of firm is more functionally diverse and therefore difficult to identify and classify using traditional indicators such as standard industrial classification (SIC) codes. A further dimension of functional diversity stems from the presence (and diversity of activities) of a range of actor types from profit-seeking firms to social enterprise and non-profit organisations, alongside governance actors and research organisations. While actor diversity is not unique to hybrid domains (or sectors), the healthy ageing domain is characterised by a high number of third sector actors. Many types of organisations that fall into this sector have their own sets of hybridity-related challenges that also create complications for innovation programme design and delivery.

Organisational hybridity

Related to the hybrid domain, but with a different lens, hybrid organisations are those that combine elements of different sectors (such as public, private and non-profit). Often this means they look to integrate profit and purposes that are traditionally associated with the social economy or third sector. In this sense, they serve a social function but generate some proportion of the revenue used to support that function from selling of goods or services rather than being purely reliant on grant funding. This gives them some flexibility to be able to function if grants are too small or difficult to predict but can also create complicated internal and external tensions. A key challenge in hybrid organisations is how to balance the bottom lines (dual or triple) of the organisation and what that means for decision making, strategy, action, ethics and all aspects of the operation. To some extent, all businesses are on a spectrum of hybridity, and particularly in the healthy ageing domain, there is an inherent dual bottom line present.

Hybrid organisations, such as social enterprises, perform important functions in the healthy ageing domain (Murtagh, 2017). However, these organisations are easy to overlook or undersupport in innovation-driven policy. They can be quite small and what constitutes innovation within them may not be seen as sufficiently significant either in terms of market potential or social scalability. Furthermore, because they are neither fully a business nor a charity (for example) they can be cut out of funding streams geared towards these actor types. In domains such as healthy ageing, where hybrid organisations make up a significant proportion of participants, it is vital to understand the role they play in the innovation system and in terms of social delivery.

Ageing population diversity

Ultimately, people are the target of healthy ageing initiatives. While the diversity of activities and actors detailed above creates complexity in supporting the supply of innovation and support for healthy ageing, it is important to remember that the target population is also quite diverse (Chivers 2021). Older people are in different places in terms of their health, mobility, and capacity; and exist in different types of communities and with different types of support networks. They have different resources and, depending on where they live, access to different resources and support structures. They are also culturally and ethnically diverse. As such, innovations in the domain of healthy ageing are not targeting a homogenous market. Another challenge of innovation support, then, is to ensure that it contributes as much as possible to healthy ageing for *all* and does not create disadvantages or widen existing disparities in health, wellbeing, and longevity. Furthermore, because ageing is about lifecourse, and not restricted to people over a certain age, it is important to acknowledge diversity in this respect as well. This also highlights the difficulty of establishing the boundaries of the ageing market.

Place-based innovation and development in the context of hybridity

It is important to understand the context and implications of domain hybridity to effectively design innovation support policy. Flowing from these, decisions need to be made about the types of activities that are eligible (given subdomain diversity), the types of functions that qualify (given functional diversity), whether to support and how to tailor interventions for social enterprises (given organisational hybridity), and how to ensure equity in outcomes (given population diversity).

The problem of how to maximise the (social and economic) benefits of limited resources is also critical. In other sectors and domains, place-based approaches - such as seeding or supporting innovative clusters or ecosystems - remain popular and are seen as mechanisms to both economic growth and

“level up” lagging areas. These approaches seek to multiply the impact of innovation interventions by supporting actors such as firms, intermediary organisations, higher education, and research that are collocated within spatially concentrated areas of related economic activity. The logic is that increasing innovation in these contexts can enhance outcomes for both the organisations that are recipients of support but that proximate actors can also benefit due to spillovers and externalities in the form of knowledge, talent, enhancements to collective resources (such as business incubation, shared specialised services, core technologies or infrastructures, and financial support, etc.). These spillovers generate positive feedback loops that ideally become self-sustaining, augment the attractiveness of the place to investment and talent, increase firm foundation and competitiveness, and raise the international innovation profile (Martin and Sunley, 2003; Cooke 2001).

While cluster strategies can effectively enhance innovation activity and enhance the growth of places and industries, they are not suitable to every context. Typically, public interventions target places with sufficient critical mass of related collocated activities or with demonstrated potential to grow such a critical mass of firms, and usually address perceived gaps in knowledge generation and transfer, skills, absorptive capacity, R&D or business resources, or support and governance structures. Where clusters are nascent, interventions will build on existing strengths, specialisms, or unique capabilities offered by location or growth trajectory - they are rarely successfully seeded *de novo*. Crucially, a critical mass of actors in any given domain of economic activity will not automatically generate the agglomeration benefits that cluster strategies rely upon. The activities of collocated actors must be related (enough) in order to generate knowledge spillovers and externalities from which other members of the cluster can benefit. As a result, clusters require a degree of *concentration*, *relatedness*, and *connectedness* to produce localisation benefits of co-location (Asheim et al. 2011).²

Evaluating the appropriateness of a cluster approach to stimulating innovation in the healthy ageing domain requires some assessment of these three factors. To that end, this project has the following objectives and core questions:

Defining the domain: What kinds of activities constitute the healthy ageing domain? How are these activities distributed spatially across the country? Are there significant concentrations that may suggest the emergence of clusters or localised competitive advantage?

Seeking evidence of cross-industry interactions and networks: Given that the domain is characterised by various types of diversity, how frequently do actors from within the same subdomains interact with one another? Do they interact frequently with actors outside of their own subdomains? What is the nature of those interactions (e.g., partnerships, participation in governance, knowledge exchange, collective learning, etc.)?

Describing innovation: Does domain hybridity translate into different perceptions of both what innovation is and innovation opportunities? How do different actors define innovation in their activities and subdomains? What kinds of interventions would most effectively support these types of innovation?

The following section outlines the process that we used for each of these objectives.

² Note that this statement refers primarily to localisation economies that are typically associated with industrial clusters. *Unrelated* variety can also generate innovation by expanding the types of knowledge spillovers and multiplying potential for cross-industry knowledge recombination and innovation (Grillitsch et al. 2018). However, as these are difficult to predict, public policy tends to regard interventions in support of unrelated variety as too risky for cluster strategies, although they may be the byproduct of supporting more generalised urbanisation economies.

Methodology

Because of the domain hybridity discussed above, we adopted a series of approaches to define the domain, explore interactions and networks, and describe innovation across two phases of research. The first involved using artificial intelligence to identify core actors in the healthy ageing economy. This data was then sense checked using qualitative methods that also enabled us to get more detail about spatial dynamics and approaches to innovation.

Phase I: Domain mapping

The different dimensions of hybridity in this domain means that typical approaches to industrial or cluster definition are difficult to apply in this context. These rely on identifying actors based on Standardised Industrial Classification (SIC) codes. In this system, firms designate their own codes and must select the most appropriate from among a list of existing classifications and rarely update them as their businesses evolve. While these can be very useful for identifying the obvious core of an industry (e.g., health-related biotechnology firms), firms that include healthy ageing activities as among a portfolio of offerings (e.g., an insurance company that has developed dedicated products for older clients) are nearly impossible to identify. This system presents similar issues for social enterprise and research organisations. Artificial intelligence (AI) is one tool that can be used to overcome some of the limitations of the SIC system to read online content to understand what organisations are actually currently doing to get a more up-to-date and nuanced map of healthy ageing active entities in the UK.

This project engaged glass.ai, an AI company, to assist with the mapping phase. It has an ongoing discovery process that reads websites and classifies the site as a company website if it detects certain criteria around content (e.g. active, in English, business content) and if possible, can predict the sector and geography of the business (e.g. a UK address). This, combined with addresses mentioned on social sites, yielded various validation points about the location of the companies. The system gathered evidence on healthy ageing organisations headquartered in the UK and foreign organisations with presence/activity in the UK market. This enabled glass.ai to produce a map of entities active in the healthy ageing economy, to identify trends in the size and significance of subsectors, and compare the size of economic activities across different geographies. This process is explained in more detail in Appendix A and results (as well as other limitations to this approach) are presented in the following section.

Ultimately, we discovered that while this approach has significant advantages, to fully exploit its potential requires a good deal of data checking and cleaning. For instance, the process was not 100% accurate, returning results outside of the geographies or key terms specified. Web scraping is resource intensive, and so was limited to only the first “layer” of internet hierarchies. This meant that the process did not search beyond organisations’ home pages (except for in cases, such as higher education institutions, where we were able to do limited deeper mining operations) and so did not capture those actors that were functionally diverse as effectively. Finally, on close examination, sectoral and subsectoral classifications were often too broad or curiously assigned to be of use in distinguishing activities. This meant getting accurate (sub)sectoral results would require checking (and reclassifying where necessary) all 9,511 records returned manually. We lacked the time and resources in this project to do so, which meant that we were unable to apply some common cluster analysis techniques, such as investigating location quotients, to quantitatively assess concentration and collocation of activities.

These limitations made the adoption of qualitative approaches in Phase 2 all the more important to enhance the validity of results.

Phase 2: Sense checking and scoping

AI data is useful for identifying and mapping actors in the healthy ageing economy. It can highlight areas where there may be a sufficient critical mass of related firms and where specific specialisms may be emerging. However, it cannot by itself give any indication of whether knowledge spillovers and networking are occurring in those places, and the nature or significance of those interactions. It is also useful to verify the algorithmically derived data against local experience to determine how reliable results may be.

In this phase, we did a set of sense checking interviews with actors in Newcastle and Swansea - both areas that were identified in partnership with the UKRI Healthy Ageing Challenge as places where a critical mass of activity may exist or be emerging. Note that these locations were chosen before the glass.ai data was processed, which later revealed that these locations were not as significant as some others around the country in terms of concentration of healthy ageing activities.³ These interviews, with representatives from the National Innovation Centre for Ageing (Newcastle) and the Awen Institute (Swansea) revealed that (this admittedly small sample of) actors had a different, and more nuanced, perception of the healthy ageing economy in their areas than the glass.ai data suggested. Most notably, they identified firms and partners that were not listed in our results. They also did not recognise some of the actors that were on the list. Their insights, paired with the diversity of actors that the results revealed in each case, suggested that we should try to speak to as many representatives from different parts of the economy as possible to gain a better understanding of the scope of the domain, patterns of interactions, and innovation opportunities.

To that end, we designed a series of workshops that aimed to gather actors from four different segments of the ecosystem that we identified through the data and initial interviews: business, governance, social, and research. We selected the Greater Manchester Area as the focus of our case study in consultation with the UKRI Healthy Ageing Challenge. These workshops consisted of 3-6 participants from each of these categories with the exception of business, for which we hosted two workshops (one for firms in housing and construction and one for firms at the intersection of health and technology). While this did not cover the diversity of businesses active in this domain, engaging with two identifiable subsectors enabled us to explore the degree and nature of differences. Workshops lasted 90 minutes and were conducted online in May and June of 2022. They were designed to gauge participants' perceptions of and roles in the healthy ageing domain; their interactions, networks, and importance of proximity; and their visions of and experiences with innovation. In this format, we were able to engage with over 20 participants across the four categories.

Before continuing, it is worth acknowledging some limitations of this approach. Even though workshops enabled us to reach a wider range of participants than some other qualitative approaches these results should not be taken as comprehensive. We relied heavily on the Greater Manchester Combined Authority (GMCA) Ageing Hub networks to source workshop participants and so there is both a

³ For reasons that we outline on p. 10, it is difficult to identify areas that are genuinely strong in healthy ageing activities. Hotspots of activity basically correlate to major metropolitan areas, meaning that places like London, Manchester, and Birmingham (and their surrounding areas) have greater concentrations of overall activity, even normalized by population. That said, it is worth emphasising that because we can say little about the dynamics between firms, or accurately categorize them without further data manipulation, we cannot draw any conclusions about the innovative potential of healthy ageing activities in any locations from this data alone.

degree of bias towards actors that are already plugged into the GMCA network and of self-selection. The results of this phase, therefore, probably accurately reflect the experiences of a core of healthy ageing actors in the area but cannot illuminate the challenges faced by those that are not (either by choice or exclusion) part of this group.

Mapping the healthy ageing economy

While there are limitations with the AI mapping approach, discussed in the previous section, it can be a useful tool for establishing a general understanding of sectoral and spatial patterns in a domain. For the reasons described above, these findings should be interpreted with caution and viewed as *indicative*, rather than as definitive descriptions of the healthy ageing domain.

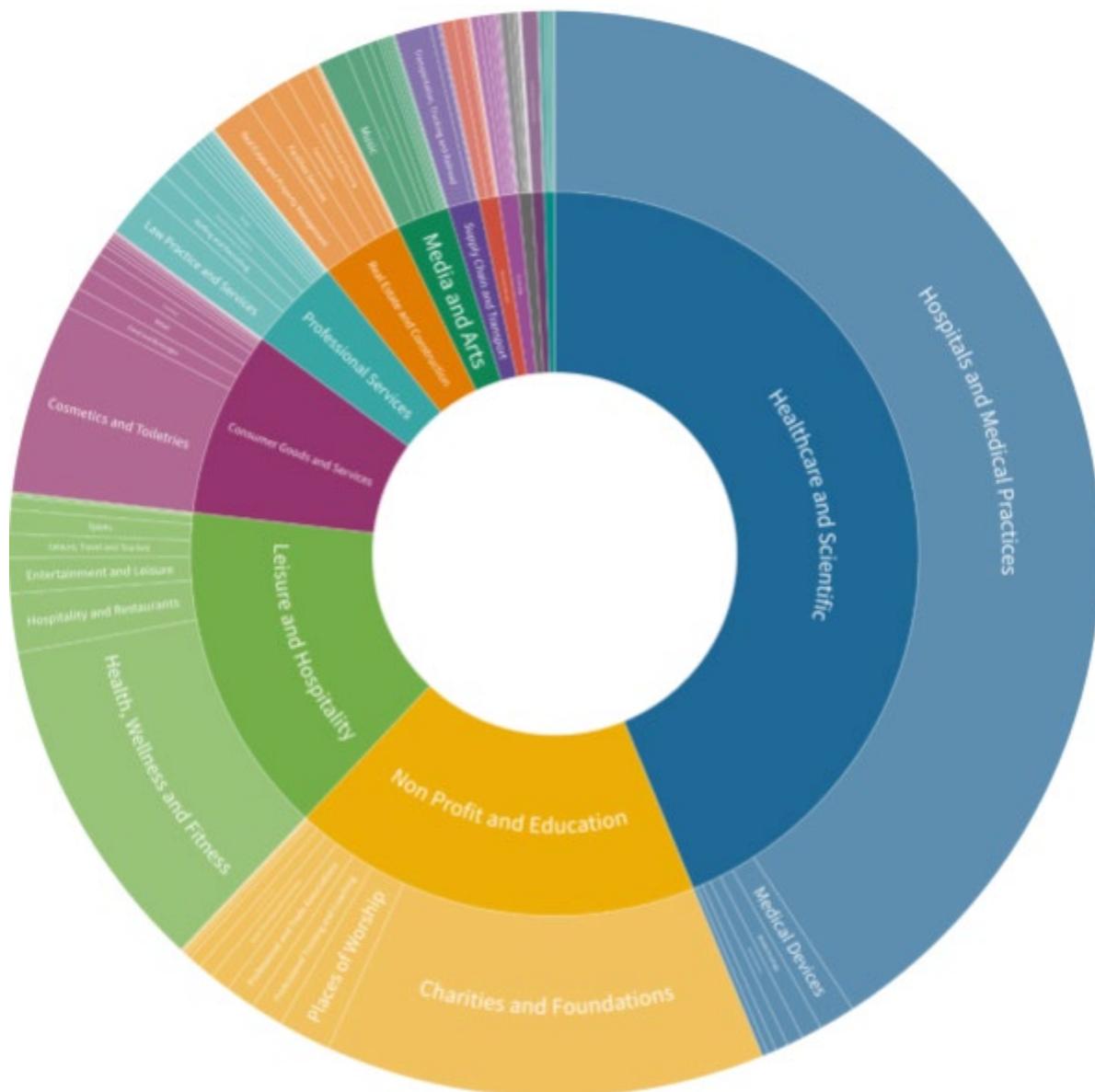


Figure 1. Sectoral breakdown of results from glass.ai web scraping

Sectors

Subdomain diversity was something that has been attributed to this domain but has never been rigorously explored. The AI methodology enabled us to look beyond officially filed firm or organisational descriptors (such as SICs) and find actors engaged in healthy ageing activities as documented on their websites. These results confirm our expectations that the domain includes actors from a wide range of sectors and also suggests the following observations:

- **Healthcare and scientific activities dominate the domain:** This is not an unexpected result, as people have greater healthcare and caring requirements as they age. This is reflected in the prevalence of hospitals and medical practices in this category. Limitations in data collection may be skewing these results in a couple of ways. The fact that we may be missing actors engaged in healthy ageing related activities lower in their webpage hierarchies probably inflates the significance of healthcare and scientific actors that are possibly more likely to list their age related activities on their home pages. Similarly, within the sector, medical devices and biotechnology (among other scientific categories) are likely dwarfed by hospitals and medical practices for similar reasons. The results listed only 67 biotechnology firms - a tiny proportion of the 1,572 biotechnology businesses listed on crunchbase (Crunchbase 2022). While some biotech and medical device firms may be classified as consumer goods and services, it is more likely that many of these firms are developing drugs and therapies that can contribute to healthy ageing but that are not viewed as exclusive to the domain and so are being missed by our protocol.
- **Nonprofits and education have a notable presence:** We had expected that these types of organisations would be significant, however it is interesting how prevalent they appear to be. Charities and foundations dominate this category reflecting (we think) a wide variety of non-profit activities including social enterprises. Further analysis of the data would enable us to draw some more informed conclusions about the relative balance between charities and social enterprises in this classification and also draw out more detail about the range of activity types that are being aggregated under this more generic label. The significance of places of worship is also notable and these too are likely involved in a range of types of service delivery and are important sites in which support and programming are available.
- **Leisure and hospitality is probably overrepresented:** Activities that legitimately fall into this category are fitness and movement studios that provide programming for healthy ageing, sports clubs (such as bowls and cricket) with senior level teams, hotels and lodgings that provide additional care or accessibility, etc. However, many of the results appear to be misclassified and this category sometimes included care homes and home care and healthcare practices (such as physiotherapy, optician, podiatry, etc.). Many social services, such as music therapy or mental health also appear (we think inappropriately because these are therapeutic interventions and not leisure activities) in this category. Of the records that we vetted, about half of these were misclassified. More generic services such as aesthetics (e.g., hair and makeup) and spas also appear. While these may provide services for older people the degree to which they contribute to healthy ageing is debatable. We have opted to leave these in for the time being but recognise that doing so might not contribute much to discussions about innovation in this domain. The key takeaway here is that this category is probably overrepresented relative to others.

- Other categories are likely smaller than anticipated due to methodological limitations and conceptual difficulties:** In particular, we expected both consumer goods and services and professional services to be proportionally more significant than they are. This is partly due to some oddities in classifications where things like medical devices (which can encompass consumer goods) appear in the healthcare and scientific category. However, we expect that these two categories are smaller because of the difficulties in detecting activities in functionally diverse firms. That is, firms that sell products and services not exclusively for an ageing population may not have been captured by the shallow web scraping methodology applied. While this is to be expected, it is very difficult to estimate how many firms are missing from our results. These categories also suffer from the ambiguity in what should be considered part of the healthy ageing domain. For instance, older people also rely on many products and services - grocery stores, banks, clothing, house goods, etc. - that everyone needs and that may be very significant to their wellbeing without being specifically targeted at that market. For example, grocery stores are cited as important to older people for providing not only necessities but the excuse for an outing and opportunities for social contact. Older people prefer certain shops over others because they have more functional spaces such as wider aisles, places to sit and socialise, the option to check out with a person, and/or cafes. How examples like these should be classified in our survey of the healthy ageing domain is unclear. For the moment, they are not included, but future iterations of this kind of research may be able to capture more nuances in this category.
- Smaller categories demonstrate the breadth of diversity in this domain:** The smaller categories - media and arts, supply chain and transport, and technology - demonstrate the diversity of activities in this domain. The arts category includes programmes and media for older people, such as lifestyle magazines, intergenerational events, and entertainment venues and galleries. The supply chain and transport category consists mainly of transportation and mobility services, but also services like house moving and storage with special assistance for older people. Technology encompasses digital networks as well as specific apps and tools. Reclassifying the data would probably increase the number of actors across most of these categories as some are likely also in the non-profit and education category (for music programming, for example) and consumer goods and services (for technology). Real estate is another category that is relatively significant in the healthy ageing domain but may be less significant in this data set. These include care homes and communities but also contractors and residential service providers with specialties in installing home aids like lifts, ramps, and bathroom fittings etc.

Overall, this data provides an interesting snapshot of the types of activities that this methodology flags as part of the healthy ageing domain. The data in its current form is classified in ways which limit its explanatory power. However, if results are properly cleaned and vetted, we think that it has greater potential to yield insights about both the economic and the spatial profile of the healthy ageing domain.

Geographies

In addition to developing a better understanding of the composition of the healthy ageing domain, this project aimed to determine how these activities are distributed spatially in order to get a sense of whether specialisms were emerging in specific areas. This question is of particular interest as places with nascent or emerging clusters may be rich sites of innovation and potential targets for public support.

Figure 2 below maps the geographic distribution of results by sector. Figure 3 depicts the distribution of results proportionally by region. Both show strong concentrations of activities around larger urban areas, with the largest amount of activity in the London metropolitan area but also strong concentrations around Manchester and Liverpool, Birmingham, Leeds, and Newcastle.

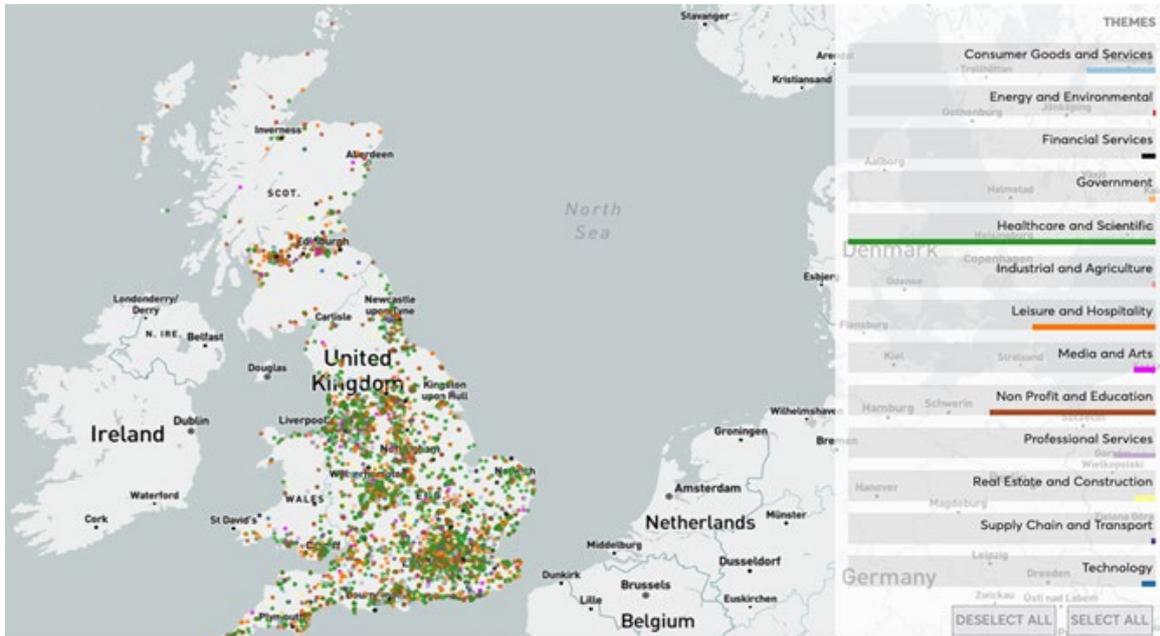


Figure 2. Geographical distribution of results by region. Source: glass.ai



Figure 3. Geographical distribution of results by region. Source: glass.ai

The density of activities is proportionally similar to that of economic activity overall in the UK, which suggests that there are no notable “hubs” that may be indicative of particular specialisms.

Because of the limitations in the data noted above, patterns of sectoral location and density should be interpreted with caution. With more confidence in data categorization we could explore relative densities of different industries to establish a quantitative basis for spatial specialisation, related variety, and diversity.

More data processing would also enable us to answer other questions that can help illuminate spatial patterns. For instance:

- **What is the distribution of tradable versus non-tradable businesses?** Tradeable businesses are those whose products or services can be sold or consumed in other places (e.g., can be exported) while non-tradeable businesses are those where the demander and supplier must be in the same location. This distinction matters in the healthy ageing domain because many organisations provide non-tradable goods and services - care homes, medical practices, local social programmes - and are, therefore, likely to be distributed around the country. Clustering and spatial specialisation behaviours are more likely in organisations producing tradeable outputs. While innovation literature tends to focus on advancements in tradable industries we caution that this should not be the case in this hybrid domain. The main point is that innovation in tradables can be enhanced by embeddedness in places with strong non-tradable activities but that clustering, as typically understood, is unlikely in purely non-tradable activities.
- **What is the distribution of healthy ageing specialised organisations versus functionally diverse organisations?** One thing that is not clear from the current data is whether there is any spatial pattern to the location of specialised (versus functionally diverse) organisations. This may matter as those organisations that serve an ageing population are more likely to dedicate resources to innovating in this space. Where there are significant concentrations of specialised organisations might indicate an emerging cluster or greater potential for knowledge spillovers. Because the benefits of proximity can also accrue to organisations that are functionally diverse as well - and indeed might carry additional benefits due to inbuilt related variety - it is not a perfect indicator of innovation potential. But the geography and density of specialised organisations might hold clues about where innovative dynamics might be most significant.

Implications for place-based innovation policy

While the glass.ai data suffers from some drawbacks in its raw form, it has begun to improve our understanding of the dimensions of the healthy ageing domain and some basic geographical patterns. Based on the analysis that we performed, we think that it is unlikely that the healthy ageing domain *as a whole* is characterised by strong clustering behaviours and related innovation enhancing benefits.

Does this mean that there is no potential for place-based innovation policy in this domain? Not necessarily. First, we suspect that clustering of healthy ageing organisations is probably happening in some subdomains/subsectors, although it is likely that these are *part of more generalised industrial groupings* - e.g., medical devices, biotechnology, health data and analytics - that do not specifically (or even predominantly) serve a healthy ageing market. From the perspective of the UKRI Healthy Ageing Challenge, this would mean aligning investments to optimise knowledge transfer and networking of organisations engaged with healthy ageing activities within those more generalised clusters. Depending

on the nature of interactions between organisations, those engaged in healthy ageing activities may constitute a distinctive subcluster. However, this strategy may bias investment and intervention more towards typical targets of innovation assistance - firms in tradable sectors and in health, technology, and life sciences - and make it difficult to enable social enterprise, other third sector actors, firms in non-tradable industries, and governance organisations engaged with social innovation.

Secondly, it is important to remember that industrial clustering is not the only place-based strategy available. Places can benefit from collocation and critical mass of related activities even if they are not specifically contributing to knowledge spillovers that enhance market innovation. We think that this is particularly true of hybrid domains where the fact that public benefit, not just economic growth, is a core output of activities (commercial and otherwise). In places with significant concentrations of healthy ageing activity, then, we might expect that networks will evolve to drive social innovation for social benefit and that this collective action might coalesce around one or several key public needs. In that case, innovation may occur not only (or even primarily) in the development of new products or services but in devising mechanisms for organisations to better reach, incorporate feedback from, respond to, and support their constituencies. In this case, the UKRI Healthy Ageing Challenge may have to reiterate its commitment to focus on broader conceptualisations of what innovation is and measurement of impact away from economic measures of growth and productivity.

In either case, the data presented in this section can help us think through potential scenarios but cannot tell us about the nature of interactions that might indicate clustering (or subclustering) or whether different kinds of productive networks have emerged (or are emerging). To explore the possibility of either form of place-based benefit we conducted a case study in the Greater Manchester area.

Exploring place and innovation: Greater Manchester case study

To deepen the insights we gained from the glass.ai data, we conducted a qualitative case study, allowing us to delve deeper into the healthy ageing ecosystem in one geography, to build a richer picture of the ways in which the hybrid domain interacts with a regional ecosystem. Case study workshops were specifically engineered to stimulate discussion about participants' perceptions of and roles in the healthy ageing domain; their interactions, networks, and importance of proximity and embeddedness; and their visions of and experiences with innovation.

Business

Because of the diversity of types of businesses involved in the healthy ageing domain, we conducted separate workshops centred on the two themes of housing and health technology. The first group included a mix of developers, housing associations, and age-friendly housing practitioners. The second group brought together the developers of apps targeting older people, social organisations that had developed their own technology solutions to track or influence wellbeing, and an organisation that supports businesses in developing age-friendly solutions.

Participation in the healthy ageing domain

From the housing perspective, healthy ageing is becoming a growing part of the varied portfolios. While typically not central to the work the housing developing firms did, they perceived the ageing market as one with growth potential over the coming years. Much of the work conducted in the healthy ageing domain discussed by housing firms involved consideration of how to encourage intergenerational living in new developments in the Greater Manchester area suggesting that for the housing firm, this is an important segment of their work, but one that fits into a larger picture of their overall business.

In the health workshop, more of the participants had a focus specifically on healthy ageing, but not all. The participants tended to work on wellbeing technologies that were often used as part of social prescribing initiatives in the NHS. For example, one organisation provides a non-competitive exercise app which encourages people to walk more as a part of a healthy movement drive. The app is open to all and therefore does not target older people specifically, but is aware of the healthy ageing agenda as particularly relevant and aligned to their mission.⁴ Another participant represented a firm which provides digital telecare products to the healthcare industry. These two examples show the range of wellbeing technology on offer, and also show that some organisations in this workshop had strong alignment with the social sector and governance sectors (e.g. the NHS).

Interaction, networking, and local embeddedness

Participants in the housing development sector relied more on national and international networks to support their businesses and did not see themselves as particularly embedded in the Greater Manchester area nor as beneficiaries of critical local spillovers. All noted that their projects were localised and therefore required them to have relationships with government and regulatory actors,

⁴ Their work is informed by research on elderly people where they found that in the ageing population, older men, especially, tend to "fall off the cliff of exercise".

and it was through these mechanisms, and due to the importance of housing and community design to urban agendas that they came to participate in networks convened by the Ageing Hub and its partners.

The participants of the health and technology group had similar reflections on their embeddedness and networking practices. Firms' suppliers were located all over the country. Some of the more socially focused businesses served local communities and so were more spatially focused through their constituencies. However, they developed business tools for and with clients outside of the region. In this group, all cited connections with support structures such as Health Innovation Manchester as beneficial, if not crucial to their commercial endeavours.

For both groups, research collaborations tended to be with the local universities. For the health workshop this kind of engagement was more common and centred around evaluations of the impact of their work rather than R&D collaborations. When discussing collaborative practices, both of the business workshops tended to mention working collaboratively with public sector or governance partners at the local level, and with older people themselves as an important voice in their work.

Overall, connections might best be conceptualised as enabling commercial aims and particularly in increasing awareness of issues, the significance of their work, and applications of their tools rather than for developing specialised knowledge or innovations.

Defining innovation

When asked about what innovative initiatives they had seen in the healthy ageing domain, the majority of both of the workshops' participants focused on elements of social innovation. For example, in the housing sector workshop, participants described the 'mundane' innovations of bringing in older people's voices to make designs more inclusive. In the workshops, innovations were discussed as preventive interventions in the context of a traditional medical model. There were also discussions on the innovative potential of services working more closely together (governance, research, aftercare and health) and how to diffuse existing innovations through these channels. Yet barriers remain. Health businesses emphasised commercialising and scaling the innovations, while recognising that "commercialising something is always seen as being a bit wasteful and possibly a bit grubby".

Social

The social sector workshop participants came from advocacy groups - made up of older people who sought to get their voices heard and community services - who provided wellbeing services directly to older people in the community. Community services included providing befriending services, food initiatives and handyman services. All participants' organisations focused on older people as central to their organisation. The social organisations that participated in the workshops had strong local ties given that they served local communities. They relied heavily on local governments for funding and in their function of influencing and feeding into local policies. However, they also reported links outside of the region both for funding purposes and knowledge networks. Several had engaged internationally through sharing programmes that had been recognised and adopted abroad, and many were also connected to national networks or were involved in advocacy at the national level. Local embeddedness and community connection were important to organisational programme development and innovation, however external networks also played a role.

The social sector organisations had close ties to each other, with some participants within the advocacy groups working for more than one group at a time. The group was quite entrepreneurial as they described themselves as impassioned advocates who actively sought out (and were reportedly almost always successful at leveraging) opportunities to have their voices, and those of the populations they represented, heard in a variety of forums. This meant that they were well connected, particularly to governance networks. As a result, most participants agreed that relevant authorities are willing to listen to them when approached. However, they noted that “what we're trying to aspire to is that we don't need to have that conversation, because everybody is aware”. Raising awareness about older people’s needs and making their voices heard is central to these social organisation’s missions.

The social sector workshop participants described working with partners in higher education and research as a mutually beneficial arrangement - social sector organisations provided opportunities for students to have placements, and researchers to get data (especially lived-experience informed), in return for the legitimacy of working with a university. As such, this kind of arrangement was common. However, as with business, these relationships were more likely to be about generating mutual understanding, creating a deeper and legitimate evidence base to support their existing activities, and another vector for expressing their interests to government departments than about generating innovation. Overall, there was a drive among the participants to hold conversations with organisations across all sectors, with an aim of "changing mindsets". The participants, however, observed that other organisations do not talk to older people (as much). Instead, they “make assumptions” about what they need, who the participants describe as a “diverse crew”. To this end, social sector organisations can potentially be filling a knowledge gap within the Healthy Ageing domain via networking and collaboration.

Innovation for this group involves bringing people together and integrating older voices into the design process and the group argued that ‘small’ changes can have potentially big impacts. The ways in which this is described aligns well with the way the housing businesses described ‘mundane’ innovation. They described the innovation needed as not so much about technology but in finding ways to better connect people and enable a variety of voices in policy, product, housing, and infrastructure design. They viewed technology as a tool - one that can be used to connect older people (e.g. tech service, training, affordable devices), can be used to organise service deliverers (e.g., CRM), and that can provide solutions to problems (e.g. tech on crosswalks) - and as a significant barrier (e.g. machines used to pay for parking can be difficult to use). But none of that matters if it is not based on understanding their impact and roles. As such, simple and low-tech interventions based on this understanding - like benches outside shops or shifts in opening hours - can have more impact in their communities than (over) engineered solutions.

Governance

Participants in the governance workshop represented organisations involved in shaping and delivering policy around ageing in the Greater Manchester Area. All had a strong focus on social intervention and addressing inequalities within the region and of ageing outcomes.

The organisations’ scope of intervention, and the activities of the individuals that represented them in this workshop, varied from the very local scale to the national. Half of the organisations represented had strong connections with the Manchester area through the GMCA Ageing Hub and its networks but operated at a national level. The others were focused exclusively in the Greater Manchester area

even if their networks tended to be global. The nationally engaged participants were in a good position to compare their experiences in Manchester with other localities. They reported that while governance networks were well established and quite active in Manchester, the problems that the area faces were not substantially different from other jurisdictions. Opinions varied as to whether the policy initiatives were unique but many felt that there was “something different” going on in the area. As in other workshops, none of the participants felt as though there was a notable concentration of commercial activity that facilitated their work. However, one did argue that there was a plethora of local partners with whom they had been able to engage, suggesting that the critical mass of relevance was less economic and more of organisations that were receptive to partnership in enabling and disseminating age friendly practices.

The Ageing Hub was cited as a key broker and convenor of governance networks that connected actors with similar objectives. These networks appeared to be strongest between other governance organisations but also social actors and, to a slightly lesser extent, the research community. Participants described this network as being focused on delivering a “cultural shift” in changing minds and practices around ageing - to make ageing “everyone’s business”. In this workshop the value of these networks was characterised primarily as setting the tone, legitimising, and supporting the work of like minded organisations and was conspicuously not designed as a vehicle for innovative policy design or delivery (although these may have been implied).

Participants agreed that innovation in this space was a multifaceted concept. They pointed to general technologies, like the iPad, that have been transformational for older people and connectivity but noted that it wasn’t developed for that and Apple would typically not be characterised as a participant in the healthy ageing economy. In that sense, everything has the potential to support healthy ageing and a challenge is to encourage thinking around design that enables those to be more broadly accessible and applied. Other more targeted innovations have a place as well; however, there was some distaste for products aimed at selling into this growing market. Things like innovations in thinking, innovations in ways of working, and innovations related to behaviours, were also thought to be easier than some of the practical technical innovations because of difficulties that governance actors sometimes have in accessing and engaging with (and generating) market innovation.

Research

All participants in the research workshop were employed by higher education institutions. Their research interests spanned both policy and practice. They tended to be active in the social sciences, particularly in health inequalities. For some, this interest was directed exclusively towards health inequalities in older populations but for others, older people’s health inequalities was one part of a more general interest in the overall topic.

Interactions for research participants centred strongly around their relationships with the social sector and community organisations. There is an element of trust driving these relationships that was highly valued by researchers. On the other hand, ‘business’ and ‘for-profit’ were described as ‘dirty’ words and researchers did not tend to collaborate with these groups. This was tied by participants to the politics of the area and feelings that the history of the area was more strongly connected to social and solidarity economies. Local authorities and governance organisations were also seen as key partners for researchers to work with, particularly when it came to policy impact work. While the researchers involved older people mostly as research participants, they noted systemic challenges that prevented

them from involving older people as research partners (for example, limitations in providing monetary reward for research contribution). One participant described the problem: “We need to be experts for their experience; their lived experience; and they are contributing to our research and making it better. We’re all getting paid. So we should be able to pay them, but you can’t, because it’s a contract which is an issue with HMRC. That’s a policy ask”. The location of these partnerships mattered more to researchers than it did to the business sector, that being because key partners were community organisations. Collaborations for research did take place outside of the Greater Manchester area but on an ad hoc basis and researchers talked about using relationships with other researchers and relying on their networks to conduct research projects on a larger scale.

When asked about innovation, the researchers typically pointed to the social sector and community organisations again, rather than any university R&D related innovations. This again suggests a strong identification with social innovation. These socially innovative projects were described as being “community led”, that “capture subtleties”, address unmet needs, and “come from the right place about actually changing people’s lives and engaging them in that process”. The researchers, therefore, identified innovation with social aims and processes that simply but effectively recombined older people’s social relationships (for example, LGBT-affirmative extra-care scheme by the Manchester City Council), enabling them to live an independent life (for example, Levenshulme Good Neighbours project). This social innovation-informed view of innovation can be a reflection of the researchers’ acknowledgment of their social responsibilities. One participant described this as “showing commitment to wanting to amplify the voices of our communities which are seldom represented, but also to address the issues that are prevalent in our communities”. To this end, the researchers’ views on both innovation and their role in the Healthy Ageing domain strongly align with those of the social sector participants. This alignment evidences their long-standing partnership.

Conclusions and recommendations

A series of core themes emerged from our analysis of the glass.ai data and the Manchester case study that reaffirms how complex the healthy ageing domain is nationally and locally and lends support to the movement already underway in UKRI recognizing the value of social innovation as a legitimate and impactful focus of innovation support. This conclusion reflects the findings of our investigation into the boundaries and constitution of the healthy ageing domain, the nature of interactions between domain participants, how these feed into and stimulate place-based innovation, and how innovation is perceived and pursued in the context of hybridity. Overall, we find weak support for clustering conceptualised as a phenomenon linked with and supporting market innovations. However, the Greater Manchester case study provides some useful insights about the potential for place-based strategies to support both more broadly defined innovation and the goals of increased longevity and wellbeing. The following summarises our findings before proposing some recommendations to feed into ongoing programme development within the UKRI Healthy Ageing Challenge.

Domain hybridity challenges traditional perceptions of critical mass for innovation

Both the glass.ai data and the Manchester case study demonstrate the challenge that the highly diverse set of activities that are assembled under the healthy ageing umbrella pose for innovation and innovation policy. At the end of the day, ageing people are people - who can face a wide variety of age-related challenges or none at all. In that sense, all innovations that impact people will have an effect, for better or worse, on the ageing population and almost all economic domains will touch their lives. Our investigation attempted to define more specifically the activities, commercial and otherwise, that could be reasonably classified as actively part of the healthy ageing domain and found a varied landscape including healthcare, social services, media and arts, mobility, financial services, and more.

While diversity in the form of related activity can often stimulate innovation, such activities are perhaps too diverse and disconnected to create the synergies that underpin clustering and place-based market innovations. This is also partly because of functional diversity - firms recognise their connection and contribution to healthy ageing but, outside of social enterprises, rarely see themselves as exclusively part of the sector.

In some places, healthy ageing subsectors that are plugged into broader clusters might have sufficient critical mass to generate innovation benefits for participants. However, in these cases, healthy ageing activities are more likely to constitute a small part of a larger cluster in biotechnology, or housing, or medicine, and not a significant subsector in and of itself. From a policy perspective, it may be more effective to encourage the recognition of the importance of designing, planning, and creating for an ageing population across all sectors than to specifically focus on stimulating innovation around ageing in specific areas.

Creative interaction centred on governance and engagement, not market innovation

Market innovations can flourish even in a diverse environment through a variety of mechanisms - knowledge spillovers between unexpected industries can create new paths of technological development, for example. Interactions and networks are at the heart of these effects. In innovative places, we expect to see higher levels of interfirm interaction through strategic partnerships, industry associations, and around research and support structures. In these contexts, firms and other types of actors typically report strong benefits to being located where they are.

We did not find strong evidence of these kinds of dynamics in the Greater Manchester area in the healthy ageing domain. Firms reported no particular benefit to being located in the area aside from access to local support structures such as Health Innovation Manchester. By contrast, researchers, social organisations, and governance actors were relatively well connected to each other. These networks serve two main purposes: first, to feed into local and combined authority governance initiatives and, second, to increase reach and engagement of projects, initiatives, and programmes. In this context, governance acts as a leader and nexus - provides support structures and connects these (primarily) social and socially focused actors. Networks disseminate and amplify the voices of ageing people in a wide variety of forums and help to create change and opportunity around healthy ageing. They were never characterised as vectors for market innovation. But this doesn't mean that they are not innovative...

Innovation in a hybrid domain is just...different

While we found little evidence that the collocation of healthy ageing activities was instrumental in creating conditions for market innovation it was clear that participants in the healthy ageing domain in Manchester conceptualised innovation differently. They did not see the creation of better products and services as key to creating positive change to healthy ageing outcomes. While they acknowledged that new tools - such as apps and technologies - had their role in enhancing wellbeing, their impacts are limited if they are not accessible (available, appropriately designed, easy to use, lower or no cost) and applied at scale. In short, making more stuff to sell to older people, the health networks, and their carers, is not a magic bullet.

Rather, most participants reported that where innovation was required was in provoking behavioural changes (in older populations but also more broadly in social interactions and design); in increasing the ambition, reach, and scale of programmes; in connecting people better to ensure better feedback processes; and in socialising the idea that ageing should be embedded in all things instead of being confined to rigid categories and informed by stigmas. They emphasised that small, and sometimes low tech, interventions can have large effects. In this context, innovation is needed, and is occurring, in overcoming barriers, connecting more people, and in supporting social change. It is social innovation.

We argue that this is not unique to Greater Manchester but is instead particularly a feature of innovation in hybrid sectors. All innovation has a social change element to it, whether it intends to or not. Everything exists on a spectrum of economic, social, environmental, and other impacts. The iPad is an excellent example of a commercial product that because of ease of use and nearly ubiquitous uptake enabled older people to connect with friends, family, and support networks - perhaps unwittingly creating a significant social benefit. Typical innovation policies focus on maximising

economic impacts - growth, productivity, knowledge spillovers - even as they recognise that social effects are also desirable and likely. The difficulty is that it is hard to predict the magnitude of social impact of market innovation and the assumption that funding market innovations in an economic space will automatically generate positive social change is flawed. Only focusing on one end of the spectrum - e.g., economic or social - limits potential impact. Instead, to realise the twin goals of economic and social benefit, a broader understanding of innovation is needed.

Opportunities for place-based innovation

Supporting and enhancing these kinds of evolving place-based networks and initiatives that we have observed in the Greater Manchester case may have greater impact on achieving progress in the seven healthy ageing themes that underpin the UKRI Healthy Ageing Challenge than relying exclusively on targeted support for market innovations.

Investing in clusters is thought to create multiplier effects for market innovation - enhancing local assets, shared knowledge bases, and labour pools, among many other expected benefits. We argue that similar effects may hold for investments in social innovation, but through very different mechanisms (Gerli et al. 2021). In these cases, rather than enhancing the pool of inputs to a localised market, investments in social innovations can multiply *outputs* as social changes reduce barriers for all, ease accessibility issues, support the broader dissemination of practices, and further strengthen governance networks. These, in turn, may open up more space for innovation (social and otherwise!) as well as (ideally) generating actual social impact.

Because these impacts are concentrated in one location, rather than being confined within a single firm, benefits may stimulate more localised activity, engagement, partnerships, and a more fertile environment for change. As with market innovation support, these kinds of impacts are not automatic. The following recommendations build on opportunities identified in the course of this research and represent a beginning to balancing the roles of market and social innovation in supporting the growth of the healthy ageing domain and goals of healthy ageing.

Recommendations

A place-based model of public intervention in a hybrid domain should focus on supporting and strengthening ecosystems that enable both social and market innovations. This should involve supporting more than just firms and social enterprises but potentially expanding this to encompass ideas, objectives, and initiatives that rely on innovation to generate impact defined more broadly to include social benefit.

- **Focus on connecting the commercial and social sectors**

Our research in Manchester demonstrated relatively strong connections between governance-research-social sectors but weaker engagement with firms. While this is partly due to the diversity of firm activities and identification issues related to functional diversity, we suspect that actors also operate in silos that make spontaneous connections more difficult. In places that have emerging or developed governance networks, extending engagement with commercial entities may help to bridge gaps and stimulate innovation (directly or indirectly).

- **Create synergies with science**

One of the barriers to closer engagement between actors within the healthy ageing domain is a notable division between those that operate within and alongside the healthcare sector and those that are not formally considered part of that ecosystem. Recent trends increased the emphasis on social prescriptions, however firms and organisations attempting to fill that space have encountered difficulties collaborating, interfacing, and engaging with healthcare actors and funding streams. Recognising the frictions between social and scientific/technical approaches and seeking mechanisms to broker relationships and reduce bureaucratic and cultural barriers to collaboration and knowledge exchange can increase innovation potential.

- **Encourage age-inclusive everything**

This study has repeatedly observed that almost any kind of innovation can contribute to ageing better. One important strategy may be to encourage age-inclusiveness (as well as other kinds of inclusivity) to become a part of all aspects of innovation - from urban or product design and development, and to be embedded in processes and practice. While there is still value in supporting the development of targeted products and services, expanding the realm of innovation “for everyone” will also see social benefits.

- **Target skills and training gaps**

Developing age-inclusive everything - from products to places to policy - will require not only the input of ageing populations (and their advocates) but the skills to translate these perspectives into practice. Localities can look to embed age-inclusivity into areas of skills with existing strengths but can also plan for future skills. This will go beyond just a demand for care workers but will impact everything from urban to industrial design, service provision, policy development, etc. Aligning the ambitions embedded in local ageing strategies (where they exist) with others, such as local industrial and skills strategies can reveal opportunities to enhance existing strengths and spot potential gaps.

- **Focus on complementarity, not competition, in place-based support**

When supporting clusters policy makers often have to pick winners - places or technologies or industries - and that support creates a zero sum game. That place benefits and its competitors lose out. Encouraging place-based innovation can create internationally-recognised centres of excellence but the lessons generated within localised networks are transferable and local assets (such as research, support structures, and social networks) can be shared, plugged into, and extended to create benefits in other locations around the country (and internationally). No one loses out when more places become more age-friendly. There is a strong and emerging set of research institutions around the UK working on aspects of longevity, healthy ageing, and age in the economy such as the National Innovation Centre for Ageing (NICA) in Newcastle, the Awen Institute in Swansea, and the Manchester Institute for Collaborative Research on Ageing (MICRA) in Manchester, among others. In addition to these, there are approximately 40 research centres specialising in aspects of ‘healthy ageing’ across the UK. Encouraging business to link with these specialist centres covering design, behavioural sciences, technology, health and care can play a key role in converting policy commitments into a thriving domain with social and economic benefits. Significantly, these assets create advantages for action on healthy ageing in their regions, but have the potential to contribute to initiatives in other places too. Furthermore, they may multiply their impact and visibility by collaborating.

- **Recognise opportunities, and pitfalls, in future challenges**

While innovation often focuses on capitalising on the supply side, little attention is being paid to the public and social implications of increasing private sector investment in serving this market. For example, some sectors, such as housing development, anticipate and are already proposing significant new projects to take advantage of the increasing ageing population. While some of these developments will be undertaken in partnership with broad governance coalitions and with input from local governments, many may not be. In the absence of planning, these private sector initiatives may not be optimised for public benefit. Preparing public actors, and linking them with networks around social innovation, can help to shape and leverage these private investments to ensure prosperity as well as diversity, inclusion, and equity.

- **Link age-friendly innovation to levelling up agendas**

The levelling up agenda emphasises not only boosting innovation and economic development, but quality of life and wellbeing, in left behind places. As such, supporting social innovation in these places has the potential to create positive lifestyle benefits for ageing populations. Additionally, the emergence of strong networks around healthy ageing can help to connect and galvanise other social and particularly intergenerational networks, such as around opportunities and training for youth.

Those we talked to noted that one of the hardest parts about engaging in policy in the healthy ageing domain is a reluctance to talk about it. Being confronted with our own mortality is uncomfortable, at any age. As a result, the topic of (healthy) ageing risks being segregated - more comfortably discussed as a healthcare problem than as something that touches on all of our daily lives. Our work affirms the UKRI Healthy Ageing Challenge's direction of travel in recognising the necessity for social innovation alongside market innovations. This aligns with a growing movement across the public sector that is increasingly seeking innovative pathways to social and behavioural change.

Stimulating change and innovation in the healthy ageing domain can be facilitated by engaging with policy makers at all levels of government to socialise the message that age-friendly innovations and places are not just for older people, but make everyone better off. Embedding age-inclusivity and encouraging innovation, broadly defined, in a wide variety of sectors has a place in everything from national initiatives, such as levelling up, to economic development through local industrial strategies.

The challenges of stimulating the healthy ageing domain are not to be underestimated, however, the potential for economic and social impact means that it is worth investing in finding a means to support this hybrid domain. Further social science studies could delve deeper into the nuances of how to support hybrid domains in both the healthy ageing and wider contexts.

References

- Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies*, 45(7), 893-904.
- Battilana, J., Besharov, M., & Mitzinneck, B. (2017). On hybrids and hybrid organizing: A review and roadmap for future research. *The SAGE handbook of organizational institutionalism*, 2, 133-169.
- BEIS (2020). UK Innovation Survey 2019: Headline Findings Covering the Survey Period 2016-2018. Released 26 March, 2020.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/873740/UKIS_2019_Headlines_Findings.pdf Accessed: June 2, 2022.
- BEIS. (2021). UK Innovation Strategy Leading the future by creating it Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009577/uk-innovation-strategy.pdf Accessed: June 2, 2022.
- BEIS. (2022). UK Innovation Survey 2021: Report covering the survey period from 2018 to 2020. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1074069/UK_Innovation_Survey_2021_Report.pdf Accessed: June 20, 2022.
- Bright, C., 2019. Ageing Society Grand Challenge, Oxford Institute of Population Ageing. Retrieved from <https://policycommons.net/artifacts/2070845/ageing-society-grand-challenge/2826143/> Accessed 29 Jun 2022. CID: 20.500.12592/nwmkkk.
- Chivers, S. (2021). “With Friends Like These”: Unpacking Panicked Metaphors for Population Ageing. *Societies*, 11(3), 69.
- Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy. *Industrial and Corporate Change*, 10(4), 945-974.
- Costa, A., Sousa, C. J., Seabra, P. R. C., Virgolino, A., Santos, O., Lopes, J., . . . Alarcão, V. (2021). Effectiveness of Social Prescribing Programs in the Primary Health-Care Context: A Systematic Literature Review. *Sustainability*, 13(5), 2731.
- Crunchbase (2022). United Kingdom Biotechnology Companies. <https://www.crunchbase.com/hub/united-kingdom-biotechnology-companies> Accessed: June 29, 2022.
- Gerli, F., Calderini, M., & Chiodo, V. (2021). An ecosystemic model for the technological development of social entrepreneurship: exploring clusters of social innovation. *European Planning Studies*, 1-23.
- Grillitsch, M., Asheim, B., & Trippl, M. (2018). Unrelated knowledge combinations: The unexplored potential for regional industrial path development. *Cambridge Journal of Regions, Economy and Society*, 11(2), 257-274.

Hamilton-West, K., Milne, A., & Hotham, S. (2020). New horizons in supporting older people's health and wellbeing: is social prescribing a way forward? *Age and Ageing*, 49(3), 319-326. doi:10.1093/ageing/afaa016

HM Government. (2017). Industrial Strategy White Paper: Building a Britain fit for the future. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf Accessed: June 2, 2022.

HM Government. (2022). Levelling Up the United Kingdom. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1052708/Levelling_up_the_UK_white_paper.pdf Accessed: June 2, 2022.

Lodge, C., Carnell, E., & Coleman, M. (2016). *The new age of ageing: How society needs to change*: Policy Press.

Martin, R., & Sunley, P. (2003). Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, 3(1), 5-35. doi:10.1093/jeg/3.1.5

Murdock, A. (2020). Responding to Ageing Demographics: A Positive View from a Public Administration and Public Policy Perspective. In *Public Management and Vulnerability* (pp. 183-201): Routledge.

Murtagh, B. (2017). Ageing and the social economy. *Social Enterprise Journal*.

ONS (2019). Living longer. Is 70 the new age 65? <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/articles/livinglongerisage70thenewage65/2019-11-19> Accessed: June 29, 2022.

Pache, A. C., & Santos, F. (2013). Inside the hybrid organization: Selective coupling as a response to competing institutional logics. *Academy of management journal*, 56(4), 972-1001.

Social Innovation Exchange, 2010. Study on Social Innovation. Available: <http://youngfoundation.org/wp-content/uploads/2012/10/Study-on-Social-Innovation-for-the-Bureau-of-European-Policy-Advisors-March-2010.pdf> Accessed: June 30, 2022

UKRI (2022) Healthy Ageing Challenge <https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/ageing-society/healthy-ageing-challenge/> Accessed: June 2, 2022

Appendix A: Innovation and approach: glass.ai methodology

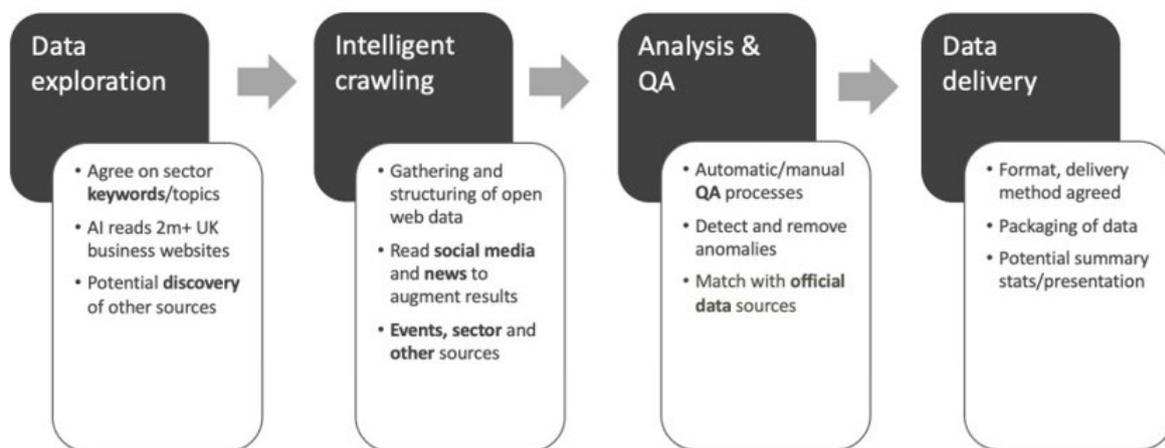
Traditionally when investigating sectors, you might turn to official data and statistics, business surveys or static company data sets, but these tend to be at least a year out of date, of poor quality and often at an aggregate level that doesn't really help with accurate decision making. Furthermore, standard classifications, such as SIC codes, are rather static and do not capture the dynamic nature of new, broad and emerging sectors of the economy such as the healthy ageing sector. A rich, detailed and up to date representation of business activity does exist though, if we turn to the open web and we read how the companies describe themselves and analyse what the companies do.

glass.ai regularly reads over 2M UK based websites of organisations (companies, partnerships, sole traders, academic institutions, government and non-profits) through its intelligent crawler technology. This represents a significant proportion of all UK organisations with a web presence. Where possible, glass.ai also matches the websites with social media and the official business register in the UK (i.e. Companies House). As well as discovering new content, this ongoing process keeps the existing view of the organisations that it knows about up to date. Below are the main sources the glass.ai system reads to gather the evidence:



To map the healthy ageing sector, glass.ai worked with the project team to develop a list of topics/keywords and other criteria relevant to the healthy ageing sector study. Once the initial set of keywords and criteria were agreed, glass.ai used its capability to identify any text on websites that may suggest the companies that are relevant to the sector. To ensure a more complete coverage, glass.ai augmented its regular web sources with other sector specific data sources shared by the project team like relevant company, news, social media, and industry websites. These lists helped us improve the search and fine-tune our language models for the crawl and ensured any large relevant organisations were not missed. The development of the final results was an iterative process where glass.ai worked collaboratively with the project team sharing and reviewing samples of the output as the crawl progressed to improve the relevance of the companies that were being identified and ultimately to ensure that the search criteria and results met the expectations of the project.

Below is the high-level process that was followed:



To make this possible, glass.ai has invented AI technology that applies techniques at the frontiers of machine language understanding to create an automatic semantic layer for the web. It combines language understanding through semantic analysis with resource crawling at scale and the maintenance of a deep topic ontology that allows us to identify businesses in given sectors (e.g. selected knowledge industries).

Semantic Analysis: first, the AI crawler classifies the content of text on web sources (e.g. company descriptions, topics, news, etc.) with state-of-the art precision. So, when the crawler goes to a website or social media profile, it makes its own decisions and it can understand what the description for the organisation is, the news, products/services mentioned, people, jobs advertised, and extracts linked entity models from the unstructured web content. The current entity-detection accuracy is 95% and the work conducted to date on this is world leading. To achieve this semantic entity recognition, models are trained offline using machine learning techniques against small volumes of data that can be efficiently applied against web-scale volumes of data. Think of these models as language templates to execute a multi-layered approach to text analysis that is able to focus online (at crawl time) onto the text that matters. This process encompasses a continuous test harness to improve models for accuracy, and a semi-automated build-test-learn pipeline to enhance complex entity detection. Using this infrastructure, new language models can be built to detect new types of content.

Organisation descriptions, for example, are identified with language models that consider multiple features such as location on the web page, use of specific keywords and phrases, sentence structure etc. Also, based on descriptions and other attributes, each organisation is classified into one or more sectors and assigned a weight showing its proximity to the sector. Specialised businesses tend to have a single sector with high weight, while those with a diversified activity have multiple sector predictions with lower weight values. The automatic sector classification has been trained using a sample of classifications based on an industrial taxonomy created by LinkedIn. Current accuracy of descriptions/sector predictions is 95%.

Resource Crawling: in a second step, glass.ai have industrialised the extraction process by developing an intelligent crawling service that targets the crawl to read content and follow links that are most likely to find the entities that it has been created to detect. By directing the crawl to find known entities and concepts 'within' the crawl instead of retrospectively filtering data returned, glass.ai is able to get large scale information-extraction efficiently running on very modest hardware, and the system as designed scales linearly. This means the AI can read millions of sources without the need of massive computation resources.

Topic Ontology: in a third step, glass.ai have derived a 'topic/keyword map' for the data. This taxonomy includes business and other activities, products and services, and is key to understanding what an organisation does and the activities it is involved in. This allows the data to be queried by subject classification. The system currently contains around 300k topics. glass.ai continue to improve this topics map to drive simple and complex entity detection and add other entity types to the ontology. The topic ontology has been built and continues to evolve from reading the web content that is crawled and consuming crowd sourced content, such as Wikipedia. It can also be augmented by subject specific lists in cases where they are not sufficiently covered by the current core topic ontology.

Limitations

The public web provides a rich context around the activities of businesses. However, not all UK organisations have a website, so our approach is limited to those that have an independent web presence. This may impact the representation of smaller organisations as they are less likely to have a website than larger organisations. Further, the absence of web presence can be sector dependent. That is, certain sectors may be more likely to have a web presence than others. glass.ai estimate there are circa 2.4m UK businesses with an active website. At present the crawler has not discovered all the websites of these organisations and is currently reading 90%+ of them. To mitigate this risk for specific research, the core glass.ai dataset can be augmented with external lists of known relevant businesses and their websites, and core online resources.

As the web is constantly changing and new sites are appearing and disappearing, sites may be missing because they have not yet been discovered by our onboarding schedule or may have been in a format or structure that our processes were not able to read or do not match the models that are being detected. In particular because the approach is language based - relying on reading static text content - it may struggle to read image, flash or Javascript-heavy sites where content is displayed dynamically or embedded in other objects.

When performing targeted research like this project on the healthy ageing sector, a challenge using specific keywords to identify activities is that if a relevant organisation doesn't list those words on their website or is on a page that has not been read by our directed crawl then the business may not be

included in the results. This can be mitigated by supplying a broad range of topics/keywords associated with the types of organisations that need to be discovered and using the topic ontology to discover topics related to the supplied list.

Contact

info@innovationcaucus.co.uk
Oxford Brookes Business School
Headington Campus
Oxford OX3 0BP

www.innovationcaucus.co.uk