

Building Elderly Fit for the Future

Mission-oriented innovation policy in a wicked, ageing society

A case study on the UK's Industrial Strategy

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Summary

Countries all over the world face a number of formidable societal challenges, many of them global in scope. An assumption that has recently come up is that these societal challenges can be mitigated through innovations. This places high expectations on innovation policy. In particular, it calls for new, more proactive and mission-oriented, policy approaches. This type of broad-based innovation policy has been called 'mission-oriented' for its aim to achieve specific objectives. An example is the Industrial Strategy, developed by the government of the United Kingdom (UK), in which they tackle four societal challenges. One of these challenge is the UK's ageing population. It is namely estimated that in 2040, nearly one in seven people will be over the age of 75. However, societal challenges such as the UK's ageing population are highly wicked. This means that these challenges are complex, intractable, open-ended and unpredictable. The notion of wicked problems has its roots in social policy planning and has been helpful in explaining the difficulties that have plagued some areas of urban planning, social policy, and environmental and natural resources policy.

Because there are multiple types of wicked problems, and each type demands another policy approach, this thesis will investigate what type of wicked problem the ageing society in the UK is. Moreover, this thesis will give some recommendations on how the UK's mission-oriented innovation policy can address this specific societal challenge. Although the literature about wicked problems and mission-oriented innovation policy agrees that there is a need for collaboration between different stakeholders and a clear problem and solution definition to tackle societal challenges, a literature gap exists in incorporating different types of wicked problems into mission-oriented innovation policy. This leads to the following research question: *How wicked is the societal challenge of an ageing society, and how can mission-oriented innovation policy address this challenge?* Incorporating wicked dimensions into mission-oriented innovation policy literature could make policy measures more effective and could therefore benefit the whole UK. The research design is a single case study and consists of qualitative data taken from the review of policy documents from the UK government and an interview.

This thesis argues that the UK's challenge of an ageing society is an analytically complex problem in which the problem is well understood and stakeholders have a co-operative relationship and are willing to share knowledge about the problem, but a clear solution is missing. Therefore, this thesis suggests that the UK government should develop more real concrete and achievable missions. These missions provide a massive opportunity to increase the impact of the UK's Research and Development, can bring people together around this ambitious common goal and therefore provide more clarity on the necessary actions

the government should take in order to tackle this problem. Moreover, intermediate milestones that indicate how the UK is tackling this challenge should be incorporated into their policy to increase the clarity of the solution.

Nederlandse samenvatting

Landen over de gehele wereld worden vandaag de dag geconfronteerd met een groot aantal maatschappelijke uitdagingen. Een veronderstelling, die recentelijk is ontstaan, is dat deze maatschappelijke uitdagingen verlicht kunnen worden door middel van innovaties. Deze veronderstelling stelt hoge verwachtingen van innovatiebeleid en vraagt om nieuwe, meer proactieve en missiegerichte beleidsbenaderingen. Dit type innovatiebeleid wordt missiegericht genoemd vanwege het streven om specifieke doelstellingen te bereiken. Een voorbeeld is de 'Industrial Strategy', een nieuw beleidsplan van het Verenigd Koninkrijk (VK) om maatschappelijke uitdagingen aan te pakken. Een van deze uitdagingen is de vergrijzende bevolking in het VK. Geschat wordt dat in 2040 bijna één op de zeven mensen ouder dan 75 jaar zal zijn. Maatschappelijke uitdagingen zoals de vergrijzende bevolking in het VK zijn echter zeer 'wicked'. Dit betekent dat deze uitdagingen complex, hardnekkig en onvoorspelbaar zijn. Het concept van 'wicked problems' kent zijn wortels in beleid voor sociale vraagstukken en heeft geholpen bij het verklaren van de problemen die sommige gebieden van stadsplanning, sociaal beleid en milieu- en natuurlijke hulpbronnenbeleid hebben geplaagd.

Omdat er verschillende soorten 'wicked problems' zijn en elk type om een andere beleidsaanpak vraagt, zal deze thesis onderzoeken welk type 'wicked problem' de vergrijzende bevolking in het VK is. Bovendien zal deze thesis een aantal aanbevelingen geven over hoe het missiegerichte innovatiebeleid van het VK deze specifieke maatschappelijke uitdaging aan kan pakken. Hoewel de literatuur over problemen en missiegerichte innovatiebeleid het erover eens is dat er behoefte is aan samenwerking tussen verschillende stakeholders en aan een duidelijke oplossing voor sociale uitdagingen, bestaat er een kloof in de literatuur bij het opnemen van verschillende soorten 'wicked problems' in een missiegericht innovatiebeleid. Hierdoor is de volgende onderzoeksvraag ontstaan. *Hoe wicked is de maatschappelijke uitdaging van een vergrijzende samenleving en hoe kan missiegericht innovatiebeleid deze uitdaging aangaan?* Het opnemen van de verschillende dimensies van 'wicked problems' in een missiegericht innovatiebeleid zou beleidsmaatregelen effectiever kunnen maken, wat het gehele VK ten goede komt. Het onderzoeksontwerp is een 'case study' en bestaat uit kwalitatieve data verkregen uit beleidsdocumenten van het VK en een interview.

Deze thesis beargumenteert dat de uitdaging van de vergrijzende samenleving in het VK een analytisch complex probleem is waarbij het probleem goed wordt begrepen, stakeholders samenwerken en bereid zijn kennis over het probleem te delen, maar een duidelijke oplossing ontbreekt. Daarom suggereert deze thesis dat de Britse overheid meer concrete en haalbare missies moet ontwikkelen. Deze missies kunnen

de impact van Onderzoek en Ontwikkeling (O&O) in het VK vergroten, mensen samenbrengen rondom dit ambitieuze gemeenschappelijke doel en daardoor meer duidelijkheid geven over de noodzakelijke overheidsmaatregelen die nodig zijn om dit probleem aan te pakken. Bovendien moeten tussentijdse mijlpalen, die aangeven hoe het VK deze uitdaging aanpakt, worden opgenomen in hun beleid om meer duidelijkheid te creëren over de oplossing van deze maatschappelijke uitdaging.

1. Introduction

The 21st century is becoming increasingly defined by the need to solve social, environmental and economic challenges through innovations (Mazzucato, 2017; Weber & Rohrarcher, 2012). However, innovation policy as a distinct policy area is a relatively new addition to policy-makers' agendas. The term only came into frequent use around the turn of the millennium, reflecting the increased attention at the time from policy-makers and scholars to the role that innovation plays in long-run economic and societal change (Edler & Fagerberg, 2017). Innovation policy may be understood as actions by public organisations that influence innovation processes, i.e. the development and diffusion of innovations (Edquist, 2011). By stimulating innovation in firms, governments hope to increase productivity, employment growth and prosperity (Frenken, 2017).

An assumption that has recently come up is that societal challenges, also known as Grand Challenges (GC), can be mitigated through innovation policy (OECD, 2011; Mazzucato, 2017, Weber & Rohrarcher, 2012; Boon & Edler, 2018). These societal challenges such as environmental threats like climate change, demographic, health and wellbeing concerns, as well as the difficulties of generating sustainable and inclusive growth, are broadly defined areas which a nation may identify as a priority (Mazzucato, 2017). This type of broad-based innovation policy has been called 'mission-oriented' for its aim to achieve specific objectives (Mazzucato, 2017). Such policies, by definition, give explicit technological and sectoral directions to achieve the 'mission'. These missions provide a solution, an opportunity, and an approach to address the numerous challenges that people face in their daily lives. A well-known example that clarifies this shift is the European Horizon 2020. The European Union identified seven challenges and developed a Framework Programme for Research and Innovation that would focus on these seven challenges (European Commission, 2012).

In 2017, in line with the rising notion of mission-oriented innovation policy, the United Kingdom (UK) developed a mission-oriented policy, called the Industry Strategy. Together with the Green Paper consultation, the Government Office for Science, UK Research and Innovation, Council for Science and Technology and the National Academies, they identified four GC to put the UK at the forefront of the industries of the future, ensuring that the UK takes advantage of major global changes, improving people's lives and the country's productivity. These challenges are identified as the growing artificial intelligence and data driven economy, clean growth, future of mobility and the ageing society (Government HM, 2017). Within this last GC, the UK developed a 'Healthy Ageing Programme' in order to invest in innovations to help older people maintain their chosen lifestyle and stay independent longer (Government HM, 2017).

This thesis will focus on the UK's fourth GC: the ageing population because of the relative new focus within the UK government to tackle this GC with innovations.

In mid-2014, the average age in the UK exceeded 40 for the first time. It is estimated that in 2040, nearly one in seven people is projected to be aged over 75 (Government Office for Science, 2016). This demographic change will, due its seriousness and societal relevance, undoubtedly have its implications for public services and economic growth. The proportion of medical admissions has already risen from 27 per cent of all admissions (including mental health and maternity) in 1999/00 to 35 per cent in 2014/15 (Jones, 2016). Therefore, significant improvements in health are necessary to decrease the amount of chronic conditions, multi-morbidities, and cognitive impairments (Government Office for Science, 2016). Because an ageing society creates new demands for technologies, products and services, including new care technologies, new housing models and innovative savings products for retirement, the UK government hopes to meet the needs of an ageing society by investing in innovation (Government HM, 2017).

These societal challenges of the modern era are often described as highly 'wicked' (Mazzucato, 2017; Alford & Head, 2017). Wicked problems are complex, intractable, open-ended and unpredictable (Alford & Head, 2017). Wicked problems are not solved once and for all but pose a constant challenge, partly because it is not known for sure when or if they will be solved (Jentoft & Chuenpagdee, 2009). Although mission-oriented innovation policies do not deny that there is a wicked dimension to societal challenges, they have never incorporated this dimension within their frameworks. Even with the upcoming recognition that there is no one-size-fits-all approach (Veugelers & Schweiger, 2016; Alford & Head, 2017), very few attempts have been made to incorporate various approaches to different types of societal challenges into mission-oriented innovation policy. There is a gap in the literature between the acknowledgement that societal challenges are highly wicked and the current mission-oriented innovation policy literature (Edquist & Zabala-Iturriagagoitia, 2012, Mazzucato, 2017; Frenken, 2017; Boon & Edler, 2018).

According to Alford & Head (2017), there is no one-size-fits-all policy for the different kinds of societal challenges and every societal challenge needs a different, specific approach. They argue that there are two irreducible elements of wicked situations: the problem itself and the actors involved. In this thesis, these two elements of wicked situations will be examined in the UK's innovation policy regarding their ageing society. By collecting qualitative data through reviewing policies and interviewing a policy maker, the wicked dimensions of the UK's ageing population will be examined and some recommendations will be made about which specific innovation policy focus is needed in the UK. This will not immediately solve the

societal challenge, but it can assist the identification and adoption of appropriate interventions (Alford & Head, 2017).

This research will be a first attempt to combine the framework of Mazzucato (2018) and Alford & Head (2017) into a more extended framework in which more specific recommendations could be made according to the different types of societal challenges. This creates a more comprehensive understanding of the necessary innovation policy instruments that could tackle societal challenges in general and the challenge of an ageing society specifically. Moreover, incorporating wicked dimensions into mission-oriented innovation policy literature, could lead to a more effective approach in tackling the societal challenge of an ageing society, and therefore could benefit all citizens in the UK. To examine the current innovation policy in the UK, the following research question will be the guideline throughout this research.

How wicked is the societal challenge of an ageing society, and how can mission-oriented innovation policy address this challenge?

A case study on the UK's innovation policy will be used to apply the literature on wicked dimensions and mission-oriented policy to a real-life situation. This case study challenges the theoretical assumptions that possible solutions to societal problems are unworkable because of a high level of disagreement among stakeholders (Alford & Head, 2017), and the assumption that countries lack well-defined mission-oriented policies (Mazzucato, 2017). Moreover, this case study attempts to make complex concepts like wicked problems comprehensible and implementable for other nations and case studies. The case of the UK's policy has been chosen because it exemplifies the notion of mission-oriented policy and is therefore a 'typical' case.

In the following section the theory and origin of mission-oriented innovation policy and wicked problems will be reviewed and discussed and different elements of these two theories will be explained in order to create a detailed understanding of both theories. Thereafter, in Section 3, the research design and methodology will follow. In Section 4, the results and analysis of the two irreducible elements of wicked situations, the problem itself and the actors involved, will be discussed. In the last section, Section 5, the conclusions will be elaborated upon together with the discussion, and recommendations will be made for the UK government regarding their ageing society.

2. Theoretical background

2.1 Innovation policy

Innovation, defined here as the successful introduction of new products, services and production processes, is considered an important factor of economic growth, and more often than not, as the single most important factor (Frenken, 2017; Nooteboom & Stam, 2010). Innovation policy comprises all combined actions that are undertaken by public organisations that influence innovation processes in order to encourage and facilitate the generation, application, and diffusion of new ideas (Borrás & Edquist, 2013; Nooteboom & Stam, 2010; Bemelmans-Videc, Rist & Vedung, 2011). The justification of innovation policy consists traditionally out of two main theoretical rationales, (1) the market failure rationale (i.e. the inefficient allocation of goods and services by a free market), and (2) the system failure rationale (i.e. the inappropriate or missing organisations, institutions, or interactions between components of an innovation system) (Nooteboom & Stam, 2010; Bemelmans-Videc et al., 2011). Innovation policies in the European Union within these two rationales were focused on boosting competitiveness between countries and stimulating scientific excellence by generating knowledge (EU, 2017). However, in recent years, a third perspective on innovation policy has emerged: the complexity-theoretic perspective. This perspective emphasizing that, first and foremost, innovation patterns are highly cumulative and path dependent (Frenken, 2017). In order to transform economies and cope with the number of formidable societal challenges through innovations, a new wave of innovation policies was needed. This policy approach would start from those parts of society where the challenge is actually present and partial knowledge about it is available in order to develop a well-defined and politically supported problem (Boon, Moors, Kuhlmann & Smits, 2011; Foray, Mowery & Nelson, 2012).

Mission-oriented innovation policy

In response to these societal challenges, together with the frequently made assumption that innovation policy is able to mitigate these societal challenges, a number of policy experts and policy makers have argued for mission-oriented policies (Mazzucato, 2017; Weber & Rohracher, 2012). These challenges have created a new agenda for innovation and growth policy that require policymakers to ‘think big’ about what kind of technologies and socioeconomic policies can fulfil visionary ambitions to make growth more smart, inclusive and sustainable (Mazzucato, 2015). This meant a change in focus: from investing in competitiveness or knowledge production to trying to solve societal problems, and changed the role of

the state in innovation policy (Boon & Edler, 2018). This caused a lot of attention for proactive and mission-oriented policies (Mazzucato 2018, Frenken 2017), which are defined by Mazzucato (2018) as systemic public policies that draw on frontier knowledge to attain specific goals. This shift is most clearly being expressed in the attempt of the challenge-based approach of the European Union, known as the Horizon 2020 (European Commission, 2012), or the Sustainable Development Goals (SDGs), developed by the United Nations in 2015, known as the 2030 agenda (UN, 2015). These policies seek to define specific areas of societal concern and tackle societal challenges such as food security and ageing societies. In Europe, a first explicit manifestation of this was a strategic EU report in 2006 (Aho, Cornu, Georghiou & Subirá, 2006). Rather than being limited to supporting the capability and connectivity of and within systems to innovate, the state is increasingly seen as a major actor in shaping the directionality of innovation (Mazzucato 2011; Weber and Rohrer 2012). The Apollo mission in 1961 is a concrete example of the capability of the state to actively shape and create markets. The Apollo 'Man on the Moon' mission expressed by President John F. Kennedy was a geo-political and technological mission. It set a clear and ambitious objective: put a man on the moon and bring him back safely within a concrete timeline (European Commission, 2018). This mission was inspirational and much can be learned about the role of the state and the importance of setting ambitious goals.

To tackle the current social challenges, these challenges should be broken down into smaller, more manageable parts (Alfred & Head, 2017; Mazzucato, 2018). Transforming a societal challenge into a concrete objective and policy is a key process. Concretization of a challenge is essential for policy to address this societal challenge, but is sometimes missing (Frenken, 2017). According to Mazzucato (2018) the government should transform the GC into concrete, measurable and achievable missions, like 'Reduction of 90% of plastics entering the marine environment and collection of more than half of plastics present in our oceans, seas and coastal areas by 2025', or 'reach net zero greenhouse gas emissions balance of 100 European cities by 2030'. These missions need to be very clearly framed and need a specific target. By using intermediate milestones, the government can reflect and adapt the missions over time if the milestones provide new information or show that the mission has been framed problematically and needs adjusting. After defining missions, mission-projects should be created to engage all sorts of organisations into concrete projects within the mission. See figure 1 for an overview of this framework.



Figure 1: From Challenges to Missions Image, based on Mazzucato (2017).

2.2 Wicked societal problems

These societal challenges are often recognised as complex, systemic, interconnected and urgent. In other words, they are highly wicked, and therefore require insights from many different perspectives (Mazzucato, 2017; Alford & Head, 2017; Elia & Margherita, 2018). The concept of ‘wicked problems’ has its roots in social policy planning and is mainly used in societal problems. This concept was first examined by Rittel & Webber (1973). They noticed that in the context of social policy, a clear problem definition was missing and stakeholders had very different and sometimes conflicting perspectives on the problem. Therefore, they identified ten primary characteristics of wicked problems, which have been helpful in explaining the difficulties that have plagued some areas of urban planning, social policy, and environmental and natural resources policy (Head & Alford, 2008). Since the work of Rittel & Weber (1973), there have been many definitions of a wicked problem. The latest literature on wicked problems, used in this research, defines wicked problems as complex, intractable, open-ended and unpredictable (Alford & Head, 2017).

Besides the fact that societal challenges are highly wicked, societal challenges come in various shapes and sizes, each requiring a particular handling (Alford & Head, 2017). Although most innovation policy literature acknowledges the fact that there is no one-size-fits-all approach, it does not make specific differentiations between solutions for societal challenges. Mitigating climate change, ensuring sustainable energy and food supply, public health or the general well-being of people are urgent challenges that must be solved by innovation (Mazzucato, 2017; Weber & Rohracher 2012; Frenken, 2017), but none of the literature addresses the different wicked dimensions of those challenges, nor the different types of wicked problems.

Characterising different types of wicked problems

The policy planning literature developed a more differentiated approach to characterise wicked problems. For instance, Alford & Head (2017) emphasise that the wicked dimension of societal challenges is not the same for every societal challenge. They have formed a two-dimensional matrix on the two irreducible elements of wicked situations: the problem itself and the actors involved. When combined, they form a two-dimensional matrix of nine possibilities, see figure 2. The wickedness of a problem lies between tame problems and very wicked problems. Tame problems are characterised as a problem in which the problem and solution is clear to policy makers and whereby stakeholders or institutions have a co-operative or indifferent relationship. Very wicked problems are, on the contrary, characterised as a problem in which neither the problem nor the solution is clear and stakeholders or institutions have conflicting values and interests. Depending on the type of wickedness, policy makers can adopt the appropriate interventions to address a societal challenge effectively.

Because of the rich literature aimed at understanding other wicked dimensions like network performances, technical dimensions and instrumentalities associated with various management choices, (Weber & Khademian, 2008), focusing on the relationship between stakeholders and the clarity of the problem and solution will amplify and extend the current literature. This study will therefore focus on these two dimensions: stakeholders and complexity as demonstrated in Figure 2.

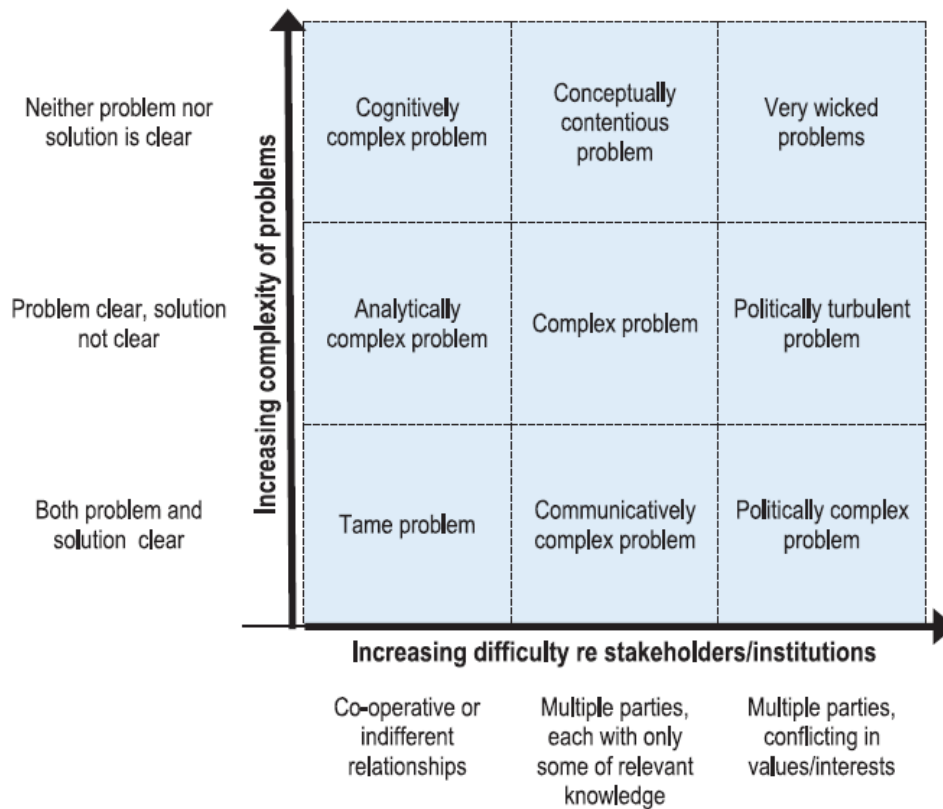


Figure 2: Different types of complex problems.

Stakeholders

Bringing a wide range of governmental and non-governmental actors into the policy process is critical to ensure policy coherence, and is an effective way to ensure that divergent views and interests are included in an explicit and transparent manner in the balancing act of policy-making (Blouin, 2007). Policy analysts have long been aware of the importance of interest groups in the policy-making process; and the need to characterise and categorize levels of interest and power which influence, and therefore impact policies (Brugha & Varvasovszky, 2000). Wicked problems are by their very nature usually beyond the cognitive capacity of any one mind to diagnose or comprehend, especially if they are technically complex issues (Heifetz, 1994). Therefore, these problems also call for thoughtful analysis, dialogue and action on the part of affected stakeholders (Alford & Head, 2017). However, stakeholders like NGOs, knowledge institutions or business corporations may have conflicting interpretations as well as different life experiences, competencies, goals, and values (Van Bueren, Klijn & Koppenjan, 2003). An example is the conflict of interests regarding the Senegal River of the westernmost part of the Sahelian zone in Africa in which the city of Dakar, other villages, and different industry sectors had conflicting interests and a complex

management framework was necessary to create a useful analysis (Varis & Fraboulet-Jussila, 2002). Important public decisions are particularly complex because of the potential disagreements among stakeholders and require trade-offs (Gregory & Keeny, 1994). Stakeholders can therefore have a huge impact on the policy making process.

Complexity

As Rittel & Weber (1973) stated, there is a lack of a clear problem definition and differing perspectives of stakeholders in social sciences, because of the nature of societal problems. Tackling such problems depends on how the solution and problem is framed. This is also agreed on in the innovation policy literature as well as the literature about wicked problems (Mazzucato, 2017; Alford & Head, 2017). There is a widespread consensus that clear formulations and measurable objectives for existing organisations are necessary to work together in finding ways to solve societal problems (Mazzucato, 2018, Alford & Head, 2017). If the solution and problem are not clear and well-defined, the societal problem will be more wicked and therefore harder to tackle (Alford & Head, 2017). Clarity of the problem and solution are therefore necessary elements in forming innovation policy for societal problems (Mazzucato, 2017).

In order to indicate the amount of clarity of the solution, the above-mentioned framework of Mazzucato (2018) will be integrated into the framework of Alford and Head (2017). This thesis argues that the framework of Mazzucato (2018) can indicate whether the solution is clear to the policy makers. If there are measurable and achievable missions, intermediate milestones and well-defined mission-projects, the solutions and therefore the way to tackle a societal challenge will be apparent and clear to the policy makers, which is indirectly suggested by Mazzucato (2018).

3. Methodology

3.1 Data collection

The research design of this thesis is a detailed and intensive analysis of a single case study. Through this design an in-depth analysis will be obtained about the wicked dimensions of the UK's innovation policy. Qualitative data is collected on the basis of clearly defined concepts and indicators which are generated by the two theoretical frameworks. The policy documents are examined by the two dimensions of the framework of Alford & Head (2017). The respective concepts and indicators can be found in the appendix I and are based on the literature of Mazzucato (2018) and Alford & Head (2017). A total number of 23 documents have been analysed. These policy documents have been obtained from different ministerial departments of the UK, their agencies and public bodies which have a clear connection to the challenge of an ageing society. These departments are the Department for Work and Pensions, the Department of Health and Social Care and especially the Department for Business, Energy & Industrial Strategy, in which the Industrial Strategy was formed. Also, other policy documents like case studies, consultation outcomes or press releases have been incorporated into the data collection. All these documents can be found on www.gov.uk/government/policies.

3.2 Data analysis

In this research, the policy documents from the UK government have been reviewed through a strict content analysis, see appendix I. In order to analyse the relationship between stakeholder, the first dimension is divided into two categories: knowledge fragmentation and stakeholder rivalry. According to Alford & Head (2017) these two categories indicate whether there is a co-operative, indifferent or rivalry relationship between the stakeholders. To examine whether knowledge is fragmentation, two indicators have been established: (1) What knowledge about the problem does every stakeholder or institution have? And (2) are stakeholders willing to share knowledge? The stakeholder rivalry is measured by four indicators, which are derived from the framework of Alford & Head (2017): (1) Do the stakeholders have conflicting goals? (2) Is there a mention of conflict between stakeholders? (3) Do the proposed solutions differ among the stakeholders? And (4), are there partnerships between stakeholders?

The second dimension, the clarity of the problem and solution, is also divided into two categories: the clarity of the problem and the clarity of the solution. To indicate whether the problem is clear to policy makers, two indicators are made: (1) Is there a consistent usage of data? And (2), is there a consensus about the origin of the problem?

To indicate whether the solution is clear, four indicators, derived from the framework of Mazzucato (2017), are used in this thesis. (1) How is the GC formulated? (2) How are the missions formulated? (3) Are intermediate milestones being used? And (4), how are the mission-projects formulated? If the GC, the mission and mission-projects are well-defined and intermediate milestones are used, the solution will be seen as clear.

In addition to the desk-research and to support the content analysis, the Head of Foresight and Strategic Futures at the Government Office for Science (GO-science), Dr. Tom Wells, was interviewed. GO-science is an organisation that advises the UK Government on policy and decision-making based on scientific evidence (GO-science, n.d.). The interview was semi-structured whereby a framework of themes was discussed, but allowed the interviewee to bring up new ideas during the interview. GO-science was contacted because of their advisory role to the Department of Business, Energy & Industrial Strategy. See appendix II for the framework of questions and themes. The interview was analysed in a narrative way, using the software Microsoft Word. By using main concepts, like 'knowledge fragmentation', 'stakeholder rivalry', 'understanding of the problem' and 'understanding of the solution', the fragments could be categorised and analysed.

Reliability and validity

For case-studies, the reliability and validity are important criteria in establishing and assessing the quality of research for quantitative research (Bryman, 2012). External reliability, the degree to which this case study can be replicated, is most often a difficult criterion to meet since it is impossible to 'freeze' the circumstances of an initial study to make it replicable (Bryman, 2012). However, the replication of this study will be made easier since this study examines mostly existing policies and interviews are only an add-on to this research. External validity or the generalisability of the research is always difficult to establish in case studies (Bryman, 2012). The nature of this research is such that it will be hard to generalise, although the theoretical background can be used as a starting point for other cases or theories on this subject.

4. Results

In the results section, the collected and analysed data of both frameworks will be outlined and discussed. Firstly, knowledge fragmentation and stakeholder rivalry as indicators for the relationship between stakeholders will be discussed. Secondly, the clarity of the problem as well as the clarity of the solution will be reviewed.

4.1 Relationship between stakeholders

In order to understand the causes of wicked problems and to be able to tackle them, policy managers need knowledge about the problem. Fragmentation of that knowledge among stakeholders can increase the difficulty of understanding and tackling societal challenges (Alford & Head, 2017). In the policy documents of the UK government, no knowledge fragmentation was mentioned among the stakeholders who developed the Industrial Strategy. Although this does not necessarily mean that knowledge fragmentation does not exist, the data analysis shows that there is no mention of any knowledge fragmentation in the policy documents and therefore suggests that there is no knowledge fragmentation. By combining data from the powerful health datasets in the National Health Service (NHS) together with world-leading design institutes, the artificial intelligence research community, a strong life sciences sector and the financial services industry (BEIS, 2017), it becomes clear that stakeholders are not reluctant to share their knowledge with other stakeholders. The knowledge about the problem is therefore presumably not fragmented among stakeholders. However, it is hard to rule out for certain that there is no knowledge fragmentation among stakeholders. There might be some internal knowledge fragmentation which is not mentioned in policy documents. Further in-depth research like interviewing these different stakeholders about their interests could confirm or contradict the statement that there is no knowledge fragmentation.

Even if the situation is of mutual goodwill, there is a problem of transaction costs because time and effort are required to identify who has what knowledge and arrange with them to provide it (Alford & Head, 2017). This affects the second part of the first irreducible element of wicked situations: the extent of rivalry between stakeholders. The Industrial Strategy was built on nearly 2,000 formal responses to the public consultation on the Green Paper, from all types of organization, sectors of the economy, groups of businesses and individuals – and many thousands of contributions through our programme of engagement throughout the UK over the last year (BEIS, 2017). Although one could imagine that the financial sector has different interests than knowledge institutes, no conflicts of interest were seen in the policy documents. Even in the Industrial Strategy Challenge Fund, a fund to strengthen UK science- and business

innovations and take on the biggest challenges that society and industries face today, there is no mention of rivalry: ‘£300 million from the Industrial Strategy Challenge Fund will support the ageing population, with opportunities for businesses and researchers to work together’ (Innovate UK, 2018). In this programme, made available by UK Research and Innovation which brings together seven Research Councils in the UK, businesses can apply for a fund over the next two years. There is clearly a huge emphasise on collaboration between governments, joint programs with the Office for National Statistics, academics and other stakeholders. The GC are an invitation to business, academia and civil society to work together to innovate and develop new technologies and industries in areas of strategic importance to the country, according to Industrial Strategy policy (BEIS, 2017). This indicates that stakeholders do not have much rivalry and have a co-operating relationship, which makes the societal challenge of an ageing population less wicked. See Table 1 for an overview of the relationship between stakeholders

However, the UK strongly believes in the power of the competitive market. Together with the financial markets and the profit motive, these are seen as the foundations of the success of the UK. ‘The best way to improve productivity is to increase exposure to competition’ (BEIS, 2017, p. 21). This huge focus on market competition could possibly create rivalry among stakeholders. Stakeholders could be reluctant to share insights with others who may be perceived as rivals. However, this hypothesis needs further examination.

Relationship between stakeholders

	Knowledge fragmentation	Stakeholder rivalry
Result	No mention of fragmented knowledge	Huge emphasis on collaboration

Table 1: Indicators of the relationship between stakeholders and their results.

4.2 Clarity of the problem

The second dimension is more related to the problem itself, whether the nature of the problem and solution are clear to policy-makers. Clarity of the problem and solution would scale-down the wickedness of the societal challenge.

In the document ‘Future of an Ageing Population’ from the Government Office for Science, the problem of the UK’s ageing society together with the implications for society and its impact on demographic change

on policy issues is elaborated and discussed (Government Office for Science, 2016). Although there is no mention of any innovation instruments or measurements, this document provides a clear picture of the problem which is not contradicted in other documents. There is a consistent use of data within the Department for Business, Energy & Industrial Strategy, the Department for Work and Pensions, the Department of Health and Social Care and the Government Office for Science. Therefore, the problem itself is presumably clear to all institutions and organisations, as no debate about the numbers or origin of the problem was written down. This statement is confirmed by Dr. Wells. This means that the nature and origin of the problem are clear to the policy makers and makes the societal challenge of an ageing population less wicked. See Table 2 for an overview of these findings.

Clarity of the problem

	Data	Origin
Result	A consistent use of data	No debate about the origin of the problem

Table 2: The indicators of the problem clarity and their results.

4.3 Clarity of the solution

The Industrial Strategy begins with a foreword from the Prime Minister in which she states that the Industrial Strategy will help young people develop the skills they need to do the well-paid, highly-skilled jobs of the future. The Industrial Strategy will create the conditions where successful businesses can emerge and grow, and help them to invest in the future of the UK. By boosting productivity and earning power throughout the UK, they want to be the most innovative country in the world. The urge to tackle societal challenges comes together with the mission to create more good jobs and better pay. Improving productivity and economic growth are seen as prerequisites for the UK to tackle societal challenges. ‘By addressing these challenges, we will be able to achieve the central objective of our Industrial Strategy: to improve living standards and economic growth across the country’ (BEIS, 2017, p. 29). The challenge of an ageing society comes with another challenge: to be the most innovative country in the world. This two-fold challenge is perfectly summarized in the following sentence: ‘Unless we improve productivity while holding on to high employment, we cannot raise living standards and quality of life for all our citizens’ (BEIS, 2017, p. 20). This shows that the focus of their innovation policy is clearly mission-oriented in which they target not solely economic goals, but also societal goals. However, these economic goals should not

dominate the societal goals. Therefore, measurable and achievable missions and intermediate milestones are crucial in order to tackle these societal goals.

As missions provide a solution and can provide policy makers for the first time a privileged view of the different elements of this vast and complex programme (Mazzucato, 2018), the UK will have to define concrete missions that bring people together around ambitious common goals. In their Industrial Strategy, the government states that ‘where appropriate, teams will develop “missions” to tackle the Grand Challenges. They involve tackling specific problems, (...) using well defined and concrete goals to allow progress to be monitored and assessed, and the option to change course when appropriate’ (BEIS, 2017, p. 35). On the 12th of March, the UK government announced that they want the UK to be the best country in the world for dementia care and research by 2020. Together with this mission, they announced that they will spend £40 million for the Dementia Research Institute, which is according to them a vitally important step on that journey (BEIS, 2018). On March the 21st, the Prime Ministers announced in a speech delivered at Jodrell Bank, that the first Ageing Society Grand Challenge mission is to ensure that people can enjoy at least five extra healthy, independent years of life by 2035, whilst narrowing the gap between the experience of the richest and poorest (BEIS, 2018). While it was unclear before what missions the UK has set itself to tackle their ageing society, because the mentioned announcements were not directly linked to the challenge of their ageing society, the government has now made its first Ageing Society Grand Challenge mission. This first official mission is a necessary step to concretize the challenge of an ageing society, although more missions will have to be made to fully tackle this challenge. This first mission can be seen as a starting point and makes the challenge less wicked.

In order to indicate whether the mission has been achieved, it is essential for missions to define concrete targets and objectives. While missions must allow for long-term investments, the use of intermediate milestones is critical (Mazzucato, 2018). However, the government did not create a detailed planning and intermediate milestones yet, but only suggest that, when appropriate, they will develop those (BEIS, 2017). Although they have set for themselves their first official Ageing Society Grand Challenge mission, ‘narrowing the gap between the experience of the richest and poorest’ remains highly vague and unmeasurable. Their first mission is therefore only partly measurable. This means that it is hard to indicate whether the government knows how to narrow the gap between the experience of the richest and poorest. The solution of the mission can therefore be seen as unclear to policy makers since there is little concretization of the mission. This makes the challenge more wicked.

After missions are defined, mission-projects should be linked to the missions and therefore to the GC. In order to tackle the societal challenge of an ageing society, the UK has created the Industrial Strategy ‘Healthy Ageing Programme’, in which they will invest £98 million in innovation to help older people maintain their chosen lifestyle, and stay independent longer (BEIS, 2017). Regarding the challenge of an ageing society, the government announced on March 12 that they will invest over £300 million from its Industrial Strategy Challenge Fund (ISCF) to bring together the UK’s world-class research expertise with business investment to develop technologies and industries that can help the UK prepare for the challenge of an ageing society (BEIS, 2018). ‘The UK Research and Innovation is developing ideas to make sure these investments have the greatest possible impact’, according to Sir Mark Walport, Chief Executive Designate of UK Research and Innovation (UKRI, 2018). Another investment is a £210 million investment in Data to Early Diagnostics and Precision Medicine to support their first official mission (BEIS, 2018).

Besides these investments, the government is asking the public for project ideas. They have set up an online dialogue to hear a range of views on global trends (The Dialogue, n.d.). Everyone can bring up ideas for projects that tackle the challenge of an ageing society. It is hosted by the Department for Business, Energy and Industrial Strategy, and is moderated together with the Department for Transport, the Department for Health and Social Care, and the Department for Culture, Media and Sport (The Dialogue, n.d.). Specifically, they ask businesses, local governments and educational institutions how the UK government can support people to have extra years of health and independence, which refers to their first official mission. Although the ISCF and other findings are the first attempts of the government to create mission-projects that are linked to the GC, concrete and well-defined mission-projects are still missing. These findings make the challenge more wicked according to framework of Alford & Head (2017). See Table 3 for an overview of results of the indicators for the clarity of the solution.

Clarity of the solution

	Grand Challenge	Missions	Concretization	Mission-projects
Results	Two-fold: Economic growth + productivity & tackling GC	One partly concrete mission	No intermediate milestones	Well-defined mission-projects are missing

Table 3: Indicators of the clarity of the solution and their results.

5. Conclusions and Discussion

This research argues that the challenge of an ageing society in the UK is an analytically complex problem, because the stakeholders have a co-operative relationship, the problem is clear to policy-makers, but the solution is unclear. The relationship between stakeholders could be seen as a co-operative since neither knowledge nor interests are fragmented. In this situation, it will be less difficult for the policy makers to access relevant knowledge and to reach agreements with external parties about appropriate actions for tackling wicked problems (Alford & Head, 2017). As was shown in the data the nature of the problem was clear to all departments. However, the solution for this societal challenge is more complicated. Although the government has set itself a partly concrete mission, to ensure that people can enjoy at least five extra healthy, independent years of life by 2035, whilst narrowing the gap between the experience of the richest and poorest, there are little concrete and well-defined mission-projects linked to this mission. The UK tries to create mission-projects through the online dialogue in which they ask industries, academia, local governments, civil societies, individuals and families to contribute and post their ideas in the dialogue, but this dialogue has still no outcomes. Besides, all funding programmes lack concrete and measurable goals. Since there is no mention of intermediate milestones, the solution for the societal challenge is highly vague and could therefore be described as unclear.

5.1 Recommendations

As the ageing society in the UK is an analytically complex problem, the government should transform the challenge of the ageing society into more, concrete, measurable and achievable missions. These missions need to be very clearly framed and need a specific target. In addition, they will need a clear time frame within which actions should take place. This needs to be long enough to allow the process to grow, for actors to build relationships and interact, while at the same time being time limited. Without specific targets and timing, it will not be possible to determine success (or failure), or measure progress towards success (Mazzucato, 2018). An example is the Brazilian attempt to build a mission-oriented policy agenda in order to become more mission-oriented through purposeful policies promoted by the state in direct partnership with the private sector in which they define missions that incorporate evaluation, accountability and auditing (Mazzucato & Penna, 2016).

The UK government should also focus more on the concretisation of the GC by using intermediate milestones. These intermediate milestones are important for flexibility and adaptation so that missions can be changed over time if the milestones provide new information or show that the mission has been

framed problematically and needs adjusting (Mazzucato, 2018). Even if the milestone or the overall mission objective is not reached, the mission might still be considered to be successful if the process produces positive, economy-wide spillovers (Mazzucato, 2018). Mission-oriented policy must have a narrower focus as compared to the GC, simply because these are so 'grand' (Edquist & Zabala-Iturriagagoitia, 2012).

Although more mission-projects require significant in-house capacities and expertise by the UK, the engagement of different organisations in concrete mission-projects within the mission will be crucial to facilitate open dialogues on expected outcomes and practical applicability of solutions (Mazzucato, 2018). A start for this open dialogue is visible in the online dialogue for the four GC of the UK (The Dialouge, n.d.). However, the UK has just begun this dialogue, and mission-projects will have yet to be developed.

5.2 Discussion

Although it seems that there is little concretisation of the mission-oriented innovation policy, the UK's innovation policy is currently subject to major transformations. Through the latest announcement of the UK government (BEIS, 2018) it seems that slowly concrete and measurable missions and mission-projects are being set up. As is visible in the policy documents and the interview, there is a debate going on within the government about what the right response to the ageing population should be. Before the Industrial Strategy, the focus of their policies was on public expenditure to increase the public services and pensions of the elderly. However, the Industrial Strategy is the first attempt to reframe the solution to the challenge of an ageing society. The Industrial Strategy is the first real public body policy document that demonstrated that their ageing society could be seen as an opportunity for businesses and other institutes to benefit from, instead of framing this societal challenge as a huge problem with a lot of downsides and disadvantages. Therefore, the UK has put a huge emphasis on building on the strengths of the UK. Because of this relative new focus, it is understandable that missions and mission-projects are still being formed and are not yet very concrete.

The ageing society in the UK will not be the only analytically complex problem in the world, therefore, the above-mentioned recommendations could also apply to other analytically complex problems. If the solution of a complex problem is not clear, one way to clarify the solution is to create GC with clear targeted missions which are broken down into mission-projects with concretisation of all elements.

Limitations and future research

Regarding the limitations of time and expenses of this research, further in-depth research such as interviewing stakeholders could confirm or contradict the statement that there is zero to very little knowledge fragmentation and rivalry among stakeholders in the UK regarding their ageing population. Because the UK strongly believes in the power of the competitive market, knowledge fragmentation or rivalry among stakeholders could possibly affect the development of policy documents. Although this was not seen in the policy documents, stakeholders could be reluctant to share insights with others who may be perceived as rivals which could play a role in the development of current and upcoming policies. Further examination of this hypothesis will be necessary.

One of the key lessons from Mazzucato's mission-oriented literature is that missions could be bold, activating innovation across sectors, across actors, across disciplines and should start bottom-up (Mazzucato, 2017). Examination of the effectiveness of the diversification of mission-projects in comparison with older policy measurements could make policy measurements more effective and shape the focus and direction of further policies. Also, it is necessary to indicate whether and how bottom-up experiments can benefit incentives to 'think outside the box' and to come up with new solutions to address mission objectives. Understanding these processes could benefit the clarity of the solution.

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Appendix I – Content Analysis

Category 1: Relationship between stakeholders

1. Knowledge fragmentation

- What knowledge about the problem does every stakeholder or institution have?
- Are stakeholders or institutions willing to share knowledge?

2. Rivalry

- Conflicting goals of stakeholders / institutes → different goals: more conflict
- Is there a mention of conflict between stakeholders / institutes → more mentioned conflicts: more conflict
- Different proposed solutions to the problem by stakeholders / institutes → different solutions: more conflict
- Partnerships (collaborations) between stakeholders / institutes → less collaboration: more conflict

Category 2: Clarity of the problem and solution by the government

3. Clarity of the problem

- Is there a consistent usage of data? → less unambiguity: more clarity of the problem
- Is there a consensus about the origin of the problem? → consensus about the origin of the problem: more clarity of the problem

4. Clarity of the solution

- How is the GC formulated? → well formulated: more clarity of the solution
- How are the missions formulated? → well formulated: more clarity of the solution
- Are intermediate milestones being used? → usage of milestones: more clarity of the solution
- How are the mission-projects formulated? → well formulated: more clarity of the solution

Appendix II – Interview framework

Theme 1: Information/involvement of the interviewee

Question:

- Can you explain the involvement of GO- science within the Department for Business, Energy & Industrial Strategy in general and specifically the involvement in the Industrial Strategy?

Theme 2: Conflict of interest by stakeholders

Questions

- This Industrial Strategy is developed by the Green Paper consultation, the UK Research and Innovation, the Council for Science and Technology, the National Academies and GO-science. In the development of the Industrial Strategy, they mention that it builds on nearly 2,000 formal responses to the public consultation on the Green Paper and all types of organization, sectors of the economy, groups of businesses and individuals. Should that not give a huge conflict of interests by the development of the Industrial Strategy?

- Because the Industrial Strategy is an attempt to form a partnership with businesses, workers, universities, local government, isn't there a lot of competition or rivalry?

Theme 3: Clarity of the problem

Questions:

- Do you think that the problem of the ageing society is clear?

- Is there a consensus about the numbers, facts and origin of the ageing population between departments and organizations?

Theme 4: Clarity of the solution

Questions:

- In the Industrial Strategy, they state they want to build on the strengths of the UK, in order to improve the productivity, economic growth and the living standards of their citizens. But what do you think is the core of the Industrial Strategy? Is that the development of the quality of lives of people living in the UK, or is it mainly productivity and economic growth? Or is it impossible to say such a thing?

- Are there concrete short-term goals that refer to the Grand Challenge that could be seen as intermediate milestones?