# The Politics and Practice of Innovation: Implications for Economic Growth of the Sheffield City Region

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

Submitted November, 2018

The University of Sheffield
Faculty of Social Sciences
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# Acknowledgements

I would like to express my sincere gratitude and thanks to all those who made this thesis possible and for their support throughout this entire process.

First I would like to thank the University of Sheffield and CREED as the funders of this research, without who’s support this thesis would never have happened. I would like thank my supervisors Tim Vorley and Nick Williams for their constant support and feedback, and on more than one occasion, patience. I would like to extend my gratitude to all participants who gave up their time to be interviewed as part of this study, and for their open and honest viewpoints. I would like to thank my parents and brother who's support throughout this process has been always gratefully appreciated and warmly received. Finally, I would like to thank Carrie, Ben, Mosby and Jennifer for being a constant source of support, friendship and for keeping me grounded and motivated in this process from start to finish, on good days and bad.

# Abstract

Innovation, due to the potential significant benefits which innovation led growth may provide in promoting sustained economic development at both national and regional scale, has become an increasingly prevalent part of national and regional economic strategies. As a result of this the best way in which innovation should be supported and at what scale has become an issue of significant importance and attention by policy makers, practitioners and academics alike. Rescaling is another issue, one which is both separate to, yet intimately related to innovation. Along with the devolution and rescaling of regions within the empirical context of the UK, in the literature of both innovation systems and regional studies, there has been an increasing push towards the devolution of power and decision making control to smaller scales of governance, bringing into question the role and place of localism for innovation led growth. In order to gain an in-depth understanding of the issues surrounding these areas and the implications of the multiscalar perspective for innovation-led growth, this thesis conducted qualitative research within the empirical context of the SCR, a weakly mono-centric region, with historically lagging innovation and growth rates. This thesis thematically presents the findings from 16 interviews conducted with regional stakeholders and 30 interviews conducted with innovative firms within the SCR's three main innovative industries: advanced manufacturing, healthcare and digital and creative, taking a multiscalar approach to the investigation of this topic, in contrast to other studies looking at innovation from a static, singular innovation systems perspective. From these findings, this research demonstrates how definitional complexity associated with the term innovation is having both practical and negative

effects on the way in which innovation is supported, highlights the significant challenges of localism for fostering and supporting innovation-led growth, and argues that path dependency may be used as a tool for explaining not only the development of regional specialisms, but also the reason why innovation systems may be created at some scales but not others.

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# PART 1: INTRODUCTION & LITERATURE REVIEW

## 1) Introduction

The issue of stimulating sustained economic development within regions is one that has received significant levels of attention from stakeholders and policymakers alike, as stakeholders seek to promote economic development on both national and regional scales, and to promote more even economic development across nations. This issue is one that is complicated further in regions which have historically lagged behind economically, as stakeholders seek to bridge the widening gap between poorly performing areas and more successful ones which need to overcome the additional and significant difficulties of entrenched issues and systemic problems within such areas. Increasingly, innovation has been viewed as one way in which this sustained growth may be achieved, and its value as a driver of economic growth across a range of metrics has become increasingly recognised (Mazzucato et al., 2015; Silve and Plekhanov, 2015; Dachs and Peters, 2014; Hackler, 2010), and as a result has become increasingly a central part of national and regional economic strategies worldwide. Innovation however, is a highly complicated and multifaceted concept. At its most fundamental level, it is difficult to define and measure what an innovation is and its impact (Gault, 2018; Janger et al., 2017; Acs and Audretsch, 2005; Johannessen et al., 2001; Kuznets, 1962). Studies of innovation therefore lack consensus, making study of the concept difficult due to an inability to cross compare many of the conducted studies with ease and robustness. Furthermore, there exists numerous different types of innovation, each with different contributions to regional growth and the performance of firms within those regions, as well as having different support needs and characteristics. Despite this however, a broad consensus exists that innovation systems are the best way in which innovation may be encouraged to flourish within a nation,

region or locality (Katz and Wagner, 2014; Lyasnikov et al., 2014; Cooke et al., 1997). This, however, is also an area rife with complexity, given the need to create a highly networked, connected and engaged system of multiple parties including innovative firms, knowledge generating institutions and institutional stakeholders. This is further compounded by the issue of scale, as there has been a move in the literature away from National Innovation Systems (NIS), towards smaller, Regional Innovation Systems (RIS), Local Innovation Systems (LIS) and Innovation Districts (Hervás-Oliver et al., 2017; Griffith, 2015; Katz and Wagner, 2014; Morrison, 2014; Johnson & Lundvall, 2002).

Related to the issue of scale, within both literature and practice in the field of regional studies, there has been a shift towards smaller scales of decision making authority, economic strategy, and the delivery of programmes as more suitable and effective scales of intervention (Morisson and Bevilacqua, 2018; Griffith, 2016; Deas et al., 2013; Pugalis and Shutt, 2012; Shaw and Robinson, 2012). This has been exemplified in the literature through a shift away from previous orthodoxies of new regionalism, towards smaller scales such as that of the city and the city region. Within the UK, this shift in the prevailing attitudes and academic standpoints towards devolution and smaller scales of intervention and authority has been practically demonstrated in the move from the Regional Development Agency (RDA) to Local Enterprise Partnership (LEP). As a result, the issue of scale and its impact on innovation, innovation support and the formation of innovation systems is one not only constrained to academic theory and debate, but one which has significant practical implications within the context of the UK. This, therefore, brings into question the role that innovation plays

for growth in the city region, how is it supported in policy and practice, and how does the issue of scale affect each of these issues, particularly across the multiscalar spectrum? Due to these factors therefore, it is the aim of this thesis to investigate innovation-led growth and the region, innovation support, and the development of innovation systems within the empirical context of the city regional scale, while also taking into account the multiscalar approach of innovation support. Furthermore, given the significant prominence and importance attached to the issue of scale in innovation systems, a number of concepts of innovation systems have developed at different scales, further complicating the issue, given that in practice innovation takes place across multiple scales and geographies. This thesis therefore seeks to add clarity to theses issues, and further contributes knowledge to the complex topic of innovation within the empirical context of the Sheffield City Region (SCR), and remedies in part the gap in the literature surrounding the adoption of a multiscalar approach to the study of innovation.

In order to acquire the in-depth data to investigate this aim, this thesis conducted a total of 16 interviews with stakeholders within the SCR, with representatives from each of the region's 9 local authorities. Following this, a further 30 in-depth interviews with local innovating firms were undertaken in order to gain a detailed and nuanced perspective on innovation within the SCR at the firm level and its connectivity to broader systems of innovation and supporting mechanisms at multiple scales. This research has policy implications through the investigation of the issue of multiscalar innovation support, the complexities of innovation system formation and innovation support in the political and spatial context of LEPs, as well as for firms through the

exploration of their innovation processes, the innovation support they require and access, as well as their broader role within innovation systems as both actors and assets of the network. The use of qualitative methods also provides new in-depth insights into these subjects and helps to redress the quantitative bias in innovation studies.

This thesis first presents a literature review, covering the two broad streams of literature most relevant to this topic. First it looks at the topic of innovation, discussing issues associated with the definition and measurement of innovation, the relationship between innovation and growth at firm and regional level, how firm type and size may affect how innovation takes place and what firm has the competitive advantage when it comes to innovation, how different types of innovation exist with different needs, characteristics and contributions, the key models of innovation, issues with innovation at the firm level, and the concepts surrounding innovation systems at sub-national levels. Secondly, this literature review looks at the issues and literature surrounding the move away from new regionalism towards localism, and how this has been reflected in practice from the move away from region wide Regional Development Agencies (RDAs) towards city regional Local Enterprise Partnerships (LEPs), as well as the concept of path dependency in regional development and innovation capacity and capabilities.

Second, from both this literature review and the broader research aims of this thesis, this thesis develops the research objectives to be used in this study, in order to give the research focus and shape. The three key research objectives developed were: to develop understanding towards the stakeholder perspective towards innovation-led

growth; to examine the nature of innovation support in the region; and to understand how the region's innovative firms perceive and access innovation support.

Third, this research presents the empirical focus and methodology to be used in this thesis in order to investigate these research objectives. The empirical focus of this study is that of the SCR, a weakly mono-centric region that has experienced significant deindustrialisation and has a history of lagging innovation and growth rates. In the methodology, this thesis advocates the adoption of a qualitative and investigative approach in order to gain in-depth and nuanced knowledge around the three core research objectives, as well as to redress the quantitative bias present within innovation studies. Furthermore, it lays out the benefits and drawbacks of such a methodology, as well as presenting literature around the usage of semi-structured interviews, the complexity and issues associated with elite interviewing. This chapter also considers the ethical implications of this study, identifying potential risks as well as the safeguards put in place to protect participants. It also lays out the way in which the gathered results have been analysed through the method of thematic coding in order to give this research further validity. This chapter next presents the participants of this study in an anonymised and codified manner. Finally, this chapter presents a description and analysis of the interviewed groups, highlighting areas in which the types and demographics of each may affect the collected results.

Fourth, this research presents and analyses the findings from these conducted interviews, grouped thematically into three chapters. The first of these chapters presents and analyses the results from respondents regarding the challenges associated

with the defining of innovation for growth and its implications for policy. This chapter demonstrates that the difficulty associated with the definition of innovation, typically discussed exclusively from the perspective of academia, is also experienced by the region's stakeholders. This has resulted in both the adoption of a wide range of definitions, resulting in reduced clarity regarding the term innovation, as well as identifying the prevalence of a highly open and inclusive definition amongst stakeholders. This definition is identified as one that fits poorly with the type of innovation that best drives economic growth, suggesting that regional stakeholders are, intentionally or not, not defining innovation for growth. Furthermore, this research finds that this definition has also demonstrable practical effects, with innovation support being shaped towards supporting low and none innovators, demonstrating that the issues associated with the definition of innovation have negative impactful effects within the SCR. This chapter also adds to our understanding of innovation support across the multiscalar support spectrum, by demonstrating that prevalent definitions at multiple levels have resulted in the development of support types that support different types of innovation, each of which contributes towards regional development in a different manner. The second findings and results chapter focusses upon governance and innovation policies programmes and initiatives, how innovation is supported in theory by stakeholders, and the issues associated with the region and scale. It demonstrates the extreme difficulties and complexities associated with local and regional support, as well as how the nature of the region has made the development of a true RIS difficult. In addition, it highlights the difficulty of creating innovation systems within confined geographical spaces, demonstrating that owing to the small size of the region it lacks the density of assets to be effective, hindering the

development of innovation systems and highlighting the challenges of localism for innovation-led growth, and how within the multiscalar spectrum smaller scales or innovation system are not always necessarily the most effective depending on local context, due to issues associated with the trade-offs between connectivity and network density. Finally, the third results chapter of this thesis looks at the practice and realities of innovation, how stakeholders access and engage with support, and the implications of this. It demonstrates that with the exclusion of the region's two universities, the region's innovative firms do not engage significantly with other regional institutions or other firms. It categorises the city region as one with numerous significant disconnects, demonstrated by a lack of interaction not only between the region's core and periphery, but between and within institutions and firms themselves. It further demonstrates that the region's innovative firms do naturally think in local terms, and although most in principle express a desire and a belief that working with regionally based partners may benefit them, there is little incentive and few available partners and appropriate regional support schemes to do so regionally. Furthermore, it demonstrates that the path dependency of the region may be used in a new and innovative manner, in order to explain why innovation systems are able to be constructed over some scales, and not others, adding further nuance and understanding towards the innovation systems approach across multiple geographical scales. Using the case study of the SCR, it highlights numerous factors that have caused disconnections within the region and the concentration of innovation assets within the region's core city, resulting in the reduced ability of the region to create an innovation system at the level of the city region, however has resulted in greater potential for the development of a Local Innovation System (LIS) or Innovation District.

Fifth, this research presents a summative discussion and conclusion to this thesis. It summarises the findings of this research around three identified threads: definitional complexity and its impact upon innovation; the challenge of localism for innovation-led growth; and innovation in practice, its components and disconnects, demonstrating how each of these areas each contributes towards our knowledge of the multiscalar nature of innovation systems in practice. Following this, this chapter then presents a discussion of how the findings of this research contribute towards answering the three overarching research objective of this thesis, tying together each of the discussed threads. Next, it provides a discussion of the limitations of this study, and how such limitations were mitigated against in order to enhance the study's validity. It then summarises the key research findings of this thesis including; its contribution towards the difficulties and complexities of defining innovation led growth; and its impact upon policy; its contribution towards the development of our understanding regarding the challenges of localism for innovation-led growth, and the development of the path dependency model as a tool for the assessment of innovation network construction and scale. Finally, it presents areas of potential future research based upon the findings of this study, as well as the final thoughts and policy implications of this thesis.

### 1.2) Conceptual Framework

Before continuing, it is necessary to lay out the conceptual framework that backs this study, informs the areas of its investigation and as such influences the areas of literature reviewed below.

Innovation is a significant driver of growth in developed economies, and an essential component in delivering sustained economic growth within a region and for the firms within them (Kogan et al., 2017; Laeven, 2015; Love and Roper, 2015; Mazzucato et al., 2015; Hall et al., 2009). Due to this accepted importance of innovation by stakeholders as a significant component and driver of economic growth there is an acceptance within national and regional governments that in order to benefit from such innovation-led growth, that it should be encouraged and supported (Laeven, 2015; Mazzucato et al., 2015). Due to the multifaceted and complex nature of innovation, however, adequately supporting innovation is a difficult and complicated task, given differences in types of innovation, the differing potential risks and rewards associated with these types of innovation (Walker et al., 2015; Camisón and Villar-López, 2014; Koberg et al., 2003; Markides, 2006; Keizer and Halman; 2007), how firms of different sizes, industries and types approach and innovate differently (Coad et al., 2016; Knott and Vieregger, 2016; Leal-Rodríguez et al., 2015), the role of innovation assets present within the area of support and the scale of such support (De Marchi and Grandinetti, 2017; Katz and Wagner, 2014; Lyasnikov et al., 2014).

Despite these complexities and multiple facets of innovation, however, it is broadly accepted that one of the best methods through which innovation is encouraged and

supported in an area is through the use of the "innovation system" (Van Oort; 2017; Lau and Lo, 2015; Lyasnikov et al., 2014). Such systems, while subject to multiple intricacies, minutia and variations, at their most basic revolve around encouraging interaction between three broad categories of actor and/or institution: the knowledge creating institution, the innovating firm and the institutional stakeholder, sometimes referred to as the "triple helix" (Etzkowitz and Ranga, 2015; Yoon, 2015; Katz and Wagner, 2014; Lundvall, 2004). It is generally accepted that by encouraging interaction between these groups, created knowledge can be commercialised into impactful innovations, and that institutional stakeholders can encourage an environment conducive and supportive of such activities.

While there is a broad consensus that the development of such systems and such interactions are beneficial for the facilitation of innovation in an area, one of the most significant debates and complexities of the innovation system concept revolves around the issue of the scale of such systems. From initial development of the innovation system concept, focusing upon this at a national level (Nelson, 1993), later discussions have brought into question whether the national scale is the most effective at which to construct such systems. Given the issues associated with the transmitting of tacit knowledge over geographical distance (Ahammad et al., 2016; Lee et al., 2016; Corral de Zubielqui et al., 2015; Cummings and Teng; 2003), later discussions have looked at the construction of innovation systems at a range of geographically smaller scales such as the region, the city region, the city, and the district or locality (Davies et al., 2017; Nawrot et al., 2017; Katz and Wagner, 2014; Cooke et al., 1997; Lundvall, 2004). Despite such discussions, however, there is a lack of consensus regarding which scale

is most effective, particularly in combination with the issue of ensuring that there is a "critical mass" of innovation assets within the boundaries of such systems. In addition, each of these concepts looks at the issue of scale in isolation, failing to consider that innovation systems are subject to multiscalar influences, both regional, sub-regional, extra regional and national support institutions, constituting a significant gap within the literature.

With regards to how such theoretical complexities relate to practice, such discussions regarding scale have also been mirrored in part in the literature concerning regionalism and within the context of the UK in practice. This is exemplified by the move from regionally based Regional Development Agencies (RDA) to city regional Local Enterprise Partnerships (LEP) as levels of economic support and authority, a move with significant implications for how innovation is supported, to what degree and at what scale. Despite discussions regarding the issue of scale, economic support and how this relates to innovation systems, however, little consideration is afforded to the support of innovation support and interactions at multiple scales. Within the context of the UK, innovation is supported at multiple scales, both at the local authority, city regional and national levels adding further complexities to the support of innovation and the construction of innovation systems.

As such, while the issue of scale in both the construction and support of innovation systems and regional governance structures is of importance, the literature currently lacks coverage of the multifaceted and multiscalar nature of innovation support. Therefore, given the accepted importance of innovation to economic development, and

the importance of the innovation system in supporting innovation-led growth, the conceptual framework of this thesis uses the lenses of innovation systems at multiple levels, (the national, regional and sub-regional level) as epitomised by the National Innovation System (NIS), Regional Innovation System (RIS) and Innovation District (ID) models, to investigate the three main categories of innovation actors and their interactions, looking at the issues of innovation and how this relates to scale and multiscalar support, innovation support and how this relates to innovation systems present within the empirical focus of the Sheffield City Region (SCR), a unit of scale which sits between the regional and local scales (Figure 1.1).

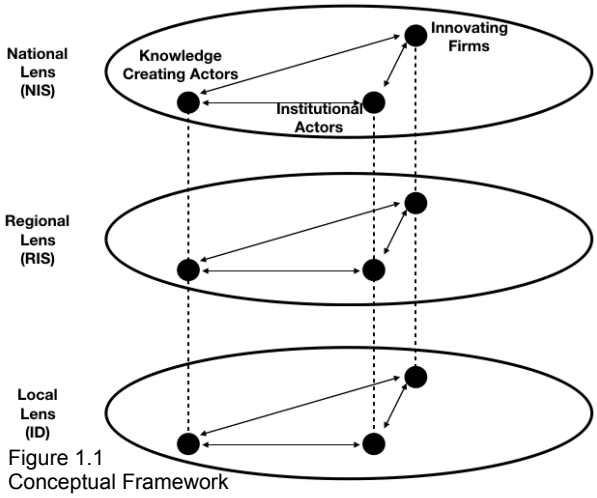


Figure 1.1
Conceptual Framework

Due to this focus and conceptual framework, this thesis reviews numerous areas of literature, centred around the two unifying topics of innovation and regionalism. Within the area of innovation, first this review analyses the literature associated with the definition and measuring of innovation. Given the complex nature of innovation, numerous difficulties emerge in both its definition and its measurement, and therefore through analysing literature in this area, this thesis both highlights difficulties associated with its studies, provides clarity through providing its own definition of innovation as used by this study, as well as providing academic context into the study of innovation. In addition, given the interpretivist standpoint of this research, analysing how the complex concept of innovation has been constructed, understood and thus

defined within the literature is an important step in order to give the study clarity given the interpretivist assertion that such concepts are socially constructed.

Having looked at the literature surrounding how innovation is defined and measured, next this review looks at the relationship between innovation and growth, given it is a fundamental underpinning behind the reasoning of this study, that higher rates of innovation lead to higher levels of growth and firm performance.

Next, this review examines literature surrounding how the role of firm size and industry type impacts upon the innovation processes of firms. This area of review is necessary due to the focus of this study upon the three industries considered most innovative within the SCR, as it provides extra nuance and detail on how such factors can affect how firms innovate, and how this may affect the results collected as part of this research. Related to this factor, this section also provides insight into how firm size also affects innovation, as a range of firms of different sizes were interviewed as part of this research.

Next this chapter reviews the literature concerning the different types of innovation that exist, focusing on what may be considered to be radical or frontier innovation, and diffusion types of innovation. Like the preceding chapter, this section provides insight into the effect different factors such as innovation type have on the innovation processes of firms, providing theoretical background necessary for interpreting this thesis's results from firms engaged in different types of innovation. another significant reason for the focus upon these types of innovation, however, relates to the

comparative differences in risk and reward for firms and the broader economy for each of these types. Given the conceptual framework adopted for this study concerns the construction of innovation systems for the benefit of economies more broadly, focusing upon this area provides insight into the complexities of supporting innovation for growth, the complexities of innovation as a topic more broadly, as well as highlighting that not all innovation is equal in terms of its potential impact for economic development.

Having demonstrated the differences between innovation types, this review next presents five key models of innovation, for the purpose of both demonstrating the development of the concept of innovation, highlighting the different ways in which firms may innovate, the importance of connection between actors for innovation and further demonstrating the complexity and multifaceted nature of the topic.

After giving a review of the literature to provide the necessary academic background and context of the concept of innovation and how its multifaceted nature has numerous implications, as well as introducing the importance of interconnectivity between innovation actors, this review next focuses upon innovation systems at national and sub-national levels. As it is the intention of this study to look at the multiscalar approach to innovation support through the lenses of innovation systems, this section looks at the historical development of the innovation systems literature, looking at each of the three lenses used as part of this study, the National System of Innovation (NSI) the Regional Innovation System (RIS) and the Innovation district (ID), as well as covering the nature of such systems and the debates surrounding them.

Finally, this section reviews the literature regarding what factors affect the ability of individual firms to innovate. Although the primarily theoretical focus of this thesis is upon the multiscalar approach to innovation support at a system level, firms ultimately act as the innovating actors within a system and it is thus important to consider what internal factors affect the ability of a firm to innovate and thus contribute to that system. Furthermore, by looking at the factors which help firms innovate at a individual level, this also bridges the gap between both innovation systems thinking and how this relates to how individual firms innovate, helping to provide clarity in how innovation takes place within the individual firm and potential implications for its support.

After looking at inoovation, this review next looks at the issue of scale, focusing on the context of the UK's governance institutions and their changing nature. First within this review of regionalism the changing scales of UK governance institutions are introduced and how this has played out in the region to city region debate within the literature. Such debates and changes have significant implications for how innovation is supported within the UK context and within theory and the scale at which systems are constructed and thus focus upon this topic significantly relates to how innovation support is provided within a scalar context.

Next, this review looks at the literature regarding the emergence of a regional focus within the literature, and its relation to the birth of Regional Development Agencies (RDA) within the UK context. While the RDAs were later replaced, this provides

historical context to the previous arrangements of economic authority and scale within the UK, examining the merits and criticisms that have parallels with innovation systems. Through reviewing the literature on this topic, this section also looks at a model of scalar governance which has significant parallels with the RIS model, which was later abandoned in favour of a more geographically focused scale and represented a shift away from a regionalist mentality, both in terms of governance and innovation systems. This therefore provides context for the comparison of current and historical arrangements, an important area due to regional stakeholders being most familiar with the RDA to LEP move, rather than the innovation systems concept. By looking at this area, this review also provides a view of one of the previously used scales in the multiscalar approach to innovation support, a useful approach given the conceptual framework of this thesis focusing upon multiscalar approaches of innovation support, as well as highlighting its changing nature and complexity.

Next this research looks at the literature regarding the shift that occurred away from the RDA and towards a smaller scale mode of governance, the Local Enterprise Partnerships (LEP). By focusing upon this area of literature, this provides necessary context into the current prevailing scale of sub-national governance in the UK, and one which has significantly affected the way in which innovation support is provided and systems constructed, shifting the scale to smaller geographies of decision making authority.

Finally, this review looks at the literature concerning the concept of path dependency and its affect upon regional development and innovation. While not directly related to

the construction of innovation systems and innovative capacity, the path dependency concept does have significant parallels with both regional development and the construction of innovation system, and acts as a useful bridging concept between the two streams of literature. Due to the core focus of this thesis being upon the role that innovation may play as a tool for regional development, this concept, due to its utility in explaining differing rates of innovation and differences in economic performance between regions, is one of significance to the aims of this study, and provides a useful tool for assessing the way in which the SCR has developed over time.

Finally, having looked at these areas of this literature, based upon both the conceptual framework of this thesis in combination with the literature reviewed this thesis presents the research questions addressed as part of this research.

## 2) Innovation: Concepts, Systems and Firm Level Application

Innovation, the process of creating and adopting new products, processes, services and organisations is a process that, due to the significant benefits it provides such as economic growth, employment growth and the creation of a sustained competitive advantage, is increasingly occupying a central role in the economic policy of both national and regional government (Berry and Berry, 2018; Guan and Yam, 2015; Hackler, 2010; Stam and Wennberg, 2009). This, combined with the rescaling of regional economic institutions and a reassessment of their role, presents a unique opportunity to investigate the construction and supporting of innovation systems and interaction with multiple scales of innovation support and systems within this new political, geographic and economic context within the Sheffield City Region (SCR), a weakly mono centric region with historically lagging innovation and growth rates. Research within this context is required to gain insight regarding the multiscalar approach of innovation support, to gain further understanding on the effectiveness of the smaller scales of intervention in fostering and supporting innovation, the congruity between innovation support offered by the region and that desired and accessed by regional innovators, as well as the role and contribution of innovation-led growth within this regional setting.

The following sections therefore review the existing literature on innovation; the spatial organisation of innovation networks and support; and the region to city region debate. This chapter will give the definition of innovation for this study, highlight the different types of innovation and the radical/incremental spectrum, review how firm size affects the innovation process as well as looking at innovation at sub-national

levels of analysis and at the level of the firm. Chapter three shall look at the emergence of a regional focus in policy and devolution of economic support and how this relates to the context in the UK in its move from Regional Development Agencies to Local Enterprise Partnerships. Finally from this review, Chapter four shall present the research objectives to be used for this study, based upon this review of the literature and the overarching aims and motivations of this research.

## 2.1) Understanding Innovation

Innovation is an integral feature of many national and regional economic agendas as a process through which numerous economic benefits may be achieved, leading to an increased focus on policies designed to aid the development of innovative economies and networks. This stance is one that is supported by a widespread agreement in the academic community and accompanying literature that knowledge, learning, technology, entrepreneurship and innovation are key contributors to economic development and competitiveness on the scale of firms, regions and nations (Hackler, 2010; Rammer et al., 2009; Stam and Wennberg, 2009; Johannessen et al., 2001). Innovation, however, is not an independent process, as studies have demonstrated that the path dependency of a region, its past innovations and economic, cultural and support structures significantly impact on the future ability of a region to innovate (Isaksen et al., 2018; Pylak, 2015; Martin and Simmie, 2008a). When studying innovation, issues exist due to a lack of consensus regarding its definition and in particular its measurement (Janger et al., 2018; Gault, 2018; Rammer et al., 2009; Acs and Audretsch, 2005; Johannesen et al., 2001). Numerous competing and contrasting definitions are used, and a wide range of sub-definitions of different variants of

innovation exist. For the purposes of this study, innovation shall be defined as: the creation and adoption (by the relevant unit) of new products, processes, services and organisations.

Due to the significant growth of academic literature on innovation and its positive effects on economic development, resilience and competitiveness, this section will first look at existing literature regarding the definition of innovation. Net it shall justify the adoption of the above definition, demonstrate the different types of innovation, examine the role of innovation in regional economic and firm growth and performance,. It shall also highlight several key models used to conceptualise innovation, observe the relationship between innovation and firm size, frame the academic discourse around national and regional systems of innovation, as well as revising the literature around innovation districts, look at the process of innovation at the firm level.

**2.2) Defining and Measuring Innovation**

The term innovation has a number of differing definitions put forward by different authors. As no one definition is suitable for this study in its entirety, a number of existing definitions have been used to construct one that is suitable for the scope of this research. As well as this, it is also necessary from a contextual standpoint, to understand the issues surrounding the complexities of adequately defining and measuring innovation in order to demonstrate the multifaceted and complex nature of the concept and the difficulties experienced by numerous stakeholders.

An early definition of innovation put forward by Schumpeter (1939) is that innovation is the setting up through “new combinations” a new production function which results in the production of new products, processes, raw materials and forms of organisations. Schumpeter, however, noted that too narrow a definition may “limit us… to the case in which the innovation consists in producing the same kind of product that had been produced before by the same kind of means of production that had been used before” (Schumpeter, 1939 p84). The adoption of a broader definition of innovation, it is argued, is better able to take account of other forms of innovation such as the creation of a new market, organisation or commodity. While the Schumpeterian definition of innovation has maintained it's sway to some degree, there exists a number of refined and altered definitions as well as various sub definitions explaining differences in innovation such as the differences between incremental and radical innovation, process, product and organisational innovation etc. It is highlighted that despite varying definitions, defining a variety of innovation sub-categories, a common theme emerges. Although a subjective term, a property which is applied in all definitions of innovation that were reviewed is that of “newness” (Lassen and Laugen, 2017; Witell et al., 2016; Damanpour and Wischnevsky, 2006; Garcia and Calantone, 2002; Johannessen et al., 2001). For this reason the definition used for this study will include the use of the term “new”.

When attempting to define innovation, a distinction needs to be drawn between innovation and invention, as the two terms are often incorrectly used interchangeably. An invention may be defined as an idea for a new product, commodity, process or organisation, whereas an innovation can be defined as the first attempt to carry out that

idea in practice, often but not necessarily, within a commercial context (Hackler, 2010). This distinction provides a useful insight for defining innovation, in that to be considered a new innovation; it must be carried out in practice i.e. within a commercial or in the case of processes, an organisational context. It is because of this distinction that an innovation may be of value to economies, whereas the mere action of invention may not. An innovation may be considered "new" at numerous levels, be that its initial adopter, the organisation, the market, or the world (Visnjic et al., 2016; Osiyevskyy and Dewald, 2015; Damanpour and Wischnevsky, 2006; Johannessen et al., 2001). It may be argued then that the degree of newness does not statically depend on the innovation itself, to be considered an innovation it must be perceived as new by the relevant unit of its adoption, be that at a firm or market level, thus giving an innovation a contextual element (Raffaelli et al., 2018; Wisdom et al., 2014; Garcia and Calantone, 2002; Johannessen et al. 2001). Therefore the definition used by this study will take into account that to be considered an innovation, it must be new, carried out in practice, and finally, adopted by the relevant unit.

Finally, while sub-divided in many ways, for practical purposes many studies separate an innovation as being either a new product, new process or new organisation, which may be a new form of organisation within a firm, or a new firm in itself (Haneda and Ito, 2018; McElheran, 2015; Damanpour and Wischnevsky, 2006; Lundvall, 2004; Propris, 2002; Johannessen et al., 2001). Such an approach prevents the definition being too restrictive, allowing academics to focus their attention on one of these three areas as innovation processes differ significantly depending on whether it generates a new physical product or service process. Although some academics may add or rename

a term, such as including the development of a new or significantly improved material as a separate category (Lundvall, 2004), these three terms appear to be the most common sub-divisions. “Services” while not quite as common a sub-division as product, process or organisation is included as a term in some studies (Djellal and Gallouj, 2016; Barrett et al., 2015; Damanpour and Wischnevsky, 2006). While it may be argued that the provision of new services may be considered a new process in an organisation, or a new organisation in itself, in order to prevent its unfair omission this study will explicitly name it in the definition of innovation. Therefore taking all the above components into account the definition of innovation that shall be used in this study is: the creation and adoption (by the relevant unit) of new products, processes, services and organisations.

With the difficulty associated with defining innovation to a suitable degree within a modern economic context comes an additional, yet related, difficulty in accurately measuring innovation (Gault, 2016; Vicente et al., 2015; Acs and Audretsch, 2005; Johannessen et al., 2001; Kuznets, 1962). As early as 1962, Simon Kuznets noted that a key problem that was hindering the ability of academics to suitably understand the role of technological change on the economy was the inability of economists to suitably and effectively measure it. Measures of technological change have typically involved one of three methods, all of which have notable problems (Acs and Audretsch, 2005). The first method, measuring the direct inputs into the innovative process usually in the form of R&D expenditure, is problematic as it is only a measure of input into the innovative process and not output, as well as only being a proxy measure of innovation. Expenditure on R&D alone provides no guarantee of an

innovative output, and often such departments may have objectives such as imitation and technology transfer which does not constitute innovation, as well as not taking into account for informal R&D which is often considerable in SMEs (Moen et al., 2018; Tell et al., 2017; Rammer at al., 2009; Kleinknecht, 1991). It is also often not necessary for low technology and service orientated firms to undertake formal R&D, and it has been found that in such areas growth aspirations of the firm's owner(s) appear to be a substitute for the growth of such new firms (Stam and Wennberg, 2009).

The second approach uses an intermediate output as a proxy measure for innovation, such as patents produced, however this has the problem which is noted above that not all inventions are innovations, and therefore the production of patented inventions is no guarantee of a positive economic innovative output, nor is it guaranteed that an invention which will be adopted into an innovation will be patented at all. Furthermore not all innovations are able to be patented, and evidence shows that some firms do not patent their innovations even if they are able to be protected under patent law (Torrance, 2016; Stam and Wennberg, 2009).

The third method is to directly measure innovative output, usually through the compilation of databases by experts looking within specific industries. While this particular method does not have the issues associated with the previous two methods, it is flawed as it assumes that each innovation is of equal importance and value to the regional or national economy and business, a factor that should ideally be measured in order to give clearer data regarding the value of such innovation as well as the number and type (Rammer et al., 2009; Acs and Audretsch, 2005). As a result of this difficulty

measuring innovation, many quantitative studies develop different ways of measuring innovation (Palacios et al., 2009), and this lack of uniformity makes it difficult to make truly accurate comparisons between data sets. Furthermore, due to the sheer scale and pace of innovative activity globally, the accuracy of such databases is questionable, and further complicates the measuring of total innovative activity over large scales. This, therefore, demonstrates that the concept of innovation is one that is highly complex, with a lack of consensus between actors and academics on both what constitutes innovation and how it should be measured, and given the difficulty associated with its measurement gives further support to the qualitative approach adopted by this study. For a study such as this one, these factors demonstrate the significant difficulty associated with measuring innovation within an empirical context, as well as that firms and stakeholders may understand innovation differently because of their competing definitions, types of innovation undertaken, methods of measurement etc. Owing to these factors, this study shall, in the interests of clarity and robustness, while also adopting its own internalised definition of innovation, explicitly investigate how regional firms and stakeholders define innovation, in order to add nuance to it's approach.

### 2.3) Innovation and Growth

Having looked at the concept of innovation, what it entails, the complexity of the concept and what is meant by innovation for the purposes of this study, it is next necessary to examine the literature behind a core underpinning of this thesis, in particular the relationship between innovation and growth. This is due to the assertion of this study's conceptual framework that innovation is a driver of growth in regional

economies, and that because of this it is a worthy area of study, support and from this a way in which a region can encourage economic growth within its boundaries.

Despite significant complexities associated with the study of innovation, at the firm level a broad consensus exists within the literature that innovation, while subject to risk and conditional modifiers, is ultimately beneficial for the innovating firm and that a host of benefits are derived from this. This consensus is exemplified by a meta-analysis of 62 studies over 20 years undertaken by Rousseau et al., (2016), which found that a strong linkage between innovation and economic performance exists at the firm level. That is not to say, however, that innovative performance guarantees economic performance, as a number of other factors may result in a firms positive or negative performance despite their innovation rate, such as an global or national economic downturn may negatively affect the demand for a particular innovation (Chen et al., 2010), competitors may be able to gain a better position within the market (Derfus et al., 2008) etc. Despite these modifiers and complexities however, innovation is demonstrated to be overall a driver of firm performance and a better predictor for firm performance when compared to other strategic predictors (Rousseau et al., 2016) Innovation drives increased growth and economic performance in such firms through a number of methods, not only through the development of new products and services, but also through decreased cost, higher customer satisfaction and better competitive positioning of the firm resulting in the development of a sustained competitive advantage (PWC, 2013; D'Aveni et al., 2010).

As has been seen, while the relationship between innovation and growth at the firm level is complex yet broadly positive, likewise the same can be said for innovation rates and the performance of regional economies. Numerous factors affect whether regional economies that are innovative are economically successful, such as its industrial composition, its lock in to certain growth paths etc (Aghion et al., 2016; Brekke 2015; Wilson, 2014; Martin and Sunley 2010). It should also be noted, as demonstrated by BIS, innovation and its contribution to economic growth requires a sustained effort, as "innovation contributes to economic growth through a long run process, and is based on a persistent investment in innovative capabilities" (BIS, 2014, p79). Again despite these complexities however, the literature demonstrates a consensus that as a whole innovation is a net contributor to economic growth within an economy, with some estimates placing innovation as responsible for between one half to a third of economic growth in developed economies (Hackler, 2010). It is due to this acceptance of the impact of innovation on economic growth that innovation has received increasing attention from a variety of stakeholders at multiple scales of governance, and that the construction of innovation systems has become an area of significant interest.

### 2.4) The Role of Firm Size and Industry Type on Innovation Processes

Unlike the link between innovation and positive economic outputs, no broad consensus exists amongst academics as to whether it is individual entrepreneurs, SMEs or large organisations that contribute most to the generation of innovations. As this section will highlight, who is the greatest contributor appears to vary quite significantly depending on a variety of factors such as the industry being examined or the measure used. Given

that this study shall focus on three specific industries within the SCR, a factor that in part affects firm size, this is a factor that requires consideration given its potential impact upon the collected results of this thesis. Furthermore, when looking at the construction of innovation systems across multiple scales, it is important to consider the industry and size of firms, as innovation systems tend to be industry specific or collections of closely related industries, and therefore the consideration of industry type and associated innovation processes provides important contextual background in understanding how such factors may relate to, and affect, the construction and nature of innovation systems.

One explanation as to why smaller firms may have an innovative advantage over their larger counterparts is put forward by Scherer (1988) in Acs and Audretsch (2005). It is noted that small enterprises and firms, owing to the fact that they are often less bureaucratic in nature due to flatter organisational structures, are less likely to have daring ventures blocked by various levels of management, are able to maintain with a "fever pitch" of excitement when developing innovations and are able to pursue innovations with smaller profit potentials which larger organisations are likely to dismiss. However, it is also argued, however, that larger firms possess better financial and human resources that can be deployed to the formal R&D process, arguably affording them a competitive advantage over their smaller competitors in some circumstances (Schumpeter, 1934). It is for this reason that well into the 1970s the academic view prevailed that entrepreneurs and SMEs had the competitive disadvantage when it came to innovation. It is also argued, however, that because the innovation process is often turned into a highly structured, formulaic and routinised

operation within these large organisations, despite the advantages afforded to them through economies of scale, the business is more likely to invest in incremental innovation rather than radical, in order to prevent affecting their established profit centres (Forés and Camisón, 2016; Leal-Rodríguez et al., 2015; Hackler, 2010; Knight, 1967). Therefore the innovation of entrepreneurs and SMEs is believed to "release innovation from its routine incremental improvement inherent in big firm capitalism (and) entrepreneurial capitalism's new firms are more likely to commercialise radical disruptive innovations or breakthroughs" (Hackler, 2010, p244), suggesting that in the current economic environment, smaller firms have the innovating advantage.

Previous work also identified that a factor that appears to influence whether it is small or large firms that possess the innovating advantage within in an industry is dependent on the amount of market imperfections and failures within the industry's market. It found that large firms hold the advantage in capital intensive, concentrated and advertising intensive industries, while small firms have the advantage in industries that are already highly innovative, are in the early stages of their life cycle, reliant on skilled labour and industries that are dominated by large firms (Acs and Audretsch, 1987). Additionally, small firms in some research-intensive industries find it difficult to acquire finance and are thus more likely to be acquired by capital rich larger firms (Barber et al., 2015; Stam and Wennberg, 2009). Due to these findings this research suggests that industries where large firms have the innovative advantage may be experiencing market failures. The importance of industry type on the innovation process of firms is also dependent on whether their knowledge base is either analytical in nature, where scientific knowledge is particularly important and innovation occurs

by the creation of new knowledge resulting in more radical innovations, or synthetic, where innovation is the result of the application or new combinations of existing knowledge, and is more incremental in nature (Asheim and Coenen, 2005). These examples clearly demonstrate how industry type affects both who has the innovative advantage, and how their innovation processes may differ. Due to this, it is important to be mindful of inter-industry differences during this study, as any findings are likely to be affected by the moderating factor of industry type.

### 2.5) Innovation at the Frontier and Innovation and Diffusion: A Comparison

Another factor to be considered when looking at the concept of innovation is what different types and categories of innovation exist, with what characteristics, and how does this affect the performance of the firm that undertakes it. As argued by Koberg et al., (2003) it is not possible to take an undifferentiated and universal approach to innovation, as there exists different types of innovation, each with fundamentally different characteristics and therefore contributions, needs and processes. Given these different innovation types, and an underpinning part of this thesis being based upon how innovation may be used as a tool to promote growth, it is necessary to consider these differences due to the focus of this thesis on its role for promoting economic growth, as institutional stakeholders at multiple scales may look to support particular types of innovation, each with particular characteristics, needs and ultimately contributions to the local, regional or national economy.

One common way of conceptualising innovation, although one which is largely focused upon the narrow area of product innovation, is whether an innovation can be

considered to be radical or incremental in nature. Much like the definition of innovation itself, the definitions of what is a radical or incremental innovation is subject to several differences and nuances, for example sometimes radical innovation and disruptive innovation are used interchangeably, and in other studies they mean different things entirely (Markides, 2006). However, without dwelling on the definitional complexities of these subtypes of innovation, they can broadly be described thusly: Radical/Disruptive innovations involve the generation of an innovation from a high degree of new knowledge, often resulting in the development of a product that may be classed as either new to the market, or new on a global scale (Markides, 2006; Koberg et al., 2003). Such a definition therefore encompasses innovations which may be considered to be on the frontiers of new technology or "world class" innovation, commercialising new knowledge generated either internally from a firms own R&D process, or from knowledge acquired externally, such as from collaborations with universities, other firms or research institutions. Conversely, incremental innovations contain a low degree of new knowledge and are usually characterised as step changes and improvements to pre-existing products (Markides, 2006; Koberg et al., 2003). While this type of innovation is still believe to be beneficial to firms however, allowing the continual development and improvement of a firm's offering as method to maintain a position of competitive advantage, such innovations are considered to be less disruptive and overall less impactful on the economic performance of a firm and economy.

Another type of innovation, related to the above discussion with regards to how innovation is defined, looks at how some definitions of what is considered to be

innovation. As noted in several of the reviewed papers, innovation is considered to be something new, such as a practice, process, or product to *the relevant unit* (Damanpour and Wischnevsky, 2006; Garcia and Calantone, 2002; Johannessen et al., 2001; Zaltman et al., 1973). While in some respects, the inclusion of the prevision that when an innovation is depends on the relevant unit adopting it is a useful one, as it demonstrates that innovation is in some respects contextual, in another respect it may also be a view of innovation which may be considered too open, particularly from the view of stakeholders attempting to define innovation in growth terms. The reason for this is that such a definition in some circumstances limits an innovation to not the creation or generation of something new, but merely its adoption and diffusion of an innovation initially developed elsewhere. Due to this it may be questioned to what extent the impact that this has on the adopting firm, beyond maintaining a competitive position.

Because the aim of this thesis is to investigate innovation, the support of innovation and its place in delivering regional growth, as well as the issues concerning the construction and support of innovation networks across multiple scales and innovative firms, it may be argued that it is prudent to briefly assess the literature's view on each of these types of innovation, with regard to the risks and potential economic impact of each.

Radical innovations in many regards appear to be a high risk, high reward approach to innovation than incremental innovations (Kyriakopoulos et al., 2016; Sorescu et al., 2004). Radical innovation is inherently risky from a number of different perspectives,

as noted by Keizer and Halman (2007) these risks included factors such as whether a new innovation would perform according to its specifications, whether suppliers could be relied upon to deliver required materials and components to both a high enough standards and at a commercially viable cost, whether consumers will adopt the new product as well as more ambiguous risks relating to the ability of the firm itself to carry out the innovation and adequately manage the process. They also note, however, that while radical innovation is undoubtedly riskier than engaging in incremental innovation, it is argued that all innovation is risky, and therefore risk is an inherent part of business and that through identifying areas of potential risk, it can be adequately managed. In addition, it is noted that radical innovations while bringing high risk also, if successful, bring significantly higher rewards than an incremental strategy, a standpoint which is backed by a significant body of literature (Keizer and Halman, 2007; Sorescu et al., 2004; Blundell et al., 1999; Geroski et al, 1993; Chaney et al., 1991). In contrast, incremental innovation is seen as a lower risk approach to innovation, but as also having significantly lower rewards than those undertaking radical innovation (Keizer and Halman, 2007). Despite this however, incremental innovation does have a utility to firms, as it allows a low risk way to innovate, updating and improving their existing offerings in a manner that allows them to aid their maintenance of competitive advantage, if not their establishment of it.

Ultimately, numerous studies indicate that although the benefit of radical innovations vary from firm to firm and between industries (Sorescu et al., 2004), the literature supports that original and new innovations have a greater overall value in terms of growth and competitiveness, to a firm than the incremental improvement of old

innovations or products (Sorescu et al., 2004; Blundell et al., 1999; Geroski et al, 1993; Chaney et al., 1991). That is not to dismiss the impact and utility of incremental innovation to a firm, given its role in helping to maintain a sustained competitive advantage, as well as it being an overall less risky manner or innovating however from the view of stakeholders wishing to develop innovation which best supports the economic growth within a region, it is radical innovation that has the most significant impact. With regards to the view of innovation as a type including the adoption and diffusion of existing innovations by companies, making it "new to the firm" if not to the market, the impact of this type of innovation is less clear, as well as being relatively sparsely discussed in the literature. It may be argued, However that as such a definition of innovation means that nothing new is created, it is possible to assume that its impact would be similar to that of incremental innovations. It should be noted however, the adoption of such products may increase its overall competitiveness and therefore financial performance and resilience. In addition, the issue of getting firms to adopt innovations, in particular radical ones, is a significant issue for those undertaking radical innovation, and as such it may be argued that this view of innovation potentially has a significant impact on innovators on the radical end of the spectrum and innovation frontier. Due to these two factors therefore, looking at this mode of innovation and its impact to firms is not entirely without merit. Furthermore, given this study's focus upon using innovation to deliver growth, and looking at innovation systems and support across multiple scales, it is necessary to consider what types of innovation are being undertaken by firms within the empirical context of the SCR, as well as to look at how multiple levels of support institutions support innovation of each type, as it is argued that there is a need for consistency in approach, and that for

institutions wishing to promote the economic development of a region or the UK more broadly, that such support should be orientated towards supporting higher value radical innovations.

### 2.6) Models of Innovation

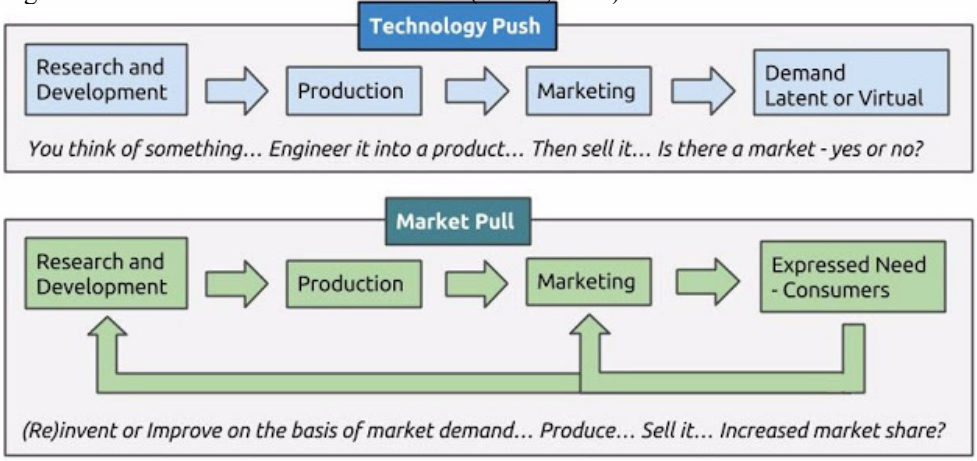
Another aspect of innovation that is worthwhile considering is how it has been conceptualised and represented in models developed from the study of innovation. Because of a combination of its importance to firms and regions, as well as its long history as a subject of enquiry, numerous models explaining the innovation process, its characteristics, how it may be encouraged in firms, as well as numerous other areas, exist. Because of this, while it is not practical to cover all innovation models and their development in their entirety, this thesis will briefly cover five models of innovation, selected due to either their centrality in innovation studies or their relation to the issues covered in this research. In addition, this thesis notes that models of innovation are simplifications of concepts, and therefore the concepts themselves are simplified in order to increase their accessibility and their ability to travel easily in both academic and public fields (Godin, 2017). As a result, it is accepted that all models of innovation have their benefits, but also limitations and drawbacks. Despite this however, it is argued that such models serve a useful purpose in explaining the different ways in which innovation takes place. With regards to their place within this study, a brief examination of innovation models is of value, not only to provide further context, nuance and understanding regarding innovation as a concept in and of itself, but also in order to help further categorise and understand how firms understand and approach innovation in practice, at what place additional support may help support this in

practice, and how firms themselves understand their innovation processes. Additionally, such models act as good demonstrators of the importance of collaboration and the transfer of knowledge in the innovation processes, an essential underpinning of the innovation systems concept.

### 2.6.1) Linear Model of Innovation

The first model that should be looked at when investigating innovation is that of the linear model of innovation (figure 2.1). The linear model is one of the earliest models of innovation, and was a widely used by both academics and practitioners alike, due to its demonstration of early innovation practices (Godin, 2006). This model is split into two archetypes, the technology push model, where research and development result in the development of a product that is marketed. The second variation, market pull, follows a path where consumer or market need is used as a basis for which R&D is conducted, in order to produce a product to solve or meet that need. Although later supplanted by newer more dynamic models of innovation, the linear model has utility in explaining early innovation processes, as well as demonstrating the central role of knowledge, namely research and development in early models, to the innovation process.

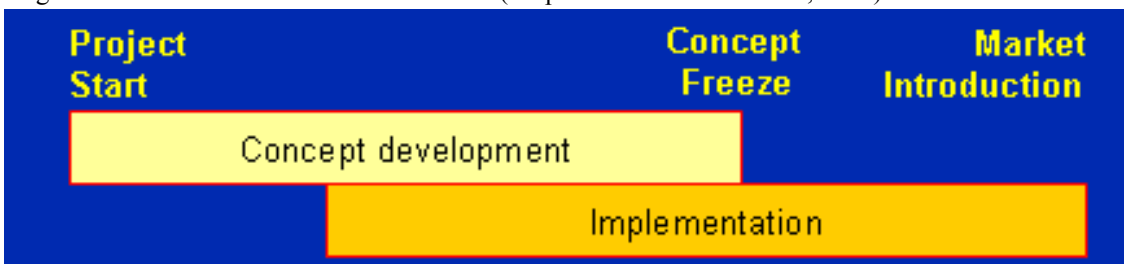
Figure 2.1 The Linear Model of Innovation (Godin, 2006)



### 2.6.2) The Flexible Model

The second model which should be investigated is that of the flexible model of innovation (figure 2.2). In contrast to the linear model of innovation, with innovation seen as a linear and planned activity, the flexible model instead assumes a more eclectic approach with ideas and improvements being found and implemented from numerous sources, areas of the businesses and stages of the innovation process (Niosi, 1999). This model demonstrates the move away from more linear models to one that are considerably more dynamic, and allow for the feedback of knowledge into the innovation process at various points.

Figure 2.2 The Flexible Model of Innovation (adapted from 1000 ventures, 2017)

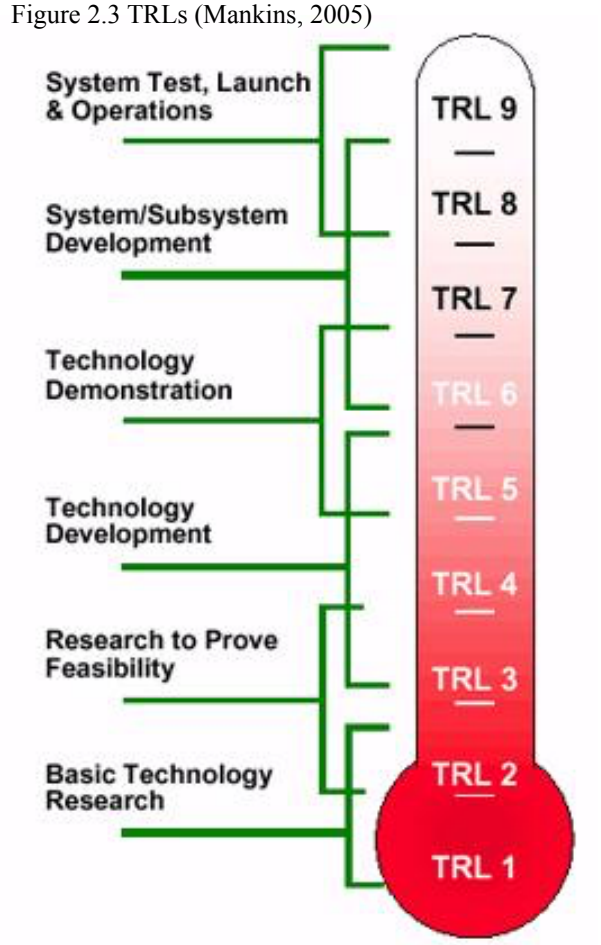



### 2.6.3) Technology Readiness Levels (TRLs)

Another model of importance is that of Technology Readiness Levels (TRLs). The TRL model was developed by the National Aeronautics and Space Administration (NASA) and US Department of Defence (DOD) as a method through which the technological maturity of different technologies and innovations could be assessed and measured (Mankins, 1995). Although initially intended for usage by NASA and the DOD, due to its utility in assessing technological maturity, and by extension its closeness to a point where it may be commercialised, with each level representing a

step further away from it being a purely theoretical idea towards an end product, TRLs have been adopted by numerous companies engaged in radical innovation and innovation at the technological frontier (Mankins, 2005). Although the model does have extensive limitations, as similar to the linear model of innovation it is a stage-gated process with little interaction or feedback between the stages, it is included in this review due to the extent of its adoption and popularity as a model figure (3.3).

Figure 2.3 TRLs (Mankins, 2005)

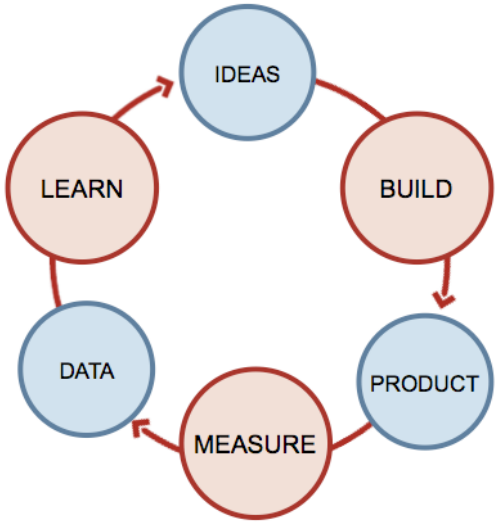



### 2.6.4) The Lean Model of Innovation

Another model of innovation that has been included in this literature review is the lean model of innovation. Proposed in 2011 by Reis the lean model is typically applied towards business start ups as opposed to innovation, however due to its utility in encouraging the cost effective and timely development of innovations has been increasingly applied in innovation. In the development of new innovations, this method focuses primarily upon the concept of "validated learning", getting end user feedback quickly and often (Muller and Thoring, 2012; Reis, 2011). The result is a method of innovating which is highly reactive to end user specifications and needs, and as a result the provision of customer value with a lower expenditure of resources,

resulting in its increased popularity with firms seeking to reduce their expenditure on innovation, particularly resource lacking SMEs (figure 2.4). The reason for this model's inclusion in this literature review is due to the fact that it places a significant

Figure 2.4 Lean Model of Innovation (Reis, 2011)

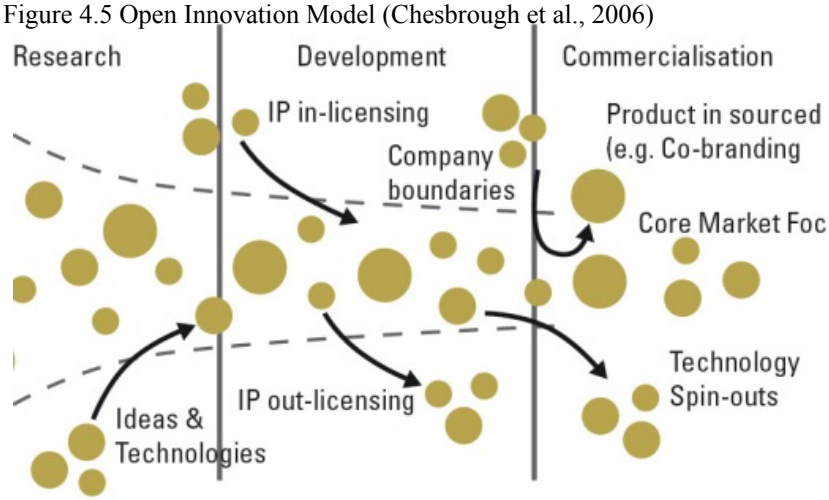



emphasis on knowledge in the innovation process, as expressed through its concept of validated learning, as well as its recent increased popularity with innovating SMEs.

### 2.6.5) The Open Innovation Model

Finally and arguably most importantly for this thesis is the open innovation model (Figure 2.5). The open innovation model demonstrates the numerous ways in which a firm may both develop and acquire new knowledge for its innovation projects, even from external sources. Conversely, it demonstrates a number of ways in which a firm may also utilise and commercialise knowledge that it has acquired or developed yet sits outside the traditional boundaries of the company (Chesbrough et al., 2006). This model is of particular importance for this study as it demonstrates the importance of knowledge acquisition and utilisation, as well as putting a heavy role on the value of collaboration in the innovation process.

Figure 4.5 Open Innovation Model (Chesbrough et al., 2006)




To summarise, these models all have utility in demonstrating the manner in which businesses innovate, or have innovated in the past. This therefore helps develop understanding of the way interviewed firms innovate. Most importantly however, is the point of commonality between these models. All of the above models demonstrate that one of the biggest drivers of innovation is the acquisition, transition and application of new knowledge. Although the extent to which this is represented varies from model to model, it demonstrates further the importance of learning and interaction in the innovation process, and the acquisition of such knowledge from both internal and external sources, a significant component and consideration for the construction of innovation systems.

### 2.7) Innovation Systems at Sub-National Levels

For a significant period, the concept of the "innovation system" has long been viewed by academics and policy makers as one of the primary methods through which innovation may be encouraged within the confines of a defined physical space (Jenson

et al., 2016; Ockwell and Byrne, 2016). This assertion is one that still broadly holds true till today, however the concept through a period of four decades has been subject to significant change, refinement, addition and development. Central to these conceptual developments concerns the issues of scale, density and connectivity, resulting in an unresolved debate concerning the scale of such systems, and the conflict between size, density and connectivity. This section therefore summarises the inception and the development of the innovation systems concept, from the National Innovation System (NIS), to Regional Innovation System (RIS) and most recently the Local Innovation System (LIS) or Innovation District (ID). It looks at the development of each of these concepts, its core characteristics, how they relate to the issue of scale, and the ensuing debate. It concludes by demonstrating that the innovation system scale issue is not a binary one, and therefore constitutes a significant gap within the literature, given the standard approach of innovation systems studies being to investigate or advocate for one scale or another, rather than taking a more holistic multiscalar approach.

Although the exact origin of innovation systems thinking is debatable, one of the first and most well known innovation systems concepts was that of the National Innovation System (NIS). From the late 1980s onwards, this concept developed based upon the work of academics such as Lundvall and Nelson, a body of research which was built around the concept of taking a holistic perspective focusing on interaction between different actors in the innovative process and how this interaction is influenced by a broad social, institutional and political context embedded in the national environment in which these actors operate (Teixeira, 2014). The national systems of innovation

approach focuses on interactive learning between actors in the innovation process, the acquisition and retention of capital as both money and knowledge, and the role that national institutions play in explaining the differences of innovation rates between different nations (Lyasnikov et al., 2014; Asheim and Coenen, 2005; Freeman, 2002). One of the most significant elements of such a system is its focus upon three broad categories of actor and/or institution. Although there are some variances in how such actors are described, ultimately they consist of institutional stakeholders, who act to support innovation through both supporting firms and creating a institutional, legal and political environment which is favourable and supportive of innovative activities, knowledge creating institutions such as universities and private research institutions, which create new knowledge that can be commercialised into an innovation, and firms who act as the institution that commercialises such new knowledge and ideas (Etzkowitz and Ranga, 2015; Ivanova and Leydesdorff, 2014; Katz and Wagner, 2014). It is mutually beneficial and supporting interaction between such actors that is at the core of the NIS, as well as being the primary focus of many of studies investigating the innovation system. These three groups of actors and institutions and the interactions between them, also known as the "Triple helix" of actors by some (Etzkowitz and Ranga, 2015; Ivanova and Leydesdorff, 2014), remains a significant component of all following refinements of the innovation system concept, and demonstrates that while the concept has been developed, this central element of innovation systems remains a robust and well accepted and established part of innovation systems thinking.

When looking at National Innovation Systems, the concept can be subdivided into the component parts that make up the term: National, Innovation and Systems (Cooke et

al., 1997). It is argued that problems exist when looking at the national component, as states may comprise of several nations and thus within national boundaries many different sub-cultures and languages may exist, hindering important elements of the innovation process. Thus within the regions it is "the elements of shared culture, territory and devolved administrative and/or political organisation (that) provide important dimensions of the institutional setting for innovation and other relative policy development" (Cooke et al., 1997, p477). This explains why within national systems of innovation there exists a collection of regional systems of innovation with varying degrees of effectiveness. It is argued that within a state some of its characteristics can be found in certain regions, but not in others within the same state. If this is the case, these characteristics will also be present in the organisational characteristics of the region's firms and innovation aiding institutions, weakening the argument for national systems of innovation, and repositioning regional systems as a more appropriate unit of investigation. It is argued that regions are also a particularly useful level of analysis due to the presence of globalising forces. As the world economy globalises, competitive advantage is increasingly derived from the exploitation of unique competencies, knowledge and resources, which are often regional in nature, and as such it is argued globalisation, though present, is not the strongest tendency of the global economy (Sunkel and Inotai 2016; Freeman, 2002). Therefore in order to effectively innovate and compete in the world economy, the regional unit of analysis has grown in prominence (Asheim and Coenen, 2005). It should be noted however, that while the above points present a compelling argument that the regional scale may be a better unit of analysis, intervention and system construction, this does not mean the NIS is any less valid. As argued in greater detail

below, innovation systems are subject to multiple scales of influence, and therefore regions are often also subject to national characteristics, interventions and institutions. This therefore presents a problem within the literature, as the majority of writing advocates for one scale or another, rather than taking into account its multiscalar nature.

From the above criticisms of the NIS approach, the alternative view of the Regional Innovation System (RIS) developed and gained in prominence (Lau and Lo, 2015). The development of the RIS concept can track its origins to two main bodies of research. The first, systems of innovation, is built along Schumpeterian lines with regards innovation as an evolutionary and social process, influenced by numerous actors and factors all engaged in a collective learning process both within a firm and external collaborations with other firms and institutions, and therefore has significant parallels with the multi-actor consideration afforded by the NIS approach. The second, regional science, asserts that innovation is a locally embedded process due to the geographical proximity of innovation aiding institutions. A regional innovation system emerges from cooperative interaction between knowledge producing institutions, such as universities, and firms able to commercialise this knowledge that is aided by an innovative regional culture that allows the institutions to evolve over time (Doloreaux and Parto, 2005). The economic trajectory of a region is also influenced over time by the region's historic path dependency, thus explaining why different cities exposed to similar evolutionary principles have divergent outcomes (Martin and Simmie, 2008a). Path dependency may be explained as a process whereby at each moment in time the numerous economic trajectories open to the region are dependent on both the past and

current form of the system, and therefore the past provides the available possibilities of the system and at the present the decision is made on which possibility to explore. Due to the self-reinforcing nature of economies, a tendency develops to "lock in" a particular economic path in preference to others, often based on a region's economic history. This concept goes some way to explaining the divergent outcomes of different regions and their varying ability to recombine endogenous and newly acquired knowledge to generate innovation, as the knowledge available to the region is influenced by its historical development, and is covered in greater detail below.

A further driver behind the move away from NIS to RIS is due to innovation being viewed as a process embedded in social relationships developed over cultural lines, occurring in an institutional, political and social context that occurs most easily when related industries are clustered together in close geographical proximity. Within the social relationship context, regions play and important role in the innovation spectrum as they provide a regional set of rules and norms developed from socio-cultural values such as shared norms and trust that shape the expectations of actors within the region. This builds social capital among actors within the region due to the exposure to these values, which then aids the exchanging of knowledge between actors and builds trust, helping to overcome market failures and reduce market costs. Within the institutional context, innovation and regions are interlinked because of innovations reliance on predominantly local resources such as specialised labour markets, local spill over effects and supporting agencies.

Another significant driver behind the NIS to RIS move was due to an increased understanding of the role of "tacit knowledge" in the innovation process, as well as associated difficulties with its transition over distance (Ahammad et al., 2016; Ketcha et al., 2015). Tacit knowledge is knowledge that may be described as difficult to codify, however is instrumental in the generation of innovation and their development (Pérez-Luño et al., 2018). Because tacit knowledge is highly difficult to codify, it is difficult to transmit over distance by conventional methods, and therefore its effective transition is often limited to the distance that one actor may travel to transmit it to another. Because of this, it is argued that it is difficult to transmit such knowledge on the geographical scale of the nation, particularly territorially large nations, as well as to have high density of such interactions required for a true system to develop. It is under this logic therefore, and the development of literature around such tacit knowledge transmission, that the literature began its move away from larger geographical scales of Innovation systems, towards smaller ones. Within the context of the UK, this was in part exemplified in policy and practice with the inception of the Regional Development Agencies (RDA), which followed in part this model and scale, which is covered in greater detail below.

Finally, another reason why geographical proximity plays a role in promoting innovation as innovation is more likely to occur in areas where the same or similar industries are in close proximity as actors are able to benefit from knowledge spill over effects and allows for easier adaption and learning (Doloreaux and Parto, 2005). This demonstrates the importance of the region in promoting innovation and the importance that is placed on the relationship between firms and innovation aiding institutions. This

within the English context however has a new level of complexity, due to the rescaling of regions, institutions and the adoption of an approach better described as localism.

Most recently, following the logic concerning the transition of knowledge and forging denser networks between innovation actors, there has been a move further away from regional levels of innovation systems towards smaller ones at the sub-regional or city region, as exemplified by the Local Innovation System (LIS) and Innovation District (ID) models. The first of these concepts, local innovation systems, is both a comparatively new and underdeveloped concept and as such is both less clear and established than the NIS and RIS concepts. Defining what constitutes a LIS presents significant difficulties, due to a lack of definitional discussion amongst academics. A LIS shares many characteristics of a RIS, such as interconnectivity between firms, knowledge creating institutions and other supporting organisations and actors, however is believed to operate at a smaller scale. The difficulty here however, is the question of at what scale does a RIS become a LIS? While numerous studies (Bento, and Fontes, 2015; Carson et al., 2014; Martin and Simmie, 2008b; Wang & Zhang, 2008; Rantisi, 2002) have used the concept of a LIS in their research or made reference to it, and given the issues associated with the scales of RISs, there exists no common consensus as to what scale this constitutes. When looking at LIS, however, studies have when looking at the local scale used several different scales of observation (Martin and Simmie, 2008b; Rantisi, 2002). Therefore this study defines a LIS as an area, comprising of similar assets to those of a RIS, constrained to the smaller geographical area smaller than that of a city region.

Another innovation systems concept, forwarded by academics such as Katz (Katz and Wagner, 2014), the concept of Innovation Districts has gained considerable recent attention from both policy and academic stakeholders. Much like the move from NIS to LIS, innovation districts involves the construction of innovative networks at a further reduced spatial scale, normally constrained to an area of a city with a few key differences, and is considerably better defined. Further developing the above NIS and RIS concepts, while the focus upon the triple helix of actors remains, the ID concept is also more specific about the assets which are included and necessary within such a system in order to have both a density of actors and density of interaction between them. An ID is made up of a collection of economic, physical and networking assets (Katz and Kline, 2015; Katz & Wagner, 2014), often concentrated at the scale of a area of a single city. Economic assets comprise of three broad categories: First, Innovation drivers are firms, entrepreneurs and research institutions that are focused on the development of technologies, products and services, and their commercialisation. Secondly, innovation cultivators are firms, organisations or groups that support innovators and the district, such as technology transfer offices, incubators, training organisations etc. Finally, neighbourhood-building amenities consist of the amenities supporting residents and workers through services such as retail, medical facilities and restaurants and cafes. The physical assets also consist of three broad categories of asset. First, public assets are public areas such as parks which have the function of becoming areas of interaction and activity between key actors. The second consists of physical assets in the private realm, privately owned buildings such as offices and residential and are necessary for the serving of businesses and innovators within the region. Finally the last category of physical assets are physical assets which tie the

district together, assets which are specifically aimed towards eliminating barriers that hinder the areas connectivity. Network assets are comprised of two broad classes: First, networking assets that build strong ties, which are assets that contribute towards strengthening relationships between actors in similar fields, such as workshops and training for those in specific fields or cluster or industry specific meetings. Secondly, networking assets that build weak ties, networks which focus on building new and cross sector relationships, including networking events, innovations centres etc (Katz & Wagner, 2014).

In terms of defining what constitutes an ID, in addition to the assets listed above IDs are believed to adhere to three broad models of development, the understanding of which helps contribute to our understanding of what does or does not constitute a ID. First, the "anchor plus" model is where anchor institutions such as universities or research centres attract a rich base of related firms, entrepreneurs and spin off companies, resulting in a highly networked collection of actors involved in the commercialisation of innovations. Second, the "re-imagined urban areas" model develops where former industrial or warehouse districts undergo transformation, when supplemented by innovative anchor companies and institutions. Third, the "urbanised science park model" is where traditionally isolated areas of innovation are urbanised through both increased density and increased variety in land usage, these areas are traditionally located in suburban and exurban areas, due to both the historical development of these areas as well as in part due to the specialised infrastructure needs of some industries (Katz & Wagner, 2014).

This however poses an interesting question with regards to scale and density: although some of the assets above can be constructed within an area, many are based upon pre-existing expertise and innovation assets, presenting difficulties for cities which have historically lagged behind in terms of innovation rates (Coenen et al., 2015). In such cases therefore it may be argued whether such smaller scales are appropriate, or despite increased difficulty associated with tacit knowledge transmission, is it better for such areas to adopt a larger scale in order to bring more innovation assets into the network? This therefore brings us to the debate in the literature with regards to the issue of geographical scale and density.

From such developments in the literature, many of the debates around innovation systems are centred around the issue of size and connectivity, and the optimum configuration of such systems based upon these issues. Although the NIS as a concept has been reduced in its overall prominence as a result of conceptual developments in the RIS, LIS and ID areas which demonstrate that increasingly global nodes of competitiveness are located in regional and sub-regional areas (Fourie, 2015), and that often within the contemporary nation state areas with differing and distinct characteristics result in significant differences in innovation rates and performance between regions (Naz et al., 2015), and a greater understanding about the limitations of tacit knowledge transmission (Almeida et al., 2017), it is argued by this thesis that NIS remains a significant and relevant concept. While it is argued that within nation states regional differences and networks exist that provides justification for RIS, LIS and ID scales of innovation system construction and analysis, the nation state remains a significant level of political and economic control, authority, and support (Wachsmuth,

2017) and often the de facto highest level of decision making authority. As such, it is accepted that while perhaps smaller, sub-national scales of innovation system are ultimately more effective at supporting and enhancing innovation within an area, as they are still subject to such national scales and its accompanying regulations and support initiatives it is necessary to investigate and refine this scale of system, even if it has been reduced in prominence somewhat due to increases in the regionalist approach (Lau and Lo, 2015; Sadyrtdinov et al., 2015). While this argument is one which is difficult to counter, it also serves to demonstrate the binary approach in the discussion of innovation systems. This is that, because it is argued the NIS remains a relevant scale of policy and intervention it should continue to be studied alongside other smaller scales of innovation systems and conceptual models, rather than accepting that areas are subject to multiple scales of innovation systems and actors, and thus instead attempting to take a multiscalar approach.

Although few would argue that the NIS still has utility as a model, discussions are increasingly more centred towards whether RIS or LIS and IDs are better scales at which innovation systems may be constructed. This is in part owing to the issue of tacit knowledge transmission, suggesting that given its poor transmission over distance that knowledge networks between actors are better constructed over smaller scales (Pérez-Luño et al., 2018). Despite these arguments however, one under examined area of the concept revolves around how the scale of such boundaries may affect the assets within them and the construction of a critical mass required for the construction of a dense innovation network. The later discussions around LIS and IDs therefore also serve to add another dimension regarding the optimum scale of innovation through

their greater consideration of innovation assets, as well as the actors themselves (Katz and Kline, 2015; Katz & Wagner, 2014). While adding a significant component to such concepts in enhancing understanding of how such systems can be facilitated and built up, few studies take into account the issue of the critical mass of such assets within an area, and how this relates to the drawing of physical boundaries. Instead, such developments tend to be associated with the ID concept and do not investigate whether drawing boundaries around a larger scale may be required in historically lagging areas with few innovation assets at smaller scales. Therefore, while there is significant debate in the literature regarding the scale of innovation systems and the assets and configurations required for their performance, and as such multiple lenses are used, preferred and advocated for by some investigators of the subject. Multiple scales exist in practice, however, and it is therefore necessary while using these multiple lenses to also consider that such lenses are in practice connected, and that a more holistic and multiscalar approach be required.

In conclusion therefore, as can be seen, the innovation systems concept has been subject to refinement and adjustment following its initial inception exemplified through the NIS concept, with an unmistakeable trend since then towards increasingly smaller geographical scales of networks and systems. Many of these discussions and debates are, however, centred around supporting innovation in what may be described as and/or in nature, in that either one scale is more effective, or another is. What the literature fails to adequately take into account in these debates, is that in practice innovation systems are subject to numerous multiscalar influences and scales of support, influences, connectivity, intervention, networks etc. Within the UK context,

numerous innovation supporting institutions affect actors within an innovation systems and both national and subnational scales, meaning that the issue of innovation support is not one of any single scale. As a result, this represents a significant gap within the literature and an under examined area within the current body of innovation systems literature. This study therefore aims to redress this gap, through looking at the complexities of the multiscalar approach within the context of the SCR, its challenges and the challenges of localism for growth, and how this relates to the multiscalar system and support spectrum.

**2.8) Innovation at the firm level**

Finally, while this study focuses on innovation taken at a regional level, it is important to note that the nature, process and level of regional innovation is the sum of the numerous actions and interactions of individual firms and actors working within the regional context. As such, it would be short sighted not to consider the innovative, networking and learning processes that occur at the individual and firm level, particularly given that it is innovative firms that are the end point of innovation, in that they are the actors that take create knowledge and access support in order to generate innovations. In addition, examination of innovation at the firm level helps to both demonstrate where support in innovation processes may be provided by institutional stakeholders, as well as helping to demonstrate parallels within firms and innovation systems thinking and concepts, and how the two areas mesh together to from a cohesive whole. Therefore, within the context of this study, it would be short sighted to not examine and provide context regarding how firms innovate in in practice.

A firm's ability to innovate is, much like path dependency, shaped by past performance and the resources and experience that it has accumulated. Its past dictates the available resources which may be recombined into new innovations. A problem that exists, however, particularly in larger firms, is that while individuals within the organisation may have the experience to solve a problem and provide an innovative solution, they may not be aware of the problems. As a result a problem of bridging exists, whereby the resources and experience to produce an innovation may be present in a firm, however due to the nature of learning, it is embedded within certain individuals. To overcome this, efforts need to be made to bridge the gap between available resources nested within the organisation, and where the resources are needed (Aalbers and Dolfsma, 2016; Palacio et al., 2009; Hargadon, 2002). The issue of bridging which is also one which is reflected in part in the construction of innovation systems. It is this interaction but across a region which helps to develop innovations from an areas pre-existing assets and expertise, and as such ensuring such bridging occurs, not only between expertise within a firm but external to it, is of extreme importance in innovation system formation.

Another particularly important factor in a firm's ability to innovate is its absorptive capacity. Absorptive capacity is the ability of a firm to gather and value commercial knowledge from external sources, and their ability to process this to produce commercial outcomes in the form of an innovation, and hence significantly affects a firm's ability to innovate. Work undertaken by Zahra and George (2002) identified four key dimensions in which a firm must be effective in order to possess a high rate of absorptive capacity. The first dimension, acquisition, is the firm's ability to identify,

value and acquire knowledge from external sources that is required to produce an innovation. The second factor, assimilation, relates to the firm's ability to understand and process the acquired information. Together, acquisition and assimilation constitute a firms potential absorptive capacity, its ability to acquire and process knowledge necessary for innovation. At this point, the knowledge acquired presents only the potential for innovation as it has yet to be transformed into a commercial output. The third and fourth factors, transformation and exploitation, relate to the firm's ability to take the acquired and assimilated knowledge, to recombine or reinterpret the knowledge, and incorporate such knowledge into its operation producing a commercial outcome. These two factors represent the firm's realised absorptive capacity that relates to the firm's ability to leverage and use the knowledge absorbed during the potential absorptive capacity stage. It is further argued that absorptive capacity's impact on innovation is most influenced by the efficiency at which potential absorptive capacity is turned into realised absorptive capacity (Zahra and George, 2002). This view has since been refined, and it is now believed that it is firms with the most efficient social integration mechanisms, that is the ability to share information across the group's members, who are most efficient at turning potential absorptive capacity into realised and producing innovations (Fosfuri and Tribo, 2008). This view is reflected in other work that identifies the importance of knowledge brokers, and the importance of knowledge diffusion in an organisation (Haas, 2015; Boari and Riboldazzi, 2014; Hargadon, 2002). This previous research in the field of absorptive capacity gives us an important insight into the firm level innovation process, the stages and factors it involves, as well as helping to identify opportunities for improvement and barriers to be overcome that are present at various levels.

One method through which firms, particularly SMEs are sometimes able to promote the knowledge diffusion required to innovate is through the use of sophisticated innovation management practices (Donate and de Pablo, 2015; Inkinen et al., 2015; Palacios et al., 2009; Rammer et al., 2009). In terms of knowledge generation, in the form of in-house R&D small firms have a distinct disadvantage compared to larger firms. Indeed, some studies have demonstrated that when taken as a whole, formal R&D has no effect on the growth of new firms (Stam and Wennberg 2009). The reasons behind this are numerous, but mainly relate to the high minimum, entry and fixed costs associated with conducting in house R&D which small firms find more difficult to bear, particularly when there is no guarantee of a successful outcome. This in turn makes it difficult to obtain external financing, further increasing the difficulty of SMEs ability to conduct formal R&D in house (Rammer et al., 2009; Stam and Wennberg, 2009). The use of innovation management practices is a way through which firms can generate innovative outputs through methods such as exploiting their internal innovation potential and accessing external sources to aid innovation, and can be used to achieve similar innovation results compared to those that do undertake R&D provided the right strategy is adopted (Rammer et al., 2009). If an appropriate innovation management strategy is introduced and adhered to, such a system is strongly connected to the innovative capacity of the firm (Palacios et al., 2009).

## 3) Scale and Regional Concepts

### 3.1) The Changing Scale of UK Governance Institutions

Similar to the move in the innovation systems literature away from the national scale as the optimum level for the building of networks of systems, this too has been in part reflected in the literature regarding the scale of institutions and regions. There has been a shift in the literature away from what was previously termed new regionalism, towards the city regional and local scales as more accepted and suitable levels for the devolution of decision-making authority and resources. This has been practically reflected in policy in the UK in the move away from regional level Regional Development Agencies (RDAs) towards smaller Local Enterprise Partnerships (LEPs), constructed at the smaller city regional scale. As this has significant potential for affecting the development of innovation systems and the ability of such regions to support and benefit from innovation-led growth, the following sections review the literature regarding this shift, the history behind it and core underlying concepts. First this section highlights the region to city region debate, and development of the literature. Second, it looks at the birth of the RDA, how they developed over time and their impact upon the areas in which they administered. Third, this chapter looks at the development of LEPs, the concept of the city region, and the literature and concepts that underpin it.

### 3.2) The Region to City Region Debate

In recent years there has been a shift away from the orthodoxy of new regionalism and a growth of support for the idea of city regions as a more accepted and useful area within the social sciences. This section presents an overview of the current academic

debates regarding this shift, and considers the city region as a more appropriate unit of political and economic function. It will also observe the practical implications this shift in focus has had on national and local economic policy in England, with particular focus on the institutions designed to carry out city regional economic policy.

In England, the shift in focus from regions to city regions has been based in part on a desire in Whitehall to move away from artificially drawn regional boundaries developed during the period of "new regionalism" to ones that reflect a "functional economic area" (Hildreth and Bailey, 2014; Deas et al., 2013; Rossiser and Price, 2013; Shaw and Robinson, 2012). This has been reflected in policy through the move from Regional Development Agencies (RDAs) which were responsible for an artificially drawn geographical boundaries, to LEPs whose area is smaller and tends to encompass a functional economic area such as a city region. This then begs the questions what constitutes new regionalism, what constitutes a city region, and how within this have the shift between the two affected the institutions administering to them. It needs to be further investigated what implications these institutions have had on economic development and innovation in their operational areas.

### 3.3) The Emergence of a Regional Focus: The Birth of Regional Development Agencies (RDAs)

Within the field of social sciences it is possible to identify five common modes of usage of the concept of "region". The concept of "new regionalism" is one of these models that has come to refer to "those theoretical and policy perspectives that directly relate the relevance of regions to the economic restructuring of national economies in

the face of globalisation and supranational regionalisation" (Agnew, 2013 p11). This usage of the region concept has become an increasingly prevalent perspective amongst policy makers as a more appropriate scale for policy intervention.

Given that new regionalism was the foundation from which there was a move away from national to regional units of control, as well as being part of later developments towards smaller units of political and economic control and authority, it is important therefore to examine from the theoretical perspective what new regionalism actually entails, what it means as well as its theoretical underpinnings and policy implications. Keating (1998) represents a key source in explaining the emergence of the new regionalism construct, as well as the breakdown of the nation state as a unit of authority and economic planning. Originating in the mid 1980s, the concept of new regionalism in part emerged as a result of characteristics associated with increased globalisation and economic interconnectivity, particularly within the EU. With the rise of the EU, as well as increasing globalisation, the ability of human and financial capital to move freely means that regions no longer are confined within national boundaries. As such it is regions that are increasingly in competition with one another rather than the sate, meaning that in effect regions are increasingly acting on the global stage independently, acting as it were as mini states and reducing the ability of the national sphere to exert political control. In addition, given a rise in globalism and the increased embracing of free trade by nation sates, the nation is less able to act in a protectionist manner towards its regional subunits and by extension is less able to mediate their interaction within the global market, further reducing both the role of the nation state, as well as explaining the breakdown of the spatial Keynesianism concept

through the emergence of the region and not the nation as the key unit of economic development.

In terms of policy implications, new regionalism is part of a body of thought that the "region" has become the main sub-unit for economic development and as such needs to become a, if not the, prime focus for economic development (Webb and Collis, 2000). Although it is argued that globalisation is increasingly creating an ever homogenising and borderless world, new regionalism asserts that some flows and processes are becoming increasingly focused in a number of areas of dense economic activity (Harrison, 2007). It has been further argued that as the importance of regions as drivers of economic growth increases, the effectiveness of the nation state to act centrally in coordinating economic policy is decreasing. This is based on the premise that the state is too large to effectively respond to rapid economic changes at a local level, and that it is those within the regions, such as business owners and policy makers, who are best placed to make decisions about the area's economic needs and act accordingly (Hildreth and Bailey, 2014; Deas et al., 2013, Shaw and Robinson, 2012; Webb and Collis, 2000). New regionalism, therefore, is seen as a logical reaction to this changing economic environment through the creation of a new framework of economic governance (Agnew, 2013).

It was under this reasoning that with the election of a Labour government in 1997, efforts were made to devolve power away from the centre and to give regions more control over their affairs. One document which was particularly important in pushing new Labour's attempts at decentralisation was the White Paper "Your Region, Your

Choice: Revitalising the English Regions" (Cabinet Office and DTLR, 2002). This proposed the creation of elected regional assemblies in regions where such a measure was supported by the majority of the people in the area as proved by a referendum, and was believed in theory to better reflect the new regionalism concept. While this was not successful, Labour continued to pursue the delivery of regional policy through decentralised means and created a number of institutions in order to achieve this (Pearce and Ayres, 2007). One set of significant institutions that were formed as a method through which the devolution of economic strategy could be achieved were the RDAs.

**Figure 3.1:** The five statutory purposes of the RDAs. From Pugalis, 2010.

1) To further economic development and regeneration
2) To promote business efficiency, investment and competitiveness
3) To promote employment
4) To enhance the development and application of skills relevant to employment
5) To contribute to sustainable development

Most advocates of new regionalism stress the importance of gaining active engagement of the private sector in regional economic developments (Quinn, 2013), and the RDAs were designed to do this through acting as a coordinator, encouraging engagement from both public and private sector agents. It was thought that by working alongside public and business organisations a regional identity could be formed, and that it would provide an institutional capacity to shape economic process within the region it operated (Pearce and Ayres, 2007).

According to the Regional Development Agencies Act in 1998, in order to achieve its five statutory purposes "a regional development agency may do anything which it considers expedient for its purposes", (Great Britain, 1998, p2). The act also, however, stated that "A Minister of the Crown may, to such extent and subject to such conditions as he thinks fit, delegate any eligible function of his to a regional development agency" (Ibid, p3). This resulted in an expansion of responsibilities accorded to the RDAs over their period of operation. Focusing on their responsibility to promote business development, in order to increase the development of businesses and their competitiveness RDAs have used a variety of different methods. These have included "research and feasibility studies, information provision, awareness raising and promotion activities, financial assistance, provision of guidance, advice and mentoring, network and capacity building, provision of training and learning, direct provision of facilities and equipment and direct funding through grants or subsidised loans" (DTI, 2005, p69). This demonstrates the wide range of project-based interventions that were used by RDAs to promote regional economic development.

RDAs have been attributed to some success with regards to promoting economic development, however despite this the performance of RDAs overall has been significantly questioned. It has been highlighted that throughout the period of their operation, the information required to accurately quantify the RDAs claims of success is scarce, making it difficult to accurately assess them, even after their disestablishment (Pearce and Ayres, 2007).

Additionally a number of criticisms have been levelled against the RDAs and their role in general. One prevalent criticism regarded the funding arrangements put in place for the RDAs by central government. Much of the funding required to deliver the regional policy goals set by Whitehall was under the control of other organisations within government, over which the RDAs were only able to exert a limited amount of influence. It is argued that the amount of resources allocated to the RDAs constrained them to a degree where they were unable to make a significant impact (Pearce and Ayres, 2007; Fuller et al, 2002). A number of other regional bodies involved in economic development have also been identified, such as the regional local authority Leaders Boards, Regional Learning and Skills Councils, Regional Select Committees and Regional Grand Committees (Larkin, 2010). These served to increase the complexity of regional development strategy and caused some duplication between bodies due to overlapping responsibilities in some areas, and it is argued resulted in a waste of public funds. While attempts were made to improve the RDAs funding arrangements through the allocation of a "single pot" of funds, the vast majority still came from other government departments such as the Department for Communities and Local Government (DCLG) and the Department for Business Enterprise and Regulatory Reform (DBERR) (Pearce and Ayres, 2007; Fuller et al., 2002). Concerns were also expressed around the Geographical boundaries in which the RDAs operated, as these were based upon administrative rather than functional ones. Additionally the argument has been made that regardless of the geographical boundaries in which they operated, many RDAs perused a generic strategy, and failed to effectively tailor their delivery to local circumstances (Huggins and Williams, 2011; Pearce and Ayres, 2007).

### 3.4) The Developing of City Regions and the Local Enterprise Partnership (LEP)

Although the definition of what constitutes a region has been widely debated amongst academics it has historically not been seen as central to debates regarding the implementation of regional economic policy (Quinn, 2013). It is further noted that as the level of cohesiveness present within the regional boundaries can have a direct impact on the success or failure of policy intervention, it is important to effectively define what constitutes a functional economic area.

Parr (2010) goes some way towards defining a set of characteristics that define a city region based on economic criteria. It is argued that the city region is made up of two elements, the dominant city in the area (known as the C zone) and the peripheral territory surrounding it (known as the S zone). This relationship can develop as a result of "urban overload" whereby increases in land rent within the C zone pushes out some economic and residential activity out into the S zone, however linkages between the two remain (Camagni, 2008). This is because C zone is an important transport and communications hub, is the centre of service provision and is a focus of ownership, control, business organisation and public administration. Where the boundaries of the S zone are drawn is not a clear cut matter, however it can be defined as "a territory that is linked more with the C zone in question than that with the C zone of some adjacent CR" (Parr, 2010, p557). This can prove a problematic issue as some areas can be classed as a functional economic area however have several C zones. An example of this is the Sheffield City Region (SCR), which although can be described as weakly monocentric, has a number of other centres of employment and production, therefore displaying some polycentric characteristics.

Additionally as these linkages between C and S Zones can be measured in terms of labour market, trade or capital flows, determining whether an area in the S zone is linked more to one C zone than that of another is open to some ambiguity. With the advent of LEPs, this issue has had practical policy implications demonstrated by a number of LEPs that overlap in some S zones, such as Barnsley, which is linked to both the Leeds and Sheffield City Region LEPs (Pugalis and Townsend, 2012). In some instances during the initial formation of LEPs old interregional political tensions featured heavily, bringing into doubt the ability for such groups to effectively work with one another (Pugalis and Bentley, 2007). Another issue associated with this, from an innovation systems perspective, is that while economic linkages may exist between C and S zones in terms of factors such as economic interactions, travel to work patterns etc, it does not take into account innovation. As such, an area that constitutes a functional economic area does not necessarily reflect a cohesive regional innovation system, particularly as this thesis argues, if innovation assets remain concentrated within the dominant C zone of a region. Despite these problems however, the definitional model put forward by Parr (2010) helps to explicitly define what can be considered to constitute a functional economic area within the city region context. It is thought therefore that by devolving power to these more functional economic areas, that economic growth and development can be encouraged by focusing on encouraging the positive multiplier effects of this arrangement (Camagni, 2010).

The formation of LEPs in 2010 under the coalition government signified an abandonment of regionalism and a move instead towards new localism, which in the

view of some academics such as Pugalis and Shutt (2012), served only as a mask for deep cuts in public expenditure. LEPs are in essence voluntary arrangements between various local interests such as business, civic and educational leaders whose aim is to unite disparate interests within the area in such a way that encourages growth and regeneration of their locality. They are governed by a board, which in theory represents business, civic, educational and community leaders, however in practice, these boards have tended to be weighted towards either capitalist interests or local authorities. Additionally, the role that LEPs could or are meant to play continues to remain somewhat highly ambiguous, with Whitehall frequently adding to the list of functions that LEPs could perform. As a result it is a little difficult to generalise LEPs as they are at varying levels of development, pursuing different paths and strategies, have taken on different responsibilities, and are using different methods to pursue their goals (Deas et al., 2013; Pugalis and Shutt, 2012; Shaw and Robinson, 2012). Through this reduction of state intervention regulation, it is thought that space will be created for private sector growth, and increased adaptability to local conditions (Hildreth and Bailey, 2012). While such an arrangement increases the potential flexibility of LEPs to meet the needs of their localities, whether the advantages of this outweigh the disadvantages associated with such a vague and ambiguous role is yet to be determined.

Another issue is that historically lagging LEP regions also have additional structural problems to overcome. With regards to their innovative performance, such regions often lack a history of innovation and thus struggle to foster it in the future. The reason for this problem lies partially within the field of evolutionary economics and path dependency. The route that an economy takes is not developed in isolation but is a

continuous process that occurs within the context of the region. Its existing industries, institutions, knowledge base, labour skills, knowledge producing organisations and various other factors all have a role in shaping what paths are open for the economy to take. As a result regions with an un-innovative history are likely to lack the required innovation fostering institutions required for future innovations. The result is that such regions therefore tend to get locked into un-innovative path dependencies, which are difficult to escape from (Martin and Simmie, 2008a). Previously, local policy makers have attempted to increase new firm formation rates generally with little or no selectivity as to the type, however studies have shown (Huggins and Williams, 2011) that this approach provides little benefit to the area, as one in four new business starts are in motors, hairdressing or beauty. Although the initial effect is to move people from unemployment to self-employment, the overall effect is to displace traders in the area who are not receiving government support and therefore provides no benefit to the local economy. These issues are therefore of particular importance to LEPs who operate in areas with a history of low innovation and economic deprivation, and as such need to be carefully considered in order to effectively tackle the issue.

From a theoretical standpoint a discussion has also taken place within the literature regarding whether the LEPs actually do in practice represent a more functional economic space in practice, than previous institutions. Pike et al., (2015) makes the argument that due to the fact that local institutions, particularly the LEP, are situated within a multiscalar and multi-institutional environment, in combination with the policy of guided localism, that this move is one which may be described as centralisation masquerading a decentralisation. As such, this draws attention to the fact

that regional institutions are subject to multiple scales of influence, and that as a result the LEPs may not in actuality represent a more functional economic area than its predecessor. Similarly, Quinn (2015) notes that through his study of the East Midlands, that the difficult nature of the region has had an impact on the effectiveness of policy intervention. As the region, much like the SCR, has a number of strong economies and only a weak core, the East Midlands as a region does not have the necessary characteristics to tie together its components, and thus represents a cartographic region, rather than a functional economic area. It is necessary therefore that a region be constructed along functional economic lines, for an area to be effective. As the LEPs have been driven from the "bottom up" through existing territorial networks, Quinn argues that such areas are significantly more business driven than their predecessors, and thus more likely to be effective and representative of a functional economic area. The question therefore is whether this is also the case for the SCR, which has within its boundaries a number of strong peripheral economies, as well as a lack of economic, political or cultural cohesiveness.

Such discussions ultimately demonstrate that the issue of scale in policy interventions, and the drawing of such boundaries, is a highly complex issue, fraught with difficulty and that whether LEPs actually represent a necessary and functional economic area, particularly in comparison to its preceding RDAs, is open to question. It also demonstrates that it is necessary for regions to be drawn based upon characteristics that bind the region together, as lack of connectivity and regional identity has been shown to hinder the ability of a region to work effectively. This also, however, highlights that such discussions tend to look at the issue of scale as an "either or"

issue, rather than taking into account that regions are subject to multiple influences and institutions at multiple scales. This therefore represents a significant gap within the literature, and ultimately one that this thesis seeks to contribute knowledge towards.

This study therefore contributes new knowledge to the regional debate as it provides a new perspective by examining the links between firm level innovation structures and innovation aiding institutions within the SCR and the interactions between them both within and outside of the region. This study will take a broad view and aims to look at all points of contact between the institutions, knowledge generating organisations and firms. This will help to contribute to a more detailed and nuanced understanding of how firms, the SCRs institutions and policy, interact with one another in order to produce positive outcomes on innovative output and innovation support and intervention across multiple scales. Additionally, given the UK's adoption of localism as the preferred level of economic policy intervention, this study through looking at SCRs regional innovation system within the new context of Local Enterprise Partnerships, will explore this new context and its impact and strategy on innovation. This will help to add detail and advance the discussions about their appropriateness and effectiveness with regards to their ability to support innovation-led growth.

### 3.5) Path dependency and regional development

Having looked at above the issues surrounding innovation, innovation systems, scale, regions and regional development, this review shall finally consider a concept which in part bridges these areas, demonstrating how a regions historical development path may affect its ability to innovate, and in turn how that this may affect its future economic

development (Aghion et al., 2016). Path dependency, although typically a tool used for assessing the resilience of a region (Brekke 2015; Wilson, 2014; Martin and Sunley 2010), provides significant insights into how the path dependency of a region may impact upon its development and ability to innovate in certain areas, why certain areas are more innovative than others, how particular innovation assets become concentrated in an area, and how areas may become locked-in to both poor pathways of economic growth as well as lower rates of innovation (Boschma, 2015; Martin and Sunley, 2003).

The concept of path dependency is centred around how the development of industrial specialisations tends to be place specific, with certain industries tending to become clustered in certain narrow geographical locations (Martin and Sunley, 2003). Much like innovation systems, it is noted that more successful regions tend to be in those where a high degree of interaction and spillovers occur between actors within the region, mirroring the ideal conditions under which innovation systems are able to enhance a region's innovative capacity (Brekke 2015; Martin and Sunley 2010). In such areas, industrial specialisations occur due to a build-up of localised specialised knowledge embedded in regional actors, through firms locating nearby due to positive spillover effects, and to benefit from regional characteristics which support firms and encourage such spillovers and interactions (Baycan et al., 2017: Herstad and Ebersberger, 2014). As can be seen, many of these reasons cited for the regional development of industrial specialisations reflect the underlying logic and reasoning present in the innovation systems literature, such as the importance of regional actors. This build-up of specialisations, knowledge and resources in turn affects the potential

industrial development pathways, affecting the options open to a regional economy to take in terms of industrial specialisations (Herstad and Ebersberger, 2014). Although this is typically used as a tool for assessing the resilience of a region, whereby regions with fewer pathways are more likely to suffer from the effects of negative "lock in" to sub-optimal development paths (Martin and Sunley 2010), it also demonstrates how a region's history can affect how innovation assets become geographically distributed and built up within an area, an important consideration in the drawing of regional boundaries and in the consideration of the size of innovation systems. As this concept has a number of significant parallels and implications for the development of innovation systems and regional development, this section shall explore these parallels between the concepts and highlight the issue of scale and the multiscalar approach.

The first major parallel between the innovation systems literature and the path dependency concept regards the importance placed upon high levels of interaction with core actors within the region (Herstad and Ebersberger, 2014). Although path dependency literature is considerably less specific as to who these actors, or groups of actors, are compared to the three groups highlighted across the different scales of innovation systems literature (Katz & Wagner 2014), both place significant emphasis on the interaction between such actors due to the spillover effects that are likely to emerge from this (Baycan et al., 2017: Herstad and Ebersberger, 2014; Martin and Sunley 2010). As can be seen therefore, this has significant parallels with the underlying reasoning behind the construction of innovation systems. The implication of this parallel is that given that both streams of literature espouse the benefits of such connectivity within an area, albeit one for resilience benefits, and the other for

enhanced innovation rates, that each stream reinforces the claims of the other, demonstrating a broad consensus that such connectivity is beneficial for regional development, regardless of its intended benefit across different literature streams.

The second major parallel between the two literature streams concerns the level of interaction between actors within institutions, and the build-up of innovation assets within a region. Both path dependency and innovation systems literature put significant emphasis upon the interaction between key actors within the geographical boundaries under consideration, in order to benefit from positive spillover effects between those groups (Baycan et al., 2017: Herstad and Ebersberger, 2014; Martin and Sunley 2010). Related to this interaction, however, is the build-up and concentration of assets within a region, in order to construct a critical mass of related actors in order to allow these networks and spillovers to occur (Martin and Sunley, 2010). The historical path dependency of a region affects what industrial specialisations, knowledge and assets are present within a region, and therefore the potential future economic pathways of a region are significantly affected by such historical factors (Aghion et al., 2016). Although this has significant implications for innovation systems however, given a need for their to be a critical mass for a system to develop, or in the case of innovation districts a minimum of an influential anchoring institution (Katz and Wagner, 2014), the history of an area is not often considered within the literature on innovation systems, and demonstrating the path dependency concept provides added value in combination with innovation systems literature. This is of particular relevance to historically lagging areas (Martin and Sunley 2010), where the region's path dependency may have resulted in a low concentration of innovation assets within an

area, affecting the future potential for the development of an innovation system to emerge. Another implication of this is that it also affects *where* innovation assets are placed and therefore impacts upon where the boundaries of innovation systems should be drawn. Although not adequately considered by the path dependency literature, which often fails to determine at what scale an area is under investigation and why, in larger areas a region's development pathway may have resulted in the depositing of innovation assets unequally across a region, meaning that sub regional innovation systems may be optimal in order to exploit densities that do not occur across the region. This therefore represents a glaring gap in the literature, where the issue of multiple scales is not adequately considered in both innovation systems and path dependency literature, despite the fact that that both focus upon defined geographical areas which are subject to inter-, intra- and external factors.

Therefore, while the concept of path dependency and the literature surrounding it provides significant insight into how the path dependency of the region affects its specialisms, potential development pathways, and by extension the innovation assets within it, it fails to adequately consider the issue of regional scale as well as multiscalar approach towards the support of innovation and regional development more broadly. As  has been highlighted, the issue of what constitutes a region and where boundaries should best be drawn is a significant issue for regional development, and is an issue that is not discussed in-depth by any of the major work on path dependency despite the centrality of the region to the path dependency concept. Furthermore, nor does the concept of path dependency adequately consider that regions are subject to multiple scales of interaction and support, within the region and

external to it. This, therefore much like innovation systems, represents a significant gap within the literature, and an area where additional consideration will yield added nuance and understanding of how such multiscalar influences impact upon the development of the region through innovation. This therefore demonstrates that the concept of path dependency, much like that of the innovations systems concept, while having utility in both enhancing our understanding of regional development, as well as in part acting as a bridge in bringing together the concepts of innovation systems and regionalism, fails to adequately consider the issues of scale and the multiscalar influences that regions are exposed to.

**4) Research Objectives**

From this literature review and the broader interest of this research on innovation, the issue of rescaling and regional development, this thesis has at its core three central research objectives. First, as innovation is believed to be a significant driver of growth within a region, this thesis looks to investigate the perspective that is adopted by stakeholders. Developing understanding within this area contributes towards the innovation systems literature, particularly with regards to stakeholders within that system, and their understanding of the role that innovation may play in regional development. Therefore, the first research objective is:

*Research Objective 1: To develop understanding towards the stakeholder perspective towards innovation-led growth.*

Related to this point, this research seeks to examine the way innovation is supported within the region, way in which this support contributes to economic growth, as well as fitting within the region. As has been seen, innovation is a highly complex and multifaceted concept, meaning that its support needs share such complexity. This is further complicated by the devolution of power, capital and decision making authority to smaller local scales, with stakeholders needing to support innovation at smaller scales than previously, an issue which has significant implications regarding the innovation systems perspective, particularly with regards to scale adding a further dimension of complexity. From this therefore, the second research objective of this thesis is:

*Research Objective 2: To examine the nature of innovation support in the region.*

Finally, after looking at innovation support from a regional perspective, it is necessary to investigate how this operates in practice. It is noted that due to the complexities associated with innovation, types of innovation, the differing innovation support needs of firms in different industries and of different sizes, that there are varied and complex support needs. This is further complicated by the multiple levels and sources of support. Therefore, it is necessary to understand how the region's innovative firms interact with that support, both at a national and regional level, and therefore the level of congruence between their needs, desired support, and what is currently offered. Expanding our understanding of this area will help contribute to knowledge regarding how innovation is best supported within a localist or regionalist scale, having significant implications for our understanding of the firm/regional institution element of innovation systems. Therefore, the final research objective of this thesis is:

*Research Objective 3: To understand how the region's innovative firms perceive and access innovation support.*

This thesis therefore seeks to develop understanding and investigate these three areas within the context of the SCR, the empirical context and method of which is described below. Through the completion of these objectives, this thesis seeks to contribute significant knowledge and insights with regards to innovation and the functioning of innovation systems across a multiscalar economic, political and spatial context.

# PART 2: EMPIRICAL FOCUS & METHODOLOGY

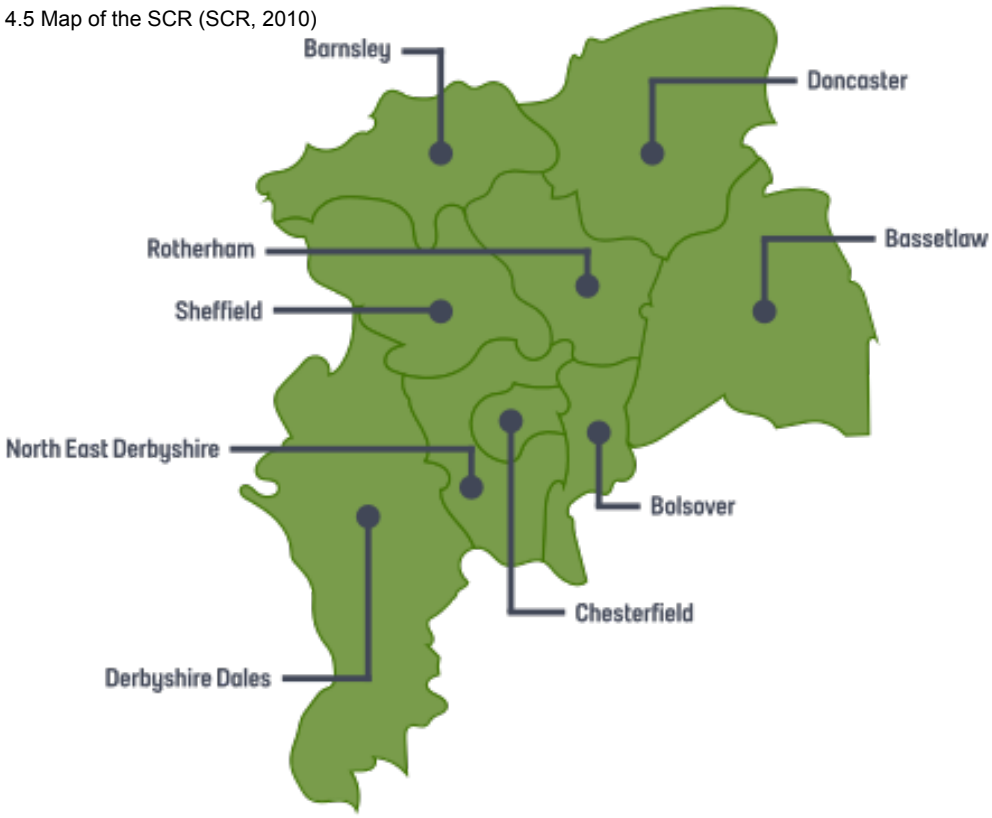
## 5 Empirical Focus

### 5.1) Contextualising the Sheffield City Region (SCR)

Before continuing it is important to observe the evolution of SCR and its economy and the impact that this has had on innovation. This is in order to put the study firmly within the context of the region's current economic environment and to understand what historical factors shaped the economy into its current form. In this section therefore this thesis will define what constitutes the SCR, observe how its economy has evolved over time to its current position, look at the nature and form of economy at its present state, and finally look at the area's current state and nature of innovation.

The SCR LEP was established in 2010, following the dissolution of the "Yorkshire Forward" regional development agency in which the area previously belonged. The SCR is comprised of 9 local authorities: Barnsley, Bassetlaw, Bolsover, Chesterfield, Derbyshire Dales, Doncaster, North East Derbyshire, Rotherham and Sheffield (see figure 5.1). This geographical area encompasses 1.8 million people (SCR, 2013a), in which there are approximately 68,000 businesses, and has an estimated economic output of £31 Billion pounds per annum (SCR 2018a). Recent findings have demonstrated that within the City Region, Sheffield is the key centre of employment for neighbouring towns and cities as well as the main driver for growth within the region. While other centres of employment exist such as Rotherham, Doncaster and Chesterfield, these are not as strong as Sheffield, and therefore the region can be described as weakly mono-centric towards Sheffield (The Northern Way, 2009).

Figure 4.5 Map of the SCR (SCR, 2010)




Sheffield is the economic core of the SCR, being the largest employer and area of economic activity within the region. It is home to the region's two universities, the University of Sheffield and Sheffield Hallam University. Although the economy has undergone significant change following the decline of large scale steel production, it maintains metallurgical and materials specialisations, as well as related manufacturing specialisations and expertise. It also has a strong, emerging CDI sector which is showing significant levels of growth, particularly in recent years (Sheffield, 2018). Additionally, although currently reorienting as an economy, it remains predominantly a city with a high proportion of public sector workers, with the largest employers being the region's two universities and the National Health Service (NHS).

Rotherham is geographically located next to Sheffield, and as such interacts with Sheffield more so than other areas, with the Sheffield-Rotherham economic corridor representing a significant area of interaction between the two areas and a space of significant innovative activity (Centre for Cities, 2015). Historically, Rotherham economic specialisations have been around coal mining and manufacturing, which given the reliance of the steel industry upon coal resulted in significant historical linkages between Rotherham and the region's core. Although the region's mining activities have ceased, it still remains economy that is engaged in a significant amount of manufacturing activity, as well as maintaining specialisations related to mining, such as the production of tunnelling and mining equipment. Rotherham is also home to the region's Advanced Manufacturing Park (AMP), which is one of the core areas of innovative activity within the SCR, as well as being described as a innovation district by multiple sources (Centre for Cities, 2015). The development of this park again demonstrates the comparative closeness between Rotherham and Sheffield, given the heavy involvement of both the University of Sheffield and Sheffield City council in its inception.

Barnsley is a major local authority area located to the north of Sheffield. Similar to Rotherham its historical economy was based heavily upon the coal mining sector, and was heavily affected by the decline in coal. Since then, Barnsley has worked to restructure its economy towards more service and digital industries, with the opening of a new Digital Media Centre.

Doncaster is another hub of economic activity in the SCR, being the second largest economy in the SCR and is located north east of Sheffield. Historically its industries were focused around the areas of coal mining, and heavy industry (Doncaster, 2015) Since then, Doncaster has been an area of non-advanced manufacturing and engineering, with a significant specialisation within the area of railway engineering. It is also an emerging logistics hub within the region, with its construction of the Doncaster Inland Port and Robin Hood Airport, as well as the existence of a number of private distribution centres (Iport, 2018).

Bassetlaw is located to the far east of Sheffield. Although having an industrial past, with recent industrial decline in the area, in combination with it's primarily rural nature it has recently worked to develop its tourism offering, with most recent estimates putting the annual value to the economy as £145.5 million (Bassetlaw, 2009).

Bolsover is located in in the south east of the SCR. Like much of the SCRs periphery, it's economy was historically centred around the production of coal. More recently it has focused upon the areas of tourism and the development of a more enterprising economy, given its high proportion of micro-businesses and SMEs, however it struggles with a comparatively low business density compared to both the rest of the UK and the region (NE Derbyshire, 2018).

Chesterfield is a major town within the SCR and is located to the south of Sheffield. Although in recent years it has seen a steady decline in employment within the manufacturing sector, its main sectoral strength, it still has a higher than average

proportion of employment within this area (BHP, 2016), and the sector remains a significant part of the region's manufacturing capability.

Finally, the Derbyshire Dales and North East Derbyshire are located on the far western and southern periphery of the SCR respectively. As highly rural areas, the economy of both of these areas are orientated towards agriculture and tourism, with an estimated £315 million brought in by tourism each year to the Derbyshire Dales (Derbyshire Dales, 2018). As such, it has little apparent economic activity within the three areas of investigation of this study: advanced manufacturing, healthcare and CDI.

In terms of the region's political organisation and affiliations, at the time of writing (2018), all of the region's constituent local authorities were Labour controlled, with the exclusion of the Derbyshire Dales, which was Conservative. These local authorities are responsible for a range of functions for the businesses and citizens under their influence, most relevant to this study including economic development. This responsibility is delivered in different ways depending on the local authorities, with some delivering such support through economic development arms, such as RIDO in Rotherham (Rotherham Investment & Development Office) and Enterprising Barnsley in Barnsley. The SCR LEP sits as an organisation that encompasses all of the 9 local authorities, acting as a voluntary partnership between local authorities with a remit of promoting economic development and job creation within the region. As such there is some overlap with the responsibilities of the local authorities.

As highlighted previously, in terms of linkages the SCR can be described as a weakly mono-centric city with Sheffield at its core (The Northern Way, 2009), with weak linkages between core and periphery in comparison to other major cities. Numerous publications have noted the draw towards Sheffield not as strong as other areas, due to a combination of the comparative strength of its periphery compared to the region's core city, as well as due to the draw of other nearby economically stronger cities such as Manchester and Leeds. This is exemplified by that fact that due to difficulty in drawing functional economic barriers, the local authorities of Barnsley, Bassetlaw, Bolsover, Chesterfield, Derbyshire Dales, North East Derbyshire are in the SCR LEP and LEPs of Leeds City Region and D2N2 respectively. This therefore illustrates that the linkages between the core and periphery are not as strong and well defined as in other comparable areas.

The strongest linkage may be described as between Sheffield and Rotherham, as illustrated by several factors that demonstrate both political and economical connectivity. The first such factor is the existence of what has been termed the "Sheffield-Rotherham Economic Corridor, an area of intense manufacturing activity which forms a corridor between the two cities and within the boundaries of both local authorities (Centre for Cities, 2015). Due to of this, significant interaction takes place between the two areas, given factors such as travel to work patterns, strategic planning as well as its overall importance to both areas as an economic asset and source of employment. Related to the above point, both Sheffield and Rotherham have intimate links with the SCRs Advanced Manufacturing Park (AMP). Located in Rotherham, but along its boundary with Sheffield, the AMP is another dense concentration of firms

within the Advanced Manufacturing sector that has significant links to both areas in terms of travel to work patterns, it acting as a key source of innovation and GVA for both areas, as well as its involvement with the University of Sheffield in the core city (AMP Technology Centre, 2018). This shared experience in and reliance on manufacturing, and in particular advanced manufacturing, has resulted in a level of connectivity not found between the core city and its periphery, nor between the constituent parts of the periphery itself, and demonstrates that the Sheffield-Rotherham link is economically the strongest within the region due to this shared expertise and reliance on these geographical areas and industries (Centre for Cities, 2015).

From a political standpoint, one factor that suggests a higher degree of connectivity between Sheffield and Rotherham concerns the SCR Devolution Deal. The SCR devolution deal is a "proposed agreement between Government and the leaders of the Sheffield City Region to devolve a range of powers and responsibilities to the Sheffield City Region Combined Authority" (SCR, 2015a, p5). At the time of writing however (2018), only the local authorities of Sheffield and Rotherham support this deal, with all other local authorities instead supporting a devolution deal at the scale of Yorkshire rather than the SCR (Yorkshire Post, 2017). This therefore serves to further illustrate the weak linkages between core and periphery given their draw towards a larger Yorkshire wide devolution deal, and the connectivity between Sheffield and Rotherham, given their collective political "buy in" to the SCR concept.

With regards to what key institutions exist within the SCR, the region is home to a strong knowledge base, containing the knowledge creating institutions of the

University of Sheffield and Sheffield Hallam University, both geographically contained within the core city of Sheffield. It is also home to the SCR LEP Growth Hub, an economic support organisation offered at the level of the SCR with the aim of supporting businesses within the region through a range of methods and initiatives (SCR Growth Hub, 2018). Despite this however, most economic support initiatives are not SCR wide, and are instead offered at local authority level, further suggesting a lack of regional unity and cohesiveness at the SCR scale.

### 5.2) A Brief Economic History of the SCR

Historically the SCR was a major centre for the production of coal, steel and traditional forms of manufacturing whose industrial origins can be traced as far back as the 14th century and whose specialisation in these areas lasted relatively unchanged until the latter half of the 20th century (Williams and Vorley, 2014). The SCR was particularly suited to early industry of this nature due to its proximity to the fast flowing rivers from the Pennines for water for production, the natural coal resources present within the region (The Northern Way, 2009). Although the region has a long history of steel production, it was in 1740 with invention of the innovative crucible process by Benjamin Huntsman that increased the region's ability to produce steel of a good quality and quantity, and developed the region towards a specialisation in steel (Lane et al., 2016). As the region gradually developed towards steel-related industrial specialisations, the importance of the region's coal reserves grew, helping to both increase the lock-in of the region towards steel production specialisations due to this natural characteristic, as well as to economically develop the region's peripheral, coal producing economies.

Due to this importance of coal in the production of steel, links between Sheffield and the surrounding coal producing areas, such as Rotherham, developed, resulting in an economic interdependence between the components of the modern day SCR developing during the period. This dominance of other industries such as coal mining geographically located outside of the core city has over time resulted in strong local and peripheral economies, resulting in a region that is not of a typically mono-centric model, such as neighbouring Manchester (SCR, 2013b). After around 1850, traditional local and often family run units of production moved towards larger scale and capital intensive modes of production, particularly in the area of steel production and manufacturing (Newton, 2006), in part stemming from the increasing prevalence of the railways opening new opportunities for production (Sheffield City Council, 2006), as well as the discovery of the Bessemser Process for creating large quantities of steel as well as producing steel of a better quality than previous "blister steel" and crucible steel methods (Lane et al., 2016). This lock-in of the region towards steel and coal industrial specialisations was further cemented with the invention of "stainless steel" in the city by Harry Brearley in 1912, which in combination with the strategic importance of steel in the first and second world war firmly established Sheffield as a leader in the production of steel as well as the concentration of a substantial amount of steel orientated knowledge, physical and human capital, and other innovation assets being concentrated in the city (Lane et al., 2016).

The traditional composition of the SCR's economy, characterised by a focus on steel production, traditional manufacturing and coal mining which had held since the 18th

century, began to change most rapidly in the 1970s to 1980s. This was a period characterised by large scale deindustrialisation during which employment within the SCR's traditional industries fell rapidly as many of the steel mills and coal mines in the area closed, significantly changing the makeup and nature of the region's economy. The decline of both the steel and coal industries is due to complex and multiple factors, but is most commonly associated as being a result of corporate restructuring associated with the 1973 oil shock which affected manufacturing and demand globally, the privatisation of the coal and steel industries by the Thatcher administration, pressure from international competition in combination with a failure to modernise production methods (Lane et al., 2016). As a result of this between 1979 and 1987 employment in South Yorkshire's steel industry fell from 43,000 to 16,000 (Hey, 1998) and the percentage of employment in manufacturing industries in Sheffield falling from 34% in 1981 to 19% by 1991 (Lane et al., 2016).

More recently, within the last twenty years, the SCR currently has moved away from its traditional economic roots in areas such as steel production, coal mining and traditional manufacturing towards a more knowledge-based economy, with industries in the areas of advanced manufacturing, healthcare technologies, CDI, logistics, retail, financial services etc. Despite this move in recent years, however, compared to other northern cities such as Manchester and Leeds, the SCR has a economy significantly more orientated towards the public sector, a higher proportion of the population in high tech manufacturing and a smaller business services sector (The Northern Way, 2009).

This history of the SCR in part demonstrates the role that path dependency and innovations may have upon a region. As can be seen from its natural characteristics promoting early industry, the innovations that took place within the city of crucible steel, followed by the Bessemer Process, followed by the invention of stainless steel and the political and tactical importance of steel during the First and Second World War represents a pathway which led to the region's specialisation in steel and the concentration of such innovation assets within the area. More recently, despite the deindustrialisation Sheffield and the region experienced in the 1980s, much of these expertise has been transferred into the advanced manufacturing and medical devices industries, further demonstrating how innovations impact upon an area's development pathways.

**5.3) The SCR Today**

Currently unemployment levels within the SCR are higher than that of the UK average. In 2016, unemployment within the region as a whole was 2.4 higher than the national average (SCR, 2016). Also, although the SCR experienced economic growth since 2000, compared to other northern economic centres its growth has occurred far more in the public sector than the private one (Williams and Vorley, 2014). The challenge of reducing unemployment within the SCR therefore is increased by the region's high level of employment within the public sector as it is estimated that cuts in the public centre within the SCR will directly result in the loss of 14,420 jobs. This is equivalent to Sheffield losing 2.7% of its total jobs by 2016 (SCR LEP, 2010).

While Sheffield is the main driver of economic growth in the region, with the highest levels of productivity within the region, it has less of an economic draw than other core cities. Sheffield itself is a rather self-contained city with 85% of residents both working and living in the city, taking 72% of its jobs. When compared to Manchester where 73% of residents live and work in the city taking only 31% of its jobs, this demonstrates Sheffield's comparatively weak economic draw. This is partially because although Sheffield is a relatively attractive place to work within the local area, the stronger economic centres of Manchester and Leeds are able to pull in more mobile workers as they offer higher wages (The Northern Way, 2009). As a result SCR has issues in retaining graduates than other areas, and although Sheffield has the highest concentration of graduates within the city region, it still falls below the national average.

Within the SCR there a number of other important employment centres that pull in significant numbers of commuters, such as Chesterfield and Doncaster (Centre for Cities, 2018). Therefore the SCR can be considered to have a fragmented economy, with a weakly mono-centric pull from Sheffield (Centre for Cities, 2018; Williams and Vorley, 2014). Sheffield and Rotherham have a particularly strong relationship in terms of labour links, and it has been argued that the two cities have begun to operate as one functional economic area (The Northern Way, 2009).

In terms of its economic composition, the SCR has developed a larger knowledge-based economy than previously, and unlike its traditional industries, these are considerably more capital, rather than labour intensive (SCR, 2013). Sheffield has a

better developed service sector than its immediate peripheral neighbours, which has resulted in Sheffield developing business links with surrounding areas, providing accountancy, business and legal services to other businesses within the region, further demonstrating Sheffield's mono-centric nature. Links also exist between the region's advanced manufacturing industries, due to shorter supply chains and the build-up of trust between local firms. As a result 30% of purchases within the metal sector are made locally (The Northern Way, 2009).

**5.4) Innovation in the SCR**

The SCR, both historically and currently, has a low level of entrepreneurship and innovation relative to the rest of England. In terms of the number of businesses to its population, in the year 2000 the SCR had a gap of 29.3% compared with the national average. While there has been a general improvement in this, with the gap reducing to 27.4% below the national average in 2010, it is evident that more work needs to be done to close this gap (SCR, 2011).

Although Sheffield is viewed to have the potential to be an innovative economy due to its strengths in the business service sector and advanced manufacturing, as well as the University of Sheffield providing a good skills and research base, Sheffield is not believed to be reaching its full innovative potential. This is because the region still has a relatively low GVA and despite its strong advanced manufacturing sector, has a significantly lower expenditure on R&D than that of the national average (Oxford Economics, 2013). It is also identified that within the SCR, Barnsley and Doncaster have characteristics of what can be described as a "low innovation area". "Low

innovation areas" are places that have below average GVA and productivity, a low-skilled workforce, negative growth in the private sector and an over reliance on the public sector for the generation of jobs and growth. As described previously, although it is difficult to accurately measure innovation due to its unclear definition and issues of proxy measures, these features still demonstrate that the SCR is not an innovative region. Given this information, the low level of business start-ups and proportion of businesses to the total population, combined with the issues relating to path dependency demonstrates that the SCR lacks the critical mass of innovative companies required to foster innovative growth.

One organisation that previously worked to promote innovation and entrepreneurship within the SCR was the "Yorkshire Forward" Regional Development Agency. Although disbanded in 2010, since 1999 the agency worked to promote entrepreneurial activity and through this work has gained a number of useful insights regarding innovation in the region, and the effectiveness of its strategies. While some progress was made by the RDAs, given the continued gap between the SCR and other regions, the SCR LEP needs to work to avoid the continuance of problems associated with RDAs. From the research of RDAs a number of common issues were identified. For example it was found that instead of a joined up policy existing with enterprise permeating through different departments within the agencies, policy tended to remain in "silos", with departments failing to see the importance of policy areas outside of their own. As a result a coherent lineage of policies across departments did not exist, reducing effectiveness due to a lack of unified interdepartmental focus on the enterprise policy field. It was also found that although broadly accepted as an

important part of strategy development, some believed that set targets were unrealistic or unhelpful to the development of long term policy making, as regional performance is in some circumstances linked to national performance and if this negatively affects the region policy makers are tied to unrealistic and unattainable targets (Huggins and Williams, 2011). Given the identification of these issues, effort must be made by LEPs to work to avoid these challenges, so as to prevent their repetition and increase their effectiveness.

## 6) Methodology

### 6.1) Introduction

In order to explore innovation, innovation systems and the issue of scale within the new spatial context of Local Enterprise Partnerships within the SCR, this study uses a combination of interviews with policy makers and case studies to gain in-depth information from those involved in the innovation process, policy makers and to understand their perspective on innovation support and the issues of innovation and scale. This in-depth, contextually grounded and qualitative data will help redress the primarily quantitative balance of innovation studies that currently exists, as well as gaining detailed information on the issues surrounding innovation, innovation systems and the multiscalar approach to innovation support.

The following section will present the adopted method for this study and its epistemological underpinning. Section one will look at the poststructuralist approach that will be used throughout this study. Section two will justify the use of qualitative methods and inductive approach, particularly within a subject usually dominated by quantitative methods. Section three will look at the method of interviewing to gain in depth information from key stakeholders. Section five will look at the use of case studies to gain data on firm level innovation and justify the selection model for firms.

### 6.2) Epistemological Standpoint: Interpretivism

Due to both the nature of this study, in combination with the broader research philosophy adopted as pat of this thesis, the epistemological standpoint adopted by this thesis is one of interpretivism.

Interpretivism, in stark contrast to positivism, is a philosophy of research that asserts that society, like the natural world, operates according to general laws identifiable through the scientific method instead argues that while this approach is appropriate for the study of the natural word, is inappropriate in the context of the social sciences (Bryman and Bell, 2011). Interpretivist thought instead asserts that society is socially constructed from social interaction between actors, and that both developing generic laws or conducting entirely objective research is not possible when conducting research within the sphere of the social sciences (Walsham, 1995). Furthermore, following on from the above points, interpretivism also takes the standpoint that positivist approaches fail to take into account the nuances associated with interaction between social actors (Schwandt, 2000). As such, the interpretivist standpoint favours the emersion of the researcher within the research context, while also using qualitative methods such as observation and interviewing such actors in order to gain an in-depth and nuanced view from which theories and insights may be derived, rather than the experimental and theory testing model preferred by positivists (Bryman and Bell, 2011; Walsham, 1995). Additionally, it also asserts that the researcher is unable to act in an entirely objective manner, due to their internal preconceptions and biases in the interpretation of results, an issue that is particularly pronounced in the analysis of qualitative data. While this is something that it is argued cannot be completely removed from interpretivist, and more broadly qualitative research, this is an issue that can be in part mitigated against, through the coding of results, as discussed later in this section. The adoption of an interpretivist standpoint therefore, while appropriate given the focus of this study has a number of both positive and negative elements. However,

due to this research being both focused upon the interaction between social actors and groups and their implications for innovation, as well as its aim to act as a theory building capacity, this research asserts that the use of an interpretivist standpoint fits well with the overall research aims, that its benefits significantly outweigh the drawbacks regarding the adoption of this research philosophy, while also adequately reflecting the epistemological standpoint of the researcher.

### 6.3) The Assumption of a Qualitative Approach and Inductive Approach to Research

This study adopts the use of qualitative methods and an inductive approach in order to gain detail, depth and understanding about innovation and innovation systems within the SCR. One reason for this choice is in order to address the imbalance currently present in innovation literature, with quantitative methods currently dominating. This study will thus help to expand the field by gaining highly detailed information from firms and policy makers on innovation, its support and nature within the context of the region's economy and the firm's structure.

A key feature of qualitative research is its inductive view towards the research process, with research used to generate theories (Bryman and Bell, 2011). Due to the investigative nature of this study, the pre-generation of theories to be tested associated with a deductive approach is not appropriate, as it may unfairly limit the scope of the investigation, hindering the depth and quality of the information collected (Thomas, 2006). Therefore, the use of qualitative methods is necessary to reflect the inductive approach adopted by the researcher. Additionally many major business journals, and

indeed studies on innovation, are heavily dominated by the use of quantitative methods (Hohenthal, 2006). As a result relationships between factors have been identified, but a more nuanced and detailed understanding of the causes of such relationships is lacking. As a result, in some instances quantitative research has produced conflicting results, which were only then understood after qualitative research provided the detail to explain such relationships (Freeman, 1995). For this reason, it may be argued that the use of qualitative methods may readdress this imbalance, generate detailed contextual and in-depth information, and open new lines of academic enquiry.

### 6.4) Research Methodology

The methodology of this research was first to conduct 16 stakeholder interviews with participants from institutions within the SCR responsible for supporting innovation, firms or regional development, within the region. Efforts were made to ensure that every one of the region's nine local authorises were interviewed, in order to make sure that the entire region was represented. These interviews were semi-structured in nature, and were then transcribed and thematically coded in order to draw out the key themes that emerged. The results of these interviews were then used to shape and inform the second set of semi-structured interviews conducted with 30 innovative firms within the region, in the SCR's three most innovative industries: advanced manufacturing, healthcare and creative and digital. Although efforts were made to interview firms in a wide variety of areas and local authorities within the SCR boundary, the majority of firms were within the core city of Sheffield and the region's Advanced Manufacturing Park (AMP), on the boundaries of Sheffield and Rotherham. Although discussed in greater detail later, the reason behind this focus towards these

two areas was due to the fact that the region's innovative industries were geographically clustered within this area, limiting the ability of this study to conduct research in a more evenly distributed manner. These were then also thematically coded, and presented in the findings and analysis chapters below.

### 6.5) In-Depth Interviews

#### 6.5.1) The Use of Interviews as a research tool

The use of semi-structured interviews is a key method for data collection in the proposed study. An interview guide was created and used as a method to guide the interviewing of key stakeholders within the SCR's public institutions such as the members of the LEP and the local council in order to explore the background of the city region's strategies, and their successes and failings in promoting innovation. From these interviews, a second interview guide was created based on collected data in an iterative approach to guide the interviews of the owners, managers and employees involved in firm level innovation processes within the firms selected for case study.

The use of a semi-structured format combined with an interview guide has a number of benefits. First, given that this study has decided to adopt a highly inductive approach, the semi-structured nature of the interviews will allow the perusal of specific questions and concepts around innovation identified from the literature review and policy documents, while allowing the subjects to focus on issues that they believed to be particularly relevant. This approach also allowed subjects to talk on tangential topics to a degree, which has been demonstrated to yield interesting data and present to the researcher previously unconsidered topics and lines of further enquiry, allowing further

refinement of the interview guide (Bryman and Bell, 2011). The use of more open ended questions delivered in a semi-structured format is argued to increase the detail of subjects' responses, as answers can be organised within the subjects own framework, allowing responses which are more detailed and less constrained than closed questions. It is also argued that the use of closed questions can hinder the receptivity of subjects, as highly educated people do not like being forced to give limited responses and much prefer to properly articulate their views and explain why they are held (Aberbach and Rockman, 2002). For these reasons it is believed that semi-structured interviews are the most appropriate method to suitably answer the research questions with suitable depth and detail.

### 6.5.2) Elite Interviewing

Due to the nature of this study, many of those interviewed may be considered as so called "elites". This is a relatively understudied area of the social sciences, with most focusing on the investigation of "ordinary" individuals in which the researcher has the position of the expert (Mikecz, 2012; Ostrander, 1993). When interviewing elites, however, they too are experts in their field, affecting the power dynamic between researcher and subject and thus affecting the research process, and this must be considered in the research process.

The issue of access is particularly pronounced in elites, as their time is limited, they may erect barriers to set them apart from society, numerous gatekeepers may prevent or hinder access to them, they may be unwilling to divulge information etc (Mikecz, 2012; Ostrander, 1993). As a result it is important to be mindful of this from an early

stage in order to adopt an appropriate strategy for gaining access and ensuring enough time is devoted to gaining access as it is a slower process when studying up. Ostrander (1993) suggests to begin researching “at the top”, attempting to first gain access to the most important individuals or institutions in your sample. As often these people or institutions are the best connected and may be willing to put you into contact with other individuals or institutions in their network. Additionally, being referred from an important starting point increases the researcher’s credibility and as a result lowers the chance of being rejected. It has also been suggested that stating the purpose of the study, and the institution which you are representing should also be mentioned when gaining access, as this helps to further enhance research credibility and make the subject feel that such research is something to be gained from (Mikecz, 2012).

Another issue that cannot necessarily be controlled for when interviewing elites is the timing of the interview. Circumstances, some of which may be beyond the control of the researcher may affect how much the subject is willing to divulge. For example, political or civil service elites may be less willing to talk about potentially sensitive data in the immediate run up to an election, or the opinions of business elites and information that they are willing to divulge may be coloured by events that have occurred in their business recently such as the loss of a large client or an particularly positive year (Desmond, 2004). To address these issues, the researcher intends to reassure the interview subjects that their responses are anonymous and their names will not be divulged unless asked otherwise by the respondents. Additionally, as recent events may colour the answers of business owners, during the case study phase of the

research efforts will be taken to investigate whether any such events have occurred which may cause an overly optimistic or pessimistic view of the respondents.

### 6.6) Ethical Implications of this Study

As in any study that involves living human participants, it is necessary to consider the ethical implications of this study, as well as its potential risks.

The most significant of the risks identified was that of participants potentially being recipients of negative repercussions for speaking openly and honestly about negative aspects of the firm, their locality or the region. In the case of firm based participants, such risks included participants being victimised by other staff, being denied advancement or promotions or facing sanctions and disciplinary action. Furthermore, in the cases of elected officials, a potential repercussion regarded their re-election, if sensitive or negative data or opinions were given as part of this research. Another risk specific to firms was that participants might inadvertently reveal commercially sensitive information, which may affect the business negatively from a number of aspects.

As a result of this, the main safeguard that was put in place was the guarantee of anonymity for all interviewed participants. This not only benefited them, but also the study, by allowing them to speak freely about a range of subjects, without the risk of reprisals or other negative consequences for potentially highlighting negative elements of the region or firm. In addition, in firm interviews not only was anonymity granted to the participants but also the firm itself. This was in order to reduce the risk that

commercially sensitive information may be revealed, potentially harming the business, its competitive position or its relationship with clients or suppliers. Furthermore, this thesis also engaged in a degree of self-censorship, where potentially commercially sensitive information, or information that may be used to identify the firms that was revealed inadvertently was not included in any of the quotes of interview transcripts.

Due to these safeguards therefore, as well as the broadly low risk nature of this research, this thesis gained full ethical approval from the University of Sheffield in line with its ethics procedure, the evidence and documentation of which is included in Appendix 1.

### 6.7) Industry Selection Justification

In order to give this study focus, both within the SCR and upon the subject of innovation, this study focused on firms within the SCR within the Advanced Manufacturing, Creative and Digital, and Healthcare industries. The reason that these industries were selected was due to their identification by numerous sources as highly innovative examples of industry within the region, and the underlying logic of this study that in order to gain insights about innovation in the region that it is necessary to speak with innovative firms.

The first category of sources that identify these areas as key innovative areas within the SCR are from academic sources such as, Vorley and Williams (2014), Dabinett (2004), Etherington and Jones (2009), and Williams, Brooks and Vorley (2016). All of these sources make reference to the region's historic or current straights in the

advanced manufacturing, CDI and healthcare industries within the region, with some highlighting their importance as innovation assets to the SCR or their overall strategic importance to the area. However, owing to the limited quantity of specifically innovation related research conducted within the SCR within the academic sphere, however, while such sources consistently identify these sectors as key innovators within the region, they are of a limited quantity. The second and much more prevalent and up to date sources that identify these industries as both good examples of innovative industries within the SCR as well as further identifying them as strategically important regional industries are sources from the region's local authorities and the SCR LEP. Since the establishment of the SCR's LEP, research and reports generated by the LEP and the region's local authorities have consistently and continuously pointed to these three industries as both key innovators, as well as core drivers of economic growth and development (SCR, 2018a; SCR 2018b; SCR, 2015b; SCR, 2011). Due to the importance of these industries, it has also been further noted that going forward that due to the previous successes and importance of these areas, that it is in these industries that future development and focus should be encouraged. This therefore also has the added value to this study that these industries have been "self identified" by the region as important, and therefore focusing upon such areas helps to assess how innovation is supported across multiple scales and how this in particular affects industries deemed to be strategically important to the region's development. It is therefore due to the identification of these industries as key areas of innovation and strategic importance to the region's economic development that this study focuses upon these three areas.

Before continuing there is value in providing an overview into the nature of these sectors within the SCR. The industry of advanced manufacturing unlike the other industries examined in this study, experiences a issue regarding definitional clarity, as it may be argued that without a clear definition there is some ambiguity between what a manufacturer and an advanced manufacturer is. Currently, there exists little consensus in how advanced manufacturing is defined, however a prevalent definition is that advanced manufacturing concerns the use of innovative technologies and methodologies for improved competitiveness within the manufacturing sectors (TWI, 2018; EMSI, 2015). Given the lack of definitional consensus, this research as adopted its own definition of advanced manufacturing, in an attempt to adequately capture both the activity of the region whilst incorporating the common characteristics of the wide variety of definition. Therefore, the definition of what constitutes an advanced manufacturer used by this study is a firm that manufactures a physical product, which has adopted an innovative technology in order to increase its competitiveness through either increased automation or increased quality of its manufactured product.

In terms of where the region's advanced manufacturing firms are concentrated geographically, this tends to be focused in the area between Sheffield and Rotherham, within the economic corridor between the two areas and in particular within the region's Advanced Manufacturing Park (SCR, 2018b). Within the SCR, many advanced manufacturing firms are materials based, in part due to the region's historical strengths and expertise in materials, particularly steel (SCR, 2018b; SCR Growth Hub, 2018a). Due to this, it has been noted that the region lacks OEMs, instead producing a high degree of materials and components, feeding into multiple supply chains (SCR

Growth Hub, 2018a). As shall be discussed in greater detail later, another significant characteristic of many of the advanced manufacturing firms in the region is that they are comparatively older than CDI or healthcare firms. This is in large part due to the region's manufacturing heritage, with old firms transitioning from traditional methods and areas of manufacture towards advanced ones. As such while these firms are comparatively older, in practice they may have been "advanced" for a significantly shorter period of time.

The creative and digital industry (CDI) within the SCR is an area that is experiencing significant growth and attention from stakeholders within the region, from actors within the region's local authorities, LEP and the SCR's growth hub. The SCR's CDI sector currently employs around 35,000 people in the region and has experienced a faster rate of growth than any other city region within the UK (SCR Growth Hub, 2018). This growth is in part due to the build-up of digital expertise within the city, supported significantly by the region's two universities, as well as a range of other support institutions designed to aid the development of the sector (SCR 2018b; SCR Growth Hub, 2018b). It is for these reasons that the CDI is believed to be an industry of significant strategic importance to the SCR's economy and a key source of innovation (SCR, 2015). Unlike advanced manufacturing, the SCR's CDIs are significantly more dispersed within the region, with concentrations in peripheral areas such as Barnsley's Digital Media Centre (Barnsley DMC, 2018), however despite this the majority of firms are still concentrated within the core city of Sheffield.

Healthcare is the final sector looked at by this study as a key area of innovation within the SCR. The nature of innovation within this sector in the SCR is that often these specialisations are concentrated around the areas of medical technologies and devices rather than other health related areas such as pharmaceuticals (SCR, 2018b). Through both the concentration of relevant knowledge in the University of Sheffield, as well as due to the region's historical strengths in materials and precision manufacturing developed through its manufacturing heritage, the region has developed a significant level of expertise in the medical technologies and devices sector, resulting in one of the UK's largest clusters of such firms (SCR Growth Hub, 2018c). This cluster is located in Sheffield, however, with few firms in this area being located outside of the core city.

### 6.8) Firm Selection Justification

In order to gain an in-depth perspective on innovation in the Sheffield City Region, the most important selection criteria for inclusion of a firm in this study is that the interviewed businesses are radically innovative, based on the definition chosen for this study. Therefore, it was decided in order to increase the likelihood that selected businesses were innovative and therefore could provide in-depth information on their innovation processes, that this study would focus on interviewing businesses from the region's three most innovative sectors. The SCRs most innovative sectors that were focused on in this study were: advanced manufacturing, digital and creative, and medical and healthcare. As mentioned above, these areas were identified as key sources of innovation and of importance to the SCR by a range of sources, as well as being identified in the SCR growth plan as being both highly innovative and drivers of GVA in the region. This approach also has the added benefit that by focusing on these

three sectors, this research enhanced understanding of sectors considered crucial by the region itself, as well as generating a sample reflective of the region's most innovative examples of industry.

By choosing these industries, it was necessary to sample businesses from a range of sizes, both in terms of employment and turnover. This approach was necessary because of significant differences both within and between the observed industries. In the region, with some exceptions, digital and creative businesses tend to be smaller both in terms of turnover and employment levels than when compared to advanced manufacturing or healthcare. As well as this, having a range of business sizes in the selection criteria allows us to compare how both size and industrial type of firm can impact a firm's innovation processes, approaches and access to support. Therefore, this sample included a range of sizes, in order to reflect firms in the region, so as not unfairly exclude smaller innovative businesses as well as to observe the effects that size may have on innovation.

In order to better reflect the region as a whole and to avoid focusing on a single specific area, the selection of businesses within the area was carried out to include firms from a range of the region's local government districts. Given the industries that this study focuses on, however, an completely reflective view of the entire region is not possible, as some areas such as the Derbyshire Dales, with much of it laying within the boundary of the Peak District National Park, have a limited number of firms falling within our definition of innovative, particularly within industrial sectors.

This study also included a range of firms based on age. The majority of firms selected for this study were over 10 years old, in order to gain an insight into a firm's experience in innovating in pre-, during, and post- recession conditions. However, in order to prevent the unfair exclusions of smaller, newer innovative businesses, however, some firms were selected that were less than ten years old.

**6.9) Sampling Method**

Before continuing it is necessary to lay out the method that was used to sample interview participants, a step necessary to both increase the transparency and clarity of the study, particularly with regards to the interpretation of the results section of this thesis and whether the sampling method may have had an impact on responses collected and themes identified. As two different groups of stakeholder were interviewed as part of this study in order get both an institutional and firm perspective, two different sampling methods were used for each group, laid out below.

The first group this study wished to gain the perspective of was institutional stakeholders within the SCR due to several factors. First, this research wanted to understand the perspective of the core pillars of the innovation system concept, of which institutional stakeholders comprised a significant part. Related to this point, through interviewing institutional stakeholders this study also hoped to gain the "strategic" view of economic development, planning and support within the region, a perspective that was believed to help support this research's aim to investigate the nature of innovation in the region, particularly with regards to the construction and supporting of innovation systems. Finally, given that the institutional stakeholder

group has responsibility for planning and in some instances providing support for the business community within the region, it was believed that speaking to this group would help generate significant insights on what innovation specific support was on offer in the region, and in combination with later interviews how this meshed with the needs of innovators within the SCR.

An important consideration was to ensure that the entirety of the city region was represented, and as such that stakeholders were interviewed from each of the region's nine local authorities. As it was the intention of this study to investigate the entirety of the City Region, it was believed to have not gained the perspective of the entire region would have been a poor research practice and would have reduced its ability to claim that it reflected the nature of the entire Sheffield City Region. As such, a condition of the sampling method was that a stakeholder from each local authority within the SCR was interviewed.

For institutional stakeholders the sampling method was the following: each of the nine local authorities websites were searched in order to identify named individuals with the responsibility for economic development, innovation, or economic strategy within their local authority. The search of named individuals was also repeated for local chambers of commerce due to both their support role, and close interaction with policy and firms. This was also repeated for the SCR LEPs governing body for the same reasoning. Once these named individuals and their contact information had been identified, this was compiled into a spreadsheet, and invites to be interviewed were sent out by email, explaining the purpose of this research and the ethical precautions

that had been put in place. While this approach elicited responses from the majority of the target groups and local authorities, in the case of two local authorities this research was initially unable to get responses through this method. This it was believed was due to the fact that in each of these local authorities represented the smallest populated districts of the SCR, and thus had a smaller local authority. In addition these local authorities also had the smallest pool of potential contacts due to a lack of information regarding key personnel available online. Following this therefore, these local authorities were contacted by phone, where the purpose of the study was explained, and were asked whether there were any relevant personnel would be able to be invited to interview. This method produced results with relevant personnel being identified, and agreeing to be identified once contacted by phone or email.

While this research accepts that this method of selection was one that was not particularly systematic, given the specialist nature of the required participant in combination with relatively small population of relevant participants in each of the targeted groups, this targeted approach was necessary and appropriate.

Unlike the institutional stakeholder sample, given this study focus on innovation in the region and the position of firms as the engines of innovation, the location of firms was considerably less important a factor than the firms being innovative, particularly radically innovative. The first step of the method through which the firm sample was constructed was through using the BSD database. This database was searched in order to construct a list of firms that were within the post codes associated with the boundaries of the SCR and in the industries targeted by this study that were noted in a

spreadsheet. From this list, further research was conducted on each firm in order to attempt to ascertain from publicly available information whether the firms were engaged in what would be considered to be radical innovation. This was not always apparent with some firms having engaged in radical innovation historically, but not currently, and therefore while the historic radial innovation may have been promoted heavily by the firm, was no longer engaged in radical innovation. As can be seen from the attached interview guide in Appendix 3, in order to ensure that interviewed firms were radically innovative, firms were asked to give examples of recent innovations in order to add clarity and certainty that radical innovation was something that they were still engaged in. In practice therefore, two firms were interviewed where it became apparent from initial questioning that they were not radically innovative, and therefore were excluded from this study.

Following the construction of this list of innovative firms, emails were sent out to invite firms to be interviewed, to relevant named individuals where such information was available, or to the firm asking to interview someone with responsibility for the firms innovation processes where such information was not available. In cases where this did not elicit response, this was followed by a second email, and a further phone call to the firm if no response was gained from the second email. This approach resulted in 30 interviews being organised with radically innovative firms in the SCR across all of the investigated industries.

**6.10) Reporting of Participants**

The below sections present the participants that were interviewed as part of this study. Due to the potential of politically and commercially sensitive information to have been exposed during this study, as well as to encourage participants to talk freely around this study's core themes, interviewed participants were granted anonymity as a condition of their participation. Therefore, the below section whilst reporting this study's participants ensures that no identifying information is included, and assigns codes to each member so as to allow necessary information to be reported, while maintaining anonymity.

### 6.10.1) Institutional Stakeholders

The below table presents the interviewed participants in the institutional stakeholder section of this study, ordered alphabetically by location. The role of these participants has not been included as in smaller sub-regions with smaller institutions and teams, their inclusion could result in the participant being identified. The method of coding uses the first letter to denote that it is a stakeholder interview, the second and third letters denoting the location of where the stakeholder was based, and the final number is used to differentiate stakeholder interviews where multiple stakeholders from an area were consulted. This table also includes the position of interviewed stakeholders, however in order to ensure anonymity promised to stakeholders as a condition of this research, the position of the respondent has been kept as broad as possible, particularly in areas where a more specific definition may result in the identification of the participant.

Table 1.1
Institutional Stakeholders

Institutional Stakeholders

| Location | Code | Position |
|---|---|---|

Institutional Stakeholders

| | | |
|---|---|---|
| Barnsley | SBA1 | Institutional Stakeholder (Council Associated Support Institution) |
| Barnsley | SBA2 | Institutional Stakeholder (Council Associated Support Institution) |
| Bolsover | SBO1 | Council Official |
| Chesterfield | SCH1 | Institutional Stakeholder (Council Associated Support Institution) |
| Derbshire Dales | SDE1 | Council Official |
| Doncaster | SDO1 | Council Official |
| Doncaster | SDO2 | Institutional Stakeholder (Chamber of Commerce) |
| NE Derbshire | SNE1 | Council Official |
| Rotherham | SRO1 | Institutional Stakeholder (Council Associated Support Institution) |
| Rotherham | SRO2 | Institutional Stakeholder (Council Associated Support Institution) |
| Sheffield | SSH1 | Council Official |
| Sheffield | SSH2 | Council Official |
| Sheffield | SSH3 | Council Official |
| Sheffield | SSH4 | Institutional Stakeholder (Chamber of Commerce) |
| Sheffield City Region | SSC1 | LEP Official |
| Sheffield City Region | SSC2 | LEP Official |

### 6.10.2) Regional Firms

The below table presents and codifies the participants from 30 of the region's innovative firms who were interviewed as part of this study. The results have been ordered by industry, followed by the physical location where the business was located. A coding system has been developed in order to keep respondents anonymised, with the first letter F, denoting that it is a firm interview, the second and third letters being the first two letters of the city where the firm was located, the final letter representing

which industry the firm was in, and the final number used as a method for separating multiple firms that were interviewed in the same location and industry. This table also includes the size of the firm, based upon the categorisations used by the UK government (Parliament, 2017). Furthermore, this table also presents the age of the interviewed firms expressed in bands. This was in order to convey the approximate age of the firm, while not giving the exact age in order to protect anonymity. The age bands in year are: <5 years, 5-9, 10-19, 20-29, 30-39, 40-49, >50.

Table 1.2
Innovating firms

Regional Innovating Firms

| Location | Industry | Size | Age | Code |
|---|---|---|---|---|
| Rotherham | Advanced Manufacturing | Large | >50 | FROA1 |
| Rotherham | Advanced Manufacturing | Medium | 30-39 | FROA2 |
| Rotherham | Advanced Manufacturing | Medium | 5-19 | FROA3 |
| Rotherham | Advanced Manufacturing | Medium | 40-49 | FROA4 |
| Rotherham | Advanced Manufacturing | Large | >50 | FROA5 |
| Sheffield | Advanced Manufacturing | Small | 5-10 | FSHA1 |
| Sheffield | Advanced Manufacturing | Large | >50 | FSHA2 |
| Sheffield | Advanced Manufacturing | Large | >50 | FSHA3 |
| Sheffield | Advanced Manufacturing | Medium | >50 | FSHA4 |
| Sheffield | Advanced Manufacturing | Large | >50 | FSHA5 |
| Sheffield | Advanced Manufacturing | Small | 10-19 | FSHA6 |
| Sheffield | Advanced Manufacturing | Small | 5-9 | FSHA7 |
| Sheffield | Advanced Manufacturing | Large | >50 | FSHA8 |

Regional Innovating Firms

| Location | Industry | Size | Age | Code |
|---|---|---|---|---|
| Sheffield | Advanced Manufacturing | Small | 10-19 | FSHA9 |
| Barnsley | Digital/Creative | Small | 10-19 | FBAD1 |
| Barnsley | Digital/Creative | Small | 5-9 | FBAD2 |
| Rotherham | Digital/Creative | Medium | 10-19 | FROD1 |
| Sheffield | Digital/Creative | Small | <5 years | FSHD1 |
| Sheffield | Digital/Creative | Large | 10-19 | FSHD2 |
| Sheffield | Digital/Creative | Small | 10-19 | FSHD3 |
| Sheffield | Digital/Creative | Small | 10-19 | FSHD4 |
| Sheffield | Digital/Creative | Small | 10-19 | FSHD5 |
| Sheffield | Digital/Creative | Small | 10-19 | FSHD6 |
| Rotherham | Health | Medium | 50> | FROH1 |
| Sheffield | Health | Small | 10-19 | FSHH1 |
| Sheffield | Health | Medium | 20-29 | FSHH2 |
| Sheffield | Health | Small | 5-10 | FSHH3 |
| Sheffield | Health | Medium | 20-29 | FSHH4 |
| Sheffield | Health | Medium | 10-19 | FSHH5 |
| Sheffield | Health | Small | 10-19 | FSHH6 |

### 6.10) Sample Analysis

Before continuing, it is necessary to analyse the nature and characteristics of the study's interview sample, and to assess the reasons behind such characteristics and the effects that this may have had upon the study's results.

### 6.10.1) Stakeholders

The sample of institutional stakeholders while meeting the sampling criteria of interviewing a stakeholder from every local authority district in the SCR exhibits characteristics of mono-centricity, with respondents from Sheffield being the largest interviewed group. The reason for this Sheffield focus is believed to be due to the nature of the region, particularly with regard to the comparative sizes of the region's local authorities. As the SCR is the economic centre of the region, as well as its most populous city, the comparative size of its local authority and supporting institutions is larger than those of the surrounding area. This has thus resulted in a higher number of relevant research participants being located in Sheffield than other areas, resulting in this imbalance. This therefore in part further demonstrates through this concentration of the sample that Sheffield, while arguable weakly mono-centric, is the dominant economy in the region, with the most innovation supporting institutions and institutional stakeholders. As such, it is necessary to be mindful of the location of the interviewed stakeholders quoted below. Despite this however, the Sheffield-centric nature of the sample is not severe, and efforts were taken during the analysis of the collected data to gain insights from the region in its entirety, reducing the likelihood of presented stakeholder perspectives and insights being biased towards a narrow Sheffield view.

This sample also reflects a significant focus upon institutional stakeholders from local authorities as well as local authority associated support institutions. A reason for this characteristic is that within the context of the SCR the majority of innovation related

support initiatives were administered by the region's local authority, or institutions related to them. Although it may be argued that this may affect the nature of the collected results due to this focus upon the local authority and related stakeholders, it is argued that given that these institutions are the main providers of innovation support at a regional level that within the context of this study and the nature of support within the SCR this focus is appropriate and necessary. As a result of this, it may be argued that the stakeholders perspectives presented below are due to the sample predominantly a "local authority view", however given the centrality of these institutions in the context of the UK as regional and sub regional economic nodes of control, authority and support, this is appropriate in the context of looking at institutional stakeholders within the SCR.

This research also interviewed participants from the region's LEP and chambers of commerce within the region, as these organisations were also related to the supporting of firms within the region (both innovative and none innovative) as well as being well placed through their interaction with numerous firms within the region to provide a broad insight into the economic, innovation and support landscape of the region. Such characteristics made them ideal candidates as institutional stakeholders in order to provide a good insight from numerous types of business within the region.

**6.10.2) Firms**

One of the first characteristics evident from this sample is the predominance of AM firms within the sample, a characteristic which arguably may affect the interpretation of innovation and support by respondents, particularly given that the type of

innovation undertaken by such firms almost exclusively involved the development of a new physical product, as well as the requirement of specialised physical assets such as plant and premisses. Given the thematic coding method adopted by this study, however, it is argued that this has helped to ensure that themes drawn from the data are not dominated by any one sector, and that insights are ones that were noted by firms of all industrial types. In addition, as the focus of this thesis was upon radical innovation given its higher potential for regional growth, all interviewed firms shared this characteristic regardless of industry. As such the most significant way in which the characteristics of the sample are likely to affect the results, by industry type, is in differing support needs, a factor also mitigated by the thematic coding method.

The second notable characteristic of this sample is that there is significant mono-centricity towards the core city of Sheffield, followed by its neighbouring town Rotherham. The reason behind this centrality of the sample owes itself largely due to the combination of Sheffield being the economic centre of the region, with a larger population of firms than other areas within the SCR, as well as the location of the region's AMP which has resulted in many AM firms being located within the boundaries of Sheffield or Rotherham. This study also had significant difficulty in finding firms within the region's periphery that met the criteria of being a radical innovator, suggesting that the majority of the region's most innovative firms are geographically concentrated within the core of the region. As a result, the perspective gained on innovation, support and innovation systems within the SCR by firms is a Sheffield-centric one, however is in line with the research's focus on innovation

systems as well as demonstrating a significant characteristic about the location of innovation assets within the region.

Another characteristic of this sample is the predominance of small and medium sized firms within the sample within all industries, but particularly within digital and health. As covered in the literature review, the size of firms is believed to impact upon the type of innovation that they are likely to engage in, with firms from small and medium sized bands being able to better undertake radical innovation for a range of factors. As such, it may be argued that it is for this reason that small and medium firms dominate the sample, and that this is a factor that may affect the insights generated from these firms. Because of this, it is necessary to be mindful of how much such insights are down to the size of the business, and how much is due to their position as a radical innovator.

Finally, another factor to note from this sample is the age of firms interviewed. It should be noted for the sake of clarity, that several of the firms interviewed have ages of greater than 50 years, particularly within the field of advanced manufacturing. It should also be noted that in such cases while these firms may not have been considered to be advanced manufactures at their inception, that they have since adopted and created radical innovation, as well as adopting advanced manufacturing techniques and methods and are therefore currently considered to be advanced manufacturers. Therefore several of these firms may be considered to have transitioned from manufactures into advanced manufactures.

Despite this however, there is a significant dominance of firms from the 10-19 years old bracket. This it may be argued could skew the results, given such firms will have survived the initial start-up phase of the firm while still being less established than other firms. It may be argued however that the prevalence of this age group may be due to a number of factors, such as the comparatively recent emergence of information technologies causing a boom in digital and creative firms within this time bracket. It may also be that small successful innovating firms are, once established, likely to be bought up by larger competitors. Regardless of the reasoning behind why this group is so dominant, however, it should be noted that their interpretation of innovation and innovation support needs may be different to older and younger firms, and should thus be considered in the results. As before however, due to the thematic coding used in this thesis, insights were generated from all firms, reducing the bias of this size bracket.

### 6.11) Analysis of Qualitative Data

One of the most significant criticisms levelled against the use of qualitative research regards the analysis of collected data (Bryman and Bell, 2011) is, that the data lacks validity due to the subjective nature of the analysis. In order to mitigate against these limitations therefore, in order to remove subjectivity from the analysis of the collected data, a thematic coding method was used to increase the robustness and validity of the findings of this study. This section therefore outlines the method used in order to analyse the data collected as part of this study.

First, following the conduction of interviews, the audio recordings of these interviews were transcribed in their entirety in order to provide a suitable document that could be

thematically coded. After the production of these transcripts the researcher engaged in several readings of the documents in order to draw out thematic codes, using a separate spreadsheet to organise the codes and themes that emerged from these readings. The purpose of the first reading was to gain a sense of what the data contained, as well as to note whether any reoccurring patterns occurred or were evident within the data. During the second reading initial codes were generated where interview respondents mentioned data relevant to the purposes of this study, which were inputted into a spreadsheet in order to aggregate the data from multiple interviews. Following this, these codes were condensed into themes based upon their relation to the research questions and the overarching aims of this research and placed in a separate column of the spreadsheet, linking together the codes encompassed by each theme. Finally, during a third reading, these themes were checked against the responses of research participants in order ensure that the themes generated were applicable to the responses given by the interviewees, thus ensuring that the themes generated did not misrepresent the responses of those interviewed . This process was done twice, first from the interviews conducted with stakeholders, which was then used to inform the interviews conducted with the region's firms, after which the coding process was repeated.

This method therefore served as a robust way in which the data generated from this study was analysed, ensuring that researcher subjectivity was limited, and that the findings of this research had increased validity. This therefore served as a further manner in which the limitations of the qualitative research method were mitigated against.

PART 3: FINDINGS AND ANALYSIS

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## 7) The Challenge of Defining Innovation for Growth

### 7.1) Introduction

Innovation is a highly complex and multifaceted concept and has been defined and characterised in numerous ways by numerous academics in the past, meaning that there is no single accepted definition, an issue that is problematic in a number of regards (Rammer et al., 2009; Acs and Audretsch, 2005). Arguably, the main way in which this difficulty manifests itself is that it makes the concept of innovation "fuzzy", and without clear boundaries and with the adoption of varying definitions by academics it reduces the clarity of the concept, as well as making the cross comparison of studies difficult due to issues associated with measurement (Janger, 2018; Acs and Audretsch, 2005). Due to this issue therefore, this study reviewed the literature on innovation and its definition in order to demonstrate its complexity, highlight the different ways in which it has been conceptualised by different groups and highlight the issues associated with these definitions, which in turn was used in order to construct a definition of innovation for use in this study, in order to promote a degree of clarity in this thesis around a highly complex concept, an important and necessary step owing to innovation being a core concept of this thesis. This approach of starting research on innovation with a discussion of its definition and its characteristics is a relatively common practice amongst academics, with numerous papers taking a similar approach, both acknowledging the complexity of the term and laying out their own definition (Witell et al., 2016; Rammer et al., 2009; Johannesen et al., 2001). Despite a widespread acknowledgment that the definition of innovation is a subject which causes significant difficulty, however, both in terms of it making the cross comparisons of studies difficult as well as broader issues surrounding the measurement of innovation

(Acs and Audretsch, 2005; Johannessen et al., 2001; Kuznets, 1962), the literature review of this thesis was able to find scant evidence regarding whether the difficulties associated with the poor definition of innovation were also experienced at a policy maker or firm level, and if so what the affects of this were.

Although this study has adopted its own definition of innovation, as stated in the literature review, to add further clarity it was decided that when interviewing stakeholders in the region an appropriate and prudent step would be to ascertain what they defined and perceived innovation to be, as this may not have necessarily related to either the definition adopted by this thesis or those identified in the literature review. Although initially intended as a method to increase the clarity and therefore robustness of this study, interviews with stakeholders demonstrated that the difficulty of definition is something which is not limited to academia, instead it is also experienced by stakeholders who have adopted a range of contrasting definitions and perceptions, which has significant consequences for the construction and provision of innovation support, particularly with regards to the role innovation plays as a driver of growth in regional economies (Hackler, 2010; Rammer et al., 2009; Stam and Wennberg, 2009). In the empirical case of the SCR, these contrasting and unclear definitions have resulted in the coherence of the region's innovation support becoming severely reduced, the prevalence of a definition regionally which fits poorly to deliver innovation-led growth and different institutions within the multiscalar spectrum through their differing definitions tending to favour particular types of definition. Ultimately therefore, this section demonstrates that the issue of definitional complexity highlighted in the literature relates to innovation in practice across the SCR at multiple

scales. It also demonstrates that given a preponderance of open definitions of innovation at the regional and sub-regional scale and closed definitions at national ones, that there is a divergence between the two groups in what types of innovation is supported in practice, and thus how the multiscalar support of innovation provides significant difficulties in the development of a united and coherent approach to supporting the development of innovation systems within the empirical context of the SCR.

This chapter therefore presents the findings regarding how stakeholders define innovation, how this differs and relates to the broader literature regarding types of innovation and their contribution to growth, as well as analysing what the broader practical implications of this difficulty in definition are from the perspective of the SCR. Section two first presents the first broad category of definition adopted by stakeholders, what this thesis has termed the open and inclusive definition, how this type of definition and perception of innovation relates to the literature, as well as the typical characteristics this type of innovation exhibits. Section three looks at the opposite end of the definition spectrum, the narrow and restrictive definition, its relation to the literature and the perception of innovation as an elitist activity. Section four concludes, looking at the issues caused by these conflicting definitions and how this relates to the formation of innovation systems and the multiscalar approach of innovation, how the theme of the literature concerning the difficulty in defining innovation has implications in practice and issues concerning innovation and growth and how this relates to the multiscalar approach of innovation support.

### 7.2) The Open Definition of Innovation

The definitions adopted by stakeholders tended to fall at one end or another of a spectrum, with highly inclusive and open definitions of innovation at one end, and highly closed and narrow definitions at the other. This section discusses the findings from stakeholders at the open end of the spectrum, how this affected their perceptions regarding innovation, how this characterisation of innovation fits with the literature on types of innovation, as well as well as how this impacts upon the provision of innovation support programmes within the SCR.

The definition of innovation by some stakeholders was both wide-ranging and highly inclusive. While taking a wide definition of innovation can in some circumstances can be beneficial, some of the definitions used by stakeholders were wide to a point that may stretch the definitional boundaries of what can be legitimately considered innovation. This is particularly true when compared to the narrower definitions of innovation sometimes forwarded by academics. For example, when asked for their definition of innovation, one participant noted:

> *"For me, if you've created and grown your business, you are to some extent, innovative. Because in some cases you have to think outside the box just to grow your business… Somebody going out and setting up a business could be defined as innovative".*
>
> SDON1

This particular definition of innovation is questionable, as the act of setting up a business is not necessarily innovative, and is not usually considered an innovation in itself by most, if not all academic definitions (Damanpour and Wischnevsky, 2006; Lundvall, 2004). Although it is not disputed that new businesses can be innovative, through the offering of a new product or service in order to enhance their competitiveness, there are numerous examples of purely replicative businesses who have copied the products or services of existing businesses, and do not innovate in any manner (Huggins and Williams, 2011). Indeed, these examples instead of generating economic growth, as is often the case in businesses with successful innovations, instead often create churn, displacement and disruption in the local economy. Therefore, definitions as wide and inclusive as this, this thesis argues, is too wide to be considered an innovation, therefore limiting understanding on how innovation might be used as a policy lever for growth and achieving other economic objectives and targets. In addition, it is difficult to link such definitions to the literature explaining definitions or characteristics of innovation because while this research cannot claim to have covered everything which has been written on the definition of innovation, an extensive search has been unable to find any academic work which defines innovation as openly as this. However, this does serve as an exemplar of how the concept of innovation is poorly understood by some stakeholders within the region, and although covered in greater detail later in this thesis, also demonstrates a focus of some stakeholders on growth as opposed to innovation, without understanding adequately the impact which innovation has on growth, a case of focusing on the ends, rather than the means. A second stakeholder noted along similar lines:

*"I don't think we badge it as innovation and that's the challenge. Everything we do has that growth label stuck to it."*

SDON2

As noted previously, due to the economic benefits which can be derived from increased innovation rates, including growth across a number of different measures such a GVA, employment etc (Rousseau et al., 2016; Hackler, 2010; Rammer et al., 2009; Stam and Wennberg, 2009), this represents a significant example of how a unclear understanding of the definition of innovation can negatively impact upon stakeholders in the region, and by extension the provision of innovation support and strategic planning around a region's economic development. This therefore suggests that in some instances regional stakeholders and supporting institutions are focusing on the end result of growth, rather than the means by which this may be achieved. This focus upon growth as opposed to the policy levers through which this can be achieved represents a significant problem, given the potential of innovation to act as a contributor to stakeholders' desires for sustainable growth.

Although the above definitions are, by most if not all accounts, too wide and inclusive to be reasonably considered an innovation, other stakeholders within the SCR adopted definitions which were narrow and bounded enough to be considered an innovation, however tended towards the wide and inclusive end of the definition spectrum. For example, when defining innovation, some stakeholders demonstrated an awareness that innovation is a term that is, to a degree, contextually bound: that innovation means different things to different people depending on various factors such as a firm's

industry, size and age. There is also an awareness that innovation has numerous levels, and while an innovation may not necessarily be entirely novel on a market level, it may be considered innovation to an individual firm. For example, one stakeholder, when explaining their view of innovation stated:

> *"Simplistically I think it's* (innovation) *doing things better. Whether that's better than previously as an individual firm or better than your competitor, that for me is innovation".*
>
> SDON2

As can be seen, the definition of innovation as doing something better than previously is qualified as doing something which may be either an internal process to the firm, or one that has a broader reach, such as doing it better than the market's other competitors. It is also a view of innovation which relates to the adoption and diffusion of existing technologies, in that the adaption of a new technology or process which if it helps make a firm perform better than its competitors, may be considered an innovation under this definition. Another two officials noted along similar lines that:

> *"From a business support perspective it's more wider than a big change in business. It's about little steps and how can we do something better than we did it yesterday… I think innovation means lots of different things to different people."*
>
> SCHE1

*"The thing is that you've got many layers of innovation… it can be that a company going from a manual to an IT related form of bookkeeping is a form of innovation within that company… If someone has a new product that they want to bring to market, well that's something clearly different from moving a manual process to an IT process, so we tend to have a broad view on innovation."*

SBAR1

This view of innovation by stakeholders is one that relates to the literature in two ways. First, such definitions have a view of innovation as diffusion, in that innovation is seen as the adoption of new technologies and processes which while not new and innovative on a global or industrial scale, are new to the firm and therefore innovations from their standpoint (Damanpour and Wischnevsky, 2006). This is exemplified in SBAR1's example that a move from a manual to an IT form of bookkeeping can be considered as an innovation. Secondly, this definition also encompassed a view of innovation as an incremental process, as SDON2's view of innovation as "doing things better" relates to innovation as step changes to products, services and processes resulting in the gradual improvement of the firms offering or internal efficiency (Norman & Verganti, 2014; Markides, 2006; Koberg et al., 2003). The concept of innovation as diffusion and innovation as an incremental process has a number of practical implications highlighted in the literature with regards to the contributions of such innovations to both firms and the region's economy, the types of firms which are likely to exhibit such forms of innovation both in terms of size and industry, and as a result of this how such innovation should be supported (Keizer and Halman, 2007; Sorescu et al., 2004). Due to these significant implications to both the development of

the region and provision of innovation support, the below sections shall analyse how such definitions of innovation relate to the literature, and what the implications of these relations are.

One implication of this open definition of innovation adopted by stakeholders is that because its focus upon innovation is highly inclusive, in that it includes small innovations such as incremental innovation and adoptive innovation, this definition is particularly inclusive of the type of innovation undertaken by small firms, a stance which is understandable given the high proportion of SMEs and micro-businesses that exist in the SCR compared to the national average. This therefore has implications regarding firm size, and their contribution to innovation and growth in a region, as such a definition and the support programmes developed by those within the region who hold such a definition is likely to favour smaller firms who are most likely engaged in this type of innovation. This therefore brings into question whether it is small or larger firms  who contribute the most to innovation?

The literature notes that although whether it is small or larger firms which contribute the most to innovation is far from clear, it does note that larger firms tend to have the advantage in industries which have high capital requirements (Acs and Audretsch, 1987). As well as this, small firms in research intensive industries often find it difficult to acquire financial capital and are more likely to be acquired by larger firms that are rich in capital (Stam and Wennberg, 2009), meaning larger firms typically contribute more to innovation in industries that have high capital requirements and are research intensive. As has been identified, both in the literature (Williams and Vorley, 2014),

and by reports from the SCR LEP itself, the three most innovative industries within the region are considered to be advanced manufacturing, healthcare and digital and creative, and it was for this reason this research focused upon these three industries. The advanced manufacturing industry has both an extremely high capital requirement, owing to the highly specialised and costly plant required to operate, as well as often requiring specialised facilities to house them. It is for this reason that Katz & Wagner note in their work on innovation districts that it is advanced manufacturing districts that are the only innovation district which consistently tends to be located outside of a city (Katz & Wagner 2014). Similarly, the healthcare industry has a high capital requirement owing to both the development and long accreditation period required for medical innovations, as well as requiring significant specialised talent for medical research and development. Therefore, it may be argued that it is the open definition of innovation adopted by some stakeholders that favours the supporting of innovation of smaller firms, which undertake less high value innovation than these larger firms in the region's most innovative industries, bringing into question whether this definition of innovation is the best definition for growth. This definition also fits poorly with the types of innovation undertaken by existing high value innovators within the region, suggesting that the open definition of innovation adopted by primarily regional stakeholders is one which results in regional support institutions being inappropriate for these three key innovative industries, and in part explains their predisposition towards using national rather than regional support mechanisms, identified in greater detail in chapter 9.

The desire to keep the definition of innovation highly open and inclusive, it may be argued, also fits poorly with the creation of innovation systems more broadly. As stakeholders wish to keep the definition of innovation, and therefore the support they offer, both highly open and inclusive, some stakeholders expressed that having defined geographical areas where innovators are based is counterproductive to this aim:

> *"I suppose what we are saying is if you are narrowing your thinking on innovation, so we have innovation parks where only certain businesses who develop things that are world-leading can go, that would discount a lot of innovation across everybody else who is not in that innovation park. We think that innovation should be more holistic rather than, you have to go to a centre of excellence or you have to be in a certain location".*
>
> SBAR2

This view, although understandable if the view is taken and it is accepted that innovation should be wide-ranging and include simply the adoption or diffusion of new innovations and technology, does not fit well with the broader findings of innovation systems, a stance with numerous implications given a broad agreement that innovation systems are one of the best methods to help foster and encourage the development of innovation systems in an area (Lyasnikov et al., 2014; Asheim and Coenen, 2005; Johnson & Lundvall, 2002). A point of commonality that exists between all strands of innovation systems, whether it be at a national, regional, local or district level, is that all emphasise the importance of connectivity and high levels of networking between institutional, firm and knowledge-creating actors (Asheim and

Coenen, 2005; Etzkowitz & Ranga 2015). Although the importance of geographical proximity is not one that is stressed in the literature on national innovation systems, one of the primary reasons that later refinements of the concept do focus on narrowing the geographical area of such systems is in order to further strengthen this connectivity and learning network, in order to overcome issues identified regarding the difficulty in transmitting tacit knowledge (Szulanski et al., 2016; Ranucci & Souder, 2015). Indeed, looking at one of the latest iterations of the innovation systems concept, the Innovation District, one of the reasons that it is confined to a narrow geographical area, aside from the geographical closeness of actors in order to foster links and connectivity, the vast majority of the concept is dedicated to how stakeholders can construct the area and built assets within the area to further foster connectivity (Katz & Wagner, 2014). The innovation district therefore narrows the geographical area in which innovation takes place in order to strengthen links between firms and allow regional stakeholders to build the networking assets required at a focused and manageable level. Therefore, it may be argued that such an open view of innovation, and the implication from this that innovation should not be geographically narrowed to one area, demonstrates a way in which the definition of innovation adopted by stakeholders may be hindering the development of innovation systems in a region. This therefore, given the broad consensus of academics that such systems significantly drive innovation and growth within a region, this demonstrates one mechanism through which the definition of innovation and the implications stemming from that may affect a region in practice to its detriment.

As has been seen from the above examples, the open definition of innovation adopted by some stakeholders heavily relates to both the incremental and diffusion typologies of innovation identified in the literature (Keizer and Halman, 2007; Sorescu et al., 2004), as well as a rejection of place based and spatially-bound innovation projects and initiatives, such as growth hubs and innovation districts. A reason why some stakeholders have adopted such an open view to innovation is due to a belief that, as a public service, regional support programmes should be accessible to everyone. As one stakeholder noted:

> *"we don't subscribe to the view that you should concentrate on a few* (businesses)... *But if someone comes with what could be seen with a fairly trivial query or problem or opportunity, we think that as a public service we should be responding to that."*
>
> SBAR1

While this motivation behind why there is a desire to have an open definition and support programs for innovation is understandable, it must be questioned whether given the type of innovation this encourages and its incompatibilities with innovation systems, whether overall such an approach is the best for the region, particularly in an era of dwindling public funding and resources? As numerous examples in the literature identify, although it mat differ from case to case, incremental innovation has been demonstrated to have a significantly smaller impact on a firms financial performance than radical innovations, (Slater et al., 2014; Sorescu et al., 2004) which in combination with the lagging history of the SCR in terms of both innovation rates and

overall economic growth, suggests that such an approach through the adoption of this definition is not in the overall interests of the region's economic development. In addition, as such definitions are also at odds with the construction of innovation systems, as regardless of their scale they are also seen as the best way in which an area can support the development of innovations, it may be argued whether this stance on innovation is the best way in which innovation may be supported as a driver of growth in the region.

In conclusion, this section identifies several characteristics and implications associated with the open view of innovation adopted by a high proportion of the region's stakeholders. First, it has demonstrated that there is evidence that the concept innovation itself is poorly understood, as some have adopted a definition of innovation that is too wide to be reasonably considered innovation by practically all standard definitions within the literature. This, in combination with the lack of consensus regarding how stakeholders in the region define innovation, demonstrates how poorly understood innovation is as a concept . This section also highlights that stakeholders have a tendency to think about growth over innovation, meaning that there is a focus, in some instances, on ends but not means, as well as a poor understanding of how innovation can contribute to economic growth.

Other stakeholders have adopted a definition innovation that is open, and also relates well to what the literature considered to be incremental innovations. Such definitions tend to include the themes of continuous improvement or more broadly simply doing things better than before. This relates broadly to a view that accepts incremental

improvements or the adoption of new innovations developed elsewhere by the firm as innovative, a view that is mirrored by some in the literature (Garcia and Calantone, 2002; Johannessen et al., 2001). Although such innovations are not without value, as they may aid a firm in maintaining its competitive position, as well as offering a comparatively low risk route of innovation (Markides, 2006; Koberg et al., 2003), the literature demonstrates that such innovation does have a lower contribution to the firms' economic performance and growth than risker, more radical innovations. This therefore brings into question whether such a definition of innovation is the best one to attempt for stakeholders wishing to realise innovation-led growth in their region, and it is suggested that in the case of the SCR, a more narrow definition of innovation would be more beneficial in helping it to innovate for growth and to overcome its historical weaknesses.

Partly due to the focus upon growth as opposed to high value innovation, stakeholders show evidence of not wanting a narrow definition of innovation, in order to ensure that innovation is highly inclusive, and as a result innovation support is not narrowed to a few areas, industries or firms, a view that has several significant implications. One such implication is that once again this view of innovation tends to favour the types of innovation that is carried out by smaller firms. Although no definitive answer exists regarding whether it is small or large firms which contribute most to innovation, the literature does suggest that larger firms contribute the most in capital intensive and research intensive industries (Stam and Wennberg, 2009; Asheim and Coenen, 2005; Acs and Audretsch, 1987). As identified by Williams and Vorley (2014), as well as by the SCR itself (SCR, 2011) the region's three most innovative sectors are advanced

manufacturing, healthcare, and digital and creative, and were therefore the three industries that this research focused upon. Because both advanced manufacturing and healthcare are both industries that are capital and research intensive, this therefore suggests that the open definition of innovation is one which focuses less upon the existing drivers of innovation in the SCR, and more towards smaller, less radically innovative firms. The benefits of this however are unclear, as while the advanced manufacturing and healthcare sectors are significant innovators within the SCR, the region also contains a higher proportion of SMEs and micro-businesses, compared to that of the national average. This therefore begs the question of when defining innovation for growth, is there a balance to be struck between having an approach which favours more small firms which are less innovative yet a significant component of the regional economy, and supporting larger firms which are the most significant drivers of innovation within an economy? This thesis argues, that while small and less innovative firms are important within the SCR, that they are unlikely to grow significantly, and that in order to benefit from both economic and employment growth, and also to overcome historical weaknesses, that the SCR needs to move its focus and support towards radical and high value innovators. This therefore again suggests that the issues associated with difficulty of definition of innovation has resulted in a practical negative outcome for the region, in that stakeholders have adopted a view of innovation which is sub-optimal for supporting the types of firm best placed to deliver growth in the region across a range of metrics.

Another implication of this is that in some instances, an open definition does not connect well with thinking on the construction of innovation systems. It has been

noted by stakeholders that one reason why they adopt the open definition of innovation is because they do not wish to limit their thinking on innovation to a few firms producing world-class innovations, clustered together in one location. This therefore puts this definition at odds with the creation of geographically close and highlight networked innovation systems, systems that are regarded by the literature to be the most effective way in which a region may encourage the development of innovations within the region (Lau & Lo, 2015; Katz and Wagner, 2014). This, in combination with the fact that the types of innovation included by this definition are not typically high value, further brings into question whether such a broad definition is one which should be adopted by stakeholders attempting to promoted regional economic growth.

This concern by stakeholders that the definition of innovation needs to be open and inclusive is one that is understandable, as there is a concern that too narrow a definition of innovation would discount much activity which occurs in the region. As noted by Schumpeter, too narrow a definition of innovation may bring along with it significant issues in that it may "limit us… to the case in which the innovation consists of producing the same kind of product that had been produced before by the same kind of means of production that had been used before" (Schumpeter, 1939 p84). However, as the above definitions of innovation related to it being the adoption of new technologies, making it related to the diffusion of innovation and a view of innovation being "new to the company", it may be questioned that as such definitions do not include the production of something new, the element mentioned by Schumpeter, how much value does such a view of innovation bring to the firm who undertakes this type of innovation as well as to the region's economy? Alternatively, is the narrower view

of innovation as a radical and frontier activity presented below a better definition for regional stakeholder to adopt for regional growth? This thesis argues that because of these above issues, that the open definition of innovation adopted by stakeholders is one which is not well placed to deliver economic growth within the region, despite its good intentions of supporting a significant and as wide a segment of the region's business community as possible.

### 7.3) The narrow Definition of Innovation

As has seen from above examples, the prevailing view of innovation in the SCR adopted by a majority of stakeholders is exceptionally open and inclusive, a definition which has significant implications with regards to defining innovation for growth, what the characteristics of such innovations are based on this definition, and how such definitions of innovation should be supported. Although it constituted a minority, however, some stakeholders had a perception of, and adopted a definition of innovation which was conversely rather narrow and restrictive. This section shall therefore investigate and analyse the implications of this finding, with regards to how this is defined, the type of innovation this entails, its contribution to growth and broader perceptions by stakeholders regarding innovation as an elitist and inaccessible activity.

Several interviewed stakeholders in the SCR in contrast to the open definition of innovation, adopted a narrow view as to what they believed an innovation to be. Although variations between definitions on this side of the innovation spectrum did

exist, the main way in which stakeholders characterised innovation was some variation on the commercialisation of research, or an idea, in order to produce something new:

> *"I see innovation as the commercialisation of research output in very simple terms. Absolutely core to staying with the world. And any business that does well, has to keep developing itself".*
>
> SSHE4

> *"Simple, innovation is* (the) *commercialisation of ideas and/or research".*
>
> SBOL1

Such definitions of innovation link back to the literature in two broad ways. First, these definitions relate to the distinctions made between innovation and invention. As the literature notes, innovation and invention are not the same thing. As Hackler (2010), highlights, while an invention may be defined as an idea, be that an idea for a new product, process, service or internal management or operation of a firm, innovation necessitates this idea to be carried out in practice. This narrow view of innovation fits well within this distinction, with innovating firms acting as the commercialising force of research and ideas. This, as shall be seen later in the chapter, is also a definition that fits well within the literature on the construction and operation of innovation systems, in particular the linkages and relationship between firms and knowledge producing institutions (Etzkowitz & Ranga, 2015; Katz & Wagner, 2014).

Secondly, this definition relates to the discussions in the literature around innovation as newness, and in particular, new to whom? These definitions, in contrast to the broad definitions adopted by stakeholders, take a narrower perspective regarding the concept of newness. The open definition is one in which newness may apply to the perspective of the adopting firm, allowing, under their definition, simply the adoption of something which is new to the firm may be considered innovation (Damanpour and Wischnevsky, 2006; Johannessen et al., 2001). Alternatively, the narrow view of innovation adopted above restricts their definition in such a way that not only to be considered an innovation does something have to be created, but it also needs to be new at the level of the market, through its commercialisation.

Therefore, one of the primary differences between these definitions is that the narrow definition has a view that an innovation has to be the creation and commercialisation of something new from the perspective of a market, versus the open definitions of innovation being the adoption of something which is new to the firm, but not necessarily the creation of anything new. As has been seen, both of these views are accepted by the literature as valid definitions of innovation (Damanpour and Wischnevsky, 2006; Johannessen et al., 2001), however as argued it is argued that it is the former, narrower definition which is the most appropriate one for stakeholders wishing to benefit from innovation led growth, something which while relevant to all regions is of particular relevance to the SCR due to its history of lagging growth and innovation rates.

One of the reasons behind why the more restrictive definitions of innovation are more appropriate for stakeholders wishing to realise innovation led growth is due to a belief that it is this type of innovation where the region, and the UK best competes at, and is best able to add value. Owing to shifts in the global economy, stakeholders expressed a belief that it is no longer possible for the UK to compete in commoditised products, due to the disadvantages that the nation has compared to developing nations in areas such as labour costs. In the production and release of new innovations to the market, however, the UK is believed to have derived a competitive advantage from its innovative capacity, in particular due to its ability to develop and design new innovations as a result of its accumulated specialist knowledge and the work undertaken by the nation and the SCRs knowledge-creating institutions. As one stakeholder explained:

> *"In terms of economic development, the UK for the foreseeable future is never going to have a competitive edge in commoditised products… Where our competitive edge comes is through innovation: product development, product design, initial manufacture when that product is carrying a premium and releasing that to the broader market and then going back on the innovation cycle".*
>
> SSHE2

To a degree, and in the case of the SCR, this assertion that the UK and by extension the region's economy is unable to compete in commoditised products but can on specialised innovations, is exemplified by the rise and fall of steel production in the

SCR. For a significant period between around 1850 to the late 1970s the SCR's main specialisation and Sheffield's single largest employer was the production of steel (Newton, 2006; Hey, 1998), after which the region experienced significant deindustrialisation particularly in its steel industry due to the pressures of foreign competition (Hey, 1998). Despite this, today the SCR currently produces more steel than at its peak in the 1970s, because of its shift away from its previous specialisation of commoditised steel to advanced and specialised steels, as well as other spinouts into advanced and high performance materials. As one stakeholder described the shift:

> *"Sheffield has turned from a high workforce low skilled job(s market), into a high tech and highly specialised niche market, with advanced steel and advanced manufacturing and things like that."*
>
> SBOL1

This therefore provides a practical example how the region, while no longer able to compete in commoditised areas, is still able to remain competitive though its production of innovations of the type covered by the narrow definition of innovation as commercialisation of products and ideas, and as such suggests that it is innovation of this nature which is best placed to support future sustainable economic growth of the SCR.

The kind of innovation covered in these more restricted definitions as put forward by by SSHE4, SBOL1 and SSHE2 can best be categorised as falling at the radical end of the innovation spectrum. This is because, as identified in the literature, radical and

disruptive innovations involve the generation of an innovation from a high degree of new knowledge, often resulting in the development of a product which may be classed as either new to the market, or new at a global scale (Markides, 2006; Koberg et al., 2003). As has been argued previously, it is this type of innovation that is believed to contribute most to growth (Sorescu et al., 2004), and therefore it may be argued that this restrictive definition of innovation is the most appropriate for stakeholders to adopt from this perspective when attempting to define innovation for growth.

As this type of radical innovation is regarded to be either high tech, or requires a high degree of specialist knowledge, and is very much on the frontier of knowledge, a concern that was expressed by multiple stakeholders was that to adopt this definition makes innovation inaccessible to a wide range of firms within the region. In particular, stakeholders have noted that this definition reinforces a negative stereotype of innovation, particularly amongst smaller businesses in the region, that innovation is beyond their capabilities and not something that they are able to partake in:

> *"There's a bit of mutual distrust of innovation by businesses if that's the right word and the perception, and perception is very important, is that innovation is high tech, men in white coats, university based stuff. I'm a X I don't need to do that* (innovate)*, its that sort of perception."*
>
> SBOL1

> *"You can build up innovation to be something which people think is beyond them, or can't access. We have a wide definition to take any barriers to innovation away."*

SBAR1

It is because of these considerations that some stakeholders believed that an open definition of innovation should be adopted, so as to avoid innovation from being considered an elitist activity, undertaken and attempted solely by universities and large firms.

As well as this, some stakeholders also presented evidence that when speaking to firms that they were charged with supporting, that these firms did not consider what they did to be innovation:

> *"I think people are always innovating, what I think is that people don't realise that they are innovating in what they are doing. Like I said someone may be on their desk and thinking I can make this a bit better or a bit cheaper, well that is R&D, and it is innovation, but they don't realise it".*
>
> SROT2

This therefore demonstrates that the complexity and difficulties associated with the definition of innovation also, to an extent, filters down and affects some firms within the region, and once again raises the question when defining innovation for growth, is it better to adopt a definition of innovation which is highly inclusive, supporting smaller firms and their incremental and adoptive innovations, or one which while more restricted supports higher value, radical innovation which contributes significantly more to the financial growth of firms and the economy? It may be argued however,

that despite these apprehensions that such a restrictive definition of innovation confines innovative activity to the realms of universities and large firms, much of the high value innovation, frontier and radical innovations which takes place in the SCR is the result of collaborations between firms and the region's universities. As such, it is further argued by this thesis that if this is the case, and if it is this innovation that is best placed to deliver growth, that stakeholders should adopt this narrow view of innovation, and begin to define innovation specifically for growth.

Although discussed in significantly greater detail later, this research found that the firms in the SCR that were engaged in innovation at the frontier, and produced the most radical innovations, were those within the advanced manufacturing and healthcare sectors. Although this research finds that a number of deep and significant disconnects exist at numerous levels and between numerous actors within the SCR, these industries are highly networked and interacted well with the region's universities at numerous levels, engaging in collaboration, the sponsorship of PhD students and research, KTPs and other methods. To simply this interaction, in the case of the SCR, most radical innovation takes place through the region's universities "inventing" new knowledge and the region's firms commercialising that knowledge, resulting in the production of radical innovations. As such the region's universities are considered to be significant drivers of innovation within the region. As one stakeholder commented on the role of the region's universities in driving innovation:

> *"We have two very good universities, one of which is very heavily connected to the growth sectors. I think we are learning now how to use universities for the*

*R&D Labs for the city. The big employers have gone and they used to invest in their own R&D. For a while that went and the university space wasn't filling that, it is now stepping much more into that space… So the strength we have at the moment is the invention of new products, which has always been Sheffield's strength. The difference is that this is very much public university sector driven, as opposed to private sector driven. Theirs is the view that the public sector does research and that the private sector does development because research is too risky for the private sector. Development is less risky. And that fine and as long as we recognise that that's the case it should work".*

SSHE2

Due to these findings, in combination with evidence presented in the literature review that radical innovations contribute the most to economic growth and development, it is argued that while the desire to make innovation accessible is understandable, in reality it is this "elitist" innovation which contributes the most to radical innovation, and should therefore be supported through stakeholders defining innovation for growth through the adoption of the narrow definition of innovation.

In addition, in stark contrast to the broad definitions of innovation that fit poorly with the place-based innovation systems concepts, the narrow definition of innovation adopted by some stakeholders fits well with innovation systems thinking. As has been seen from the above evidence and literature, such a view of innovation means that an emphasis is placed on interaction between knowledge-creating institutions and the region's firms, with the former conducting research and creating knowledge, and the

latter commercialising it in order to produce an innovation that is radical and new on a market or global scale. This has clear parallels with all of the major types of place-based innovation systems, all of which place a significant emphasis upon this interaction, known as the triple helix when in combination with supporting institutions (Petersen et al., 2016; Katz & Wagner, 2014; Godin, 2009). Additionally, when interviewed, several stakeholders expressed that in attempting to support innovation-driven growth, they were aware of, and subscribed to, the innovation district model proposed by Katz and Wagner:

> *"We are currently looking at the advanced manufacturing and innovation district. The innovation district concept is something that a guy called Bruce Katz put forward… So that's starting to gather a bit more momentum now, we are starting to work out where do we go from here and develop that further?".*
>
> SROT2

> *"We kind of take an approach which is similar to Bruce Katz and his innovation district approach. Its very similar to that, and his point was don't have a long term detailed plan. Have an idea of where you are going and get on with it and then keep adjusting as you go along."*
>
> SSHE2

Given this conscious decision to pursue a strategy that is in-line with the innovation district concept, it is argued that if the region is beginning to take a strategic decision to pursue this plan of development, a prudent measure would be to adopt a definition

and view of innovation which best coincides with the view of innovation taken by the concept. As this thesis has argued, evidence suggests that the open definition of innovation as adopted by some stakeholders poorly fits with this concept, and that it is the narrow definition of innovation, which views innovation as the commercialisation of knowledge, which best fits with this concept.

It appears because of this, that innovation systems, considered to be one of the best methods for supporting the development of innovation in a region (Katz & Wagner, 2014; Godin, 2009), appear to have a view of innovation which parallels that of stakeholders adopting a more restrictive definition of innovation, as it involves the formation of tightly bound and geographically restricted networks between regional firms, institutions and knowledge creators, in order to facilitate the transfer of knowledge and commercialisation of ideas. Therefore, this further brings into question whether the concern by stakeholders regarding elitism in innovation and its accessibility are a relevant one when attempting to define innovation for growth, particularly as this restrictive definition relates to types of innovation as well as innovation systems, which are believed to best contribute to economic development. Alternatively should a balance be struck between supporting innovation of both types, radical and incremental, given that most businesses in the SCR are unlikely to be engaged in innovation at the frontier? This thesis argues that given the historic problems of the SCR with regards to its growth and innovation rates, in combination with the low value added by such incrementally innovating firms, that it is defining innovation for growth which is necessary in order to ensure such innovation is supported, and to help overcome these historical barriers.

In conclusion, the definition of innovation by stakeholders and the more restricted end of the spectrum may broadly summarise innovation as the commercialisation of ideas and/or research. This definition takes a view that innovation involves the creation of a new product, process or service, its commercialisation and for it to be considered new at a market of global perspective. This is in contrast to the broad definition of innovation, whereby simply the adoption of something new from the firm's perspective may be considered innovation.

The narrow definition of innovation relates heavily to the literature describing radical innovations, as such innovations are typically described as involving the creation of innovation from a high degree of new knowledge (Forés & Camisón, 2016; Markides, 2006). In addition, this also relates to discussions in the literature regarding innovation and the concept of newness. Although a consensus exists amongst definitions that innovation includes a degree of "newness", be that to an adopting firm, as seen in wider definitions, to the market, or on a global scale, a point of commonality exists around this concept of newness (Damanpour and Wischnevsky, 2006; Garcia and Calantone, 2002). As the narrow definition of innovation includes the commercialisation of a new idea or new research, however, this once again includes radical innovation as the commercialisation of such new ideas or research means that such innovations are likely to be new to the market, and often at the forefront of technology, particularly relevant to the SCR given its specialisation in the high technology industries of advanced manufacturing and healthcare. As this type of definition has implications for the type of innovation that it encompasses, this also has

implications for defining innovation for growth. As has been identified in the literature review, although to what degree is argued, a broad consensus exists that it is radical innovations that contribute most to economic performance and development over incremental and adoptive innovations (Sorescu et al., 2004). This therefore has significant implications upon how stakeholders in the region should define innovation, in order to adequately support areas that contribute most to the region's development.

The findings also show that within the context of the SCR, the majority of radical innovation takes place as the result of interactions between the region's innovative firms, and the region's universities. As radical innovations typically are characterised as containing a high degree of new knowledge, it is the region's universities that appear to be the sources and creators of such knowledge types (Simon et al., 2018; Markides, 2006; Koberg et al., 2003). Therefore, as highlighted above, as the literature makes a distinction that when defining innovation that a distinction is required between invention and innovation (Hackler, 2010), in the context of the SCR and the generation of radical innovations it is the universities that invent, creating new knowledge, and the firms that innovate, taking that knowledge and commercialising it through a variety of methods.

Despite the comparative successes of the SCR's radically innovating firms, this research shows that within the SCR a concern exists that adopting such narrow definitions of innovation risks making it appear to be an elitist activity carried out by "men in white coats", and constructing the perception that innovation is beyond the capabilities of many smaller and less innovative firms in the SCR, and therefore a

reluctance to adopt the narrow view of innovation exists. Despite this however, the majority of the region's high value innovation does appear to be carried out in this "elitist" manner, brining into question whether, while such restrictive definitions of innovation may create such a perception of innovation, should these concerns be put aside given the contribution of such elitist innovation to growth (Baker et al., 2014; Sorescu et al., 2004)? In addition, due to the high proportion of lifestyle businesses in the SCR whose contribution to growth is believed to be low, should stakeholders attempting to define innovation for growth be concerned about excluding such groups from innovation, given their poor contribution to the region's economic development? As this thesis has argued, although the rational behind the supporting of such businesses is understandable, given that they are a significant component of the SCR's economy, it is argued that in order to achieve sustainable economic growth stakeholders need to put aside such concerns and focus upon supporting such elite innovation, given its superior potential over smaller lifestyle and family firms.

Another significant way in which this definition relates with the literature is due to its fit with placed-based innovation systems. This is both the radical/restrictive definition of innovation emphasising connectivity between firms and knowledge creating institutions (Katz & Wagner, 2014; Godin, 2009; Doloreaux and Parto, 2005; Lundvall, 2004), and is the way most radical innovation within the SCR takes place. This is opposed to the open definition of innovation, which as has been seen above rejects the notion that innovative activity and innovation support should be confined to a small geographical area, as this is believe to limit its inclusivity. As innovation systems are widely considered to be the best method through which innovation in a

region may be encouraged, it may be argued therefore given the congruity between the restrictive/radical definition of innovation by some of the SCR's stakeholders and the literature and characteristics of innovation systems, that for stakeholders defining innovation for growth this is further evidence that a restrictive definition is the most appropriate.

That this view of innovation fits well with innovation systems models is of particular importance given the study's findings that there is an increased strategy and push by stakeholders around the creation of innovation districts, of the type described by Katz and Wagner (2014). As this research has identified, several stakeholders within the SCR actively subscribe to this model and are attempting to encourage the development of such districts, the primary example of which being the region's Advanced Manufacturing Park (AMP). It may be argued therefore that competing definitions held by the region's stakeholders are complicating the development of such systems, due to that such competing definitions have in turn resulted in competing interpretations of what innovation is, which results in competing and conflicting aims and goals with regards to the supporting and development of innovation and the broader economic strategy of the region.

Overall, this section demonstrates another competing definition of innovation, showing that such definitions do have what may be described as having real word impacts regarding how such innovation should be supported and its contribution to regional growth. As such definitions have resulted in competing goals, this hinders the region's ability to come together and formulate a unified innovation strategy, as well as

hindering its ability to develop regional innovation systems. Although open to further research and interpretation, this research believes that there is sufficient evidence in the literature to suggest that for stakeholders defining innovation for growth, due to the broad acceptance that radical innovation is a significantly larger contributor to regional growth than incremental, and that it is innovation systems which are the best method through which to drive such innovators that stakeholders need to be convinced of the benefit that such innovation has on growth, and come together to develop a unified and restrictive definition of innovation.

### 7.4) Conclusion - How Definition Impacts Practice

As has been seen in both of the above sections, significant differences between the definitions of innovation by regional stakeholders exist. These differences in definition mean that stakeholders from within the SCR have differing views of what practically constitutes an innovation, which has a number of significant implications with regards to how such innovation is supported, the perceptions surrounding such types of innovation, how such definitions of innovation relate to the external reality of the SCR, how these definitions fit within innovation systems, and how such types of innovation may contribute to the growth of the SCR. The responses given by stakeholders with regards to how they defined innovation could broadly be split into two categories:

The first type of definition, and the most prevalent within the SCR, was very broad and may be summarised as a business taking action to do something better than it had previously, be that to offer a better product or to adopt a new practice which meant that its internal operations were improved. Ultimately however, this view of whether

something was or was not innovation was dependent upon the perspective of the adopting firm, in that to be considered an innovation, it only had to be something which was considered new to the firm. The implications of this broad definition of innovation is that it heavily relates to innovation as either incremental, the step and minor improvement of processes or products, or adoption, that adopting something new would be considered innovation. While inclusive, it is questionable how much growth is generated from this type of innovation, as demonstrated in the literature, and it fits poorly with the concept of place based innovation systems.

The second type of definition identified was narrow and restrictive, concerning the commercialisation of research or an idea. The implications of the narrow definition of innovation are that it takes a view of innovation which is radical and at the frontiers of new knowledge or technology. As it involved the commercialisation of new knowledge, such definitions mean that there is an emphasis between connections between the region's innovating firms and knowledge creating institutions. Although there is a concern that this type of innovation may be considered elitist and confined to a few businesses and universities, within the SCR this appears to be how most innovation radical innovation takes form. Finally, such innovation is both believed to contribute the most to growth, and fits well within the view of innovation taken in the innovation systems literature. These implications therefore demonstrate that within the region there is a high degree of dimensional complexity with regards to the defining, and therefore supporting of innovation.

In addition, this difficulty associated with defining innovation and its dimensional complexity is one not just limited to the SCR, but also extends further into national institutions. Innovate UK, the government agency with a broad responsibility over aiding innovation in the UK acknowledges the difficulty associated with its definition, and that innovation can mean different things to different people (Innovate UK, 2015). Despite this however, the UK national government has previously used more rigid definitions of innovation, in particular in attempting to classify innovators and non-innovators. One of the most recent examples of this is through the UK Innovation Survey, conducted in 2015 as a method of assessing innovation in the UK. In this instance, the definition of innovation followed that of the EU-wide definition, adopted by Eurostat, a Directorate-General of the EU with the responsibility of the collection and provision of statistical data on an EU scale. The definition here of an "innovation active" firm is an enterprise that engaged in either the introduction of a new or significantly improved product or service, engaged in innovation projects that were incomplete or abandoned, that had developed new and significantly improved forms of organisation, business structures or practices and marketing concepts or strategies, or had invested in areas such as internal R&D, training, the acquisition of external knowledge or machines and equipment linked to innovation activities (BIS, 2016).

As can be seen from these criteria, the definition of what it is to be innovative is both broad, encompassing the introduction of new products, goods, services or processes without specifying "new to who" as well as having some criteria which match the narrower definition of innovation as the development of something new through the commercialisation of new knowledge. This brings three issues to light. First, this

demonstrates that the complexity in defining innovation is one that is not limited to the SCR, and is an issue which is experienced more widely. Secondly given the impacts and consequences associated with different definitions of innovation given above, this further brings into question what impact this lack of clarity of definition may be having on a national scale. Thirdly, as these definitions of innovation encompass both innovations which may be considered to be high and low value in terms of economic impact and development, while the 2015 UK innovation survey appeared to show that the Yorkshire and the Humber region, which encompasses the SCR, had been seen to have undergone significant improvement in terms of businesses being engaged in innovative activity, rising to 65% from 43% in 2013 (BIS, 2015), this brings into question how much of this innovation was radical and therefore of the most value in terms of economic growth. Furthermore, as the narrow view of innovation was one which was considerably less prevalent than open definitions, this also suggests that there is a lack of unification in vision and approach between national and regional support institutions, demonstrating a significant difficulty experienced from this definitional complexity in combination with the multiscalar approach to innovation support.

In addition, as demonstrated by several stakeholders there is an awareness around the concept of innovation districts, something which the region is taking efforts to foster and develop. Due to this, it is argued that if this is the stated goal of the SCR, then steps should be taken to ensure that stakeholders within the region have a definition and perception of innovation that is most in-line with the innovation produced by such a district, in order to ensure that congruent innovation is supported. From the evidence

above therefore it would appear the narrow yet rarer definition adopted by some stakeholders is the most appropriate for supporting the development of such districts.

This section ultimately demonstrates that the issue of definitional complexity as identified in the literature, is also present in practice. This in particular relates to how innovation is supported, as the definition adopted by stakeholders affects their understanding of the concept, and how innovation support is constructed from this. Given the prevalence of the open definition amongst regional stakeholders and a narrow definition amongst those at the national level, this has an implication with regards to the multiscalar support of innovation, given it shows how definitions between institutional scales differs, resulting in practice in the type of support being offered being orientated towards different types of innovation at the national and regional level. This therefore has significant implications for how innovation is supported across multiple scales in practice, as such differing types of support reduces coherency and connectivity between the two scales. As will be demonstrated in chapter 9, this therefore in part relates to why the firms interviewed as part of this study, primarily radical innovators, were significantly more likely to access support at a national level, with the vast minority accessing any regional support mechanisms.

Based on the analysis of the above findings, as well as the literature presented both above and in the literature review, this thesis argues first, that it is necessary for stakeholders to define innovation for growth and to adopt a unified definition, as the literature suggests that not all innovation is created equal with regards to its contribution to economic growth. Furthermore, interviews with stakeholders suggest

that the concept of innovation and the impact that it may have upon a region is poorly understood by some, resulting in some focusing on the end of growth, but not the means of achieving that growth, innovation.

In addition, the findings demonstrate that if it is to be assumed that innovation is of an overall benefit to an economy, and therefore efforts should be made to promote innovation and in particular the types of innovation which contribute to growth the most, and if is is also assumed that it is innovation systems that best contribute to the development of such innovation, points which this study believes it has backed up by evidence presented above and in the literature, then the following may be argued. Because the evidence suggests that the type of innovation that is encompassed by the narrow definition of innovation both fits best with the type of innovation realised by innovation systems, as well as evidence suggesting that this type of radical innovation in isolation contributes the most to economic development, therefore it is this definition which is the best to adopt from a regional growth perspective.

The findings also show that while similarities regarding the difficulty of definition are prevalent at both national and regional scales, that national level support organisations have a much narrower definition of innovation, and in practice support more innovation at a radical level. This highlights the difficulty in supporting innovation across multiple scales, given the misalignment of definition between national and regional institutions, resulting in conflicting aims and incoherent and varied support practices.

In conclusion, this research finds that regional stakeholders within the SCR tend to hold one of two polar views when it comes to defining innovation. The first adopted definition is one that views innovation as a very broad concept, related to doing things better than previously and the adoption of new innovations by the firm. This view of innovation relates to the literature on innovation as incremental process, making minor and step changes to the firm, or as an adoptive process, bringing in new technologies and innovations into the firms which while not innovative in a broad sense may be described as "new to the firm". The literature associated with these types of innovation identifies that such innovation may be described as incremental or adoptive, and is not a significant contributor to economic growth. On the other end of the spectrum, some stakeholders have a highly restrictive and limited view of innovation, broadly being confined to the commercialisation of research or ideas, a definition that relates to the literature on radical and disruptive innovation. The literature suggests that this type of innovation while more risky and less inclusive due to its usage and application of newly acquired or created knowledge, that this type of innovation is believed to have a significantly larger impact on growth. Although some of the interviewed stakeholders have an awareness that innovation is in some regards a spectrum, and as such means different things to different people, most tend to have a definition that broadly relates to one of these two areas. In addition, these views of innovation have numerous implications, some of which actively conflict with one another. Therefore it is argued that a lack of consensus on the definition of innovation results in a lack of clarity with regards to the region's strategy and approach to innovation, ultimately hindering its ability to develop highly networked innovation systems.

The primary contribution of these findings is the demonstration that the problems experienced by academics associated with the complexity of defining innovation, a theme highlighted in the literature review (Tonsberg & Henderson, 2016; Damanpour and Wischnevsky, 2006) are also experienced by stakeholders with implications upon their practice, and that given a split of definitional types between national- and regionally-embedded institutional actors, this represents both difficulty and impact with regards to the supporting of innovation in an multiscalar context. As has been identified, because these definitions of innovation relate to the different typologies of innovation as laid out in the literature review, these different types of innovation have different characteristics, and relate to different types of firm in regard to industry and size, and as a result have different support needs (Acs and Audretsch, 1987). In addition, these different innovation types also make significantly different contributions to growth in the regional economy (Sorescu et al., 2004). Due to these differing support needs and contributions of innovation, a lack of regional consensus regarding it definition therefore impacts upon the development and provision of innovation support to firms within the SCR, as the adopted definition by stakeholders affects what type of innovation they refer to, which then in turn impacts upon how such innovation should be best supported. Because of these difficulties experienced by stakeholders, there exists a lack of clarity regarding how innovation is supported across the region, as well as a broader lack of a clear regional "vision" of innovation. As a result, this exacerbates the already significant difficulties of the SCR in the creation of regional innovation strategies, formulating appropriate innovation support and by extension innovation systems, as covered in greater detail later in chapter 8. Furthermore, given that the prevailing definition within the region is an open one, this

is in conflict with those narrower definitions adopted by national level institutions, presenting difficulties with regards to the support of innovation across multiple scales.

In addition, it should be noted that definitions are not just definitions, the discussion and analysis of which is a purely semantic exercise. Definitions are the foundation from which discussions and judgements are built upon, by stakeholders and academics alike, and while the complexity of defining innovation has long been acknowledged and discussed within the academic sphere (Rammer et al., 2009), little, if any, has looked upon how this may be experienced by stakeholders, and the effect such difficulties may result in. As definitions affect how innovation is understood and perceived by stakeholders, this in turn affects what decisions are made by stakeholders in the region, affecting the support programmes and strategies that are developed. As has been demonstrated, the definitions adopted by stakeholders at both ends of the spectrum have implications with regards to how innovation is perceived, what type of innovation they refer to and the implications of this in terms of the impact these innovation types may have on regional growth and how they are best supported. Because of this lack of clarity of definition in the SCR, however, this hinders the ability of the region to come together in forming a clear and coherent innovation strategy and support structure.

In addition, it is possible to argue these difficulties in definition are either widespread problem experienced by numerous regions, due to these findings relating to the difficulty in defining innovation as expressed in the literature, as well as the above evidence demonstrating that ambiguity of definitions also occurs within national

government (BIS, 2015), albeit to a lesser degree. Alternatively, it may be argued that that regions which have built better innovation systems may have a clearer regional definition on innovation amongst its stakeholders, allowing a clearer strategy and support programme, therefore aiding them in their creation of an innovation system. Although this research accepts that these hypotheses cannot be confirmed with any certainty without the conducting of further research, a necessary limitation associated with the theory building nature of qualitative research (Bryman and Bell, 2011), this research believes that both of these theories are likely to be true. This is because they are not mutually exclusive, in that the difficulties experience by the SCR and in academia in defining innovation for growth are likely to be experienced elsewhere, however areas which do have successful innovation systems may do so in part because of their clarity of definition.

Therefore, this research makes two assertions. First, that regions with a high proportion of stakeholders that adopt a definition of innovation that is restrictive and relates heavily to radical innovation will benefit more from innovation-led growth than regions where a high proportion of stakeholders adopt a broad definition of innovation, which is inclusive of incremental and adoptive innovations. The underpinning of this assertion is that the findings and literature show that definitions relate to innovation types, and that radical innovation is believed to have the most impact in terms of growth, as well as that such definitions having congruity with innovation systems, which are widely considered to be the best way regions can encourage innovation. Secondly, this research asserts that regions where there is a high degree of consensus regarding the definition of innovation, will have better connected and more innovative

innovation systems, than regions which have a low degree of consensus regarding the definition of innovation. The underpinning of this assertion being that as definitions of innovation have implications as to what type of innovation is encompassed by this, and with different types of innovation requiring different needs, having a region with a low degree of consensus will result in stakeholders attempting to support innovation in a disconnected and poorly unified manner, ultimately reducing the coherence of the region's innovation strategy and hindering the development of innovation systems.

## 8) Governance and Innovation Policies, Programmes and Initiatives

### 8.1) Introduction

Having identified issues with the definition of innovation at multiple scales, and the difficulty that this causes with regards to the supporting of innovation and the construction of innovation systems in the previous chapter, next this thesis shall expand upon these issues by looking at governance and innovation policies and initiatives. It shall look at how there exists significant challenges for the localist approach to innovation-led growth, the complexities of the multiscalar approach of innovation support, and issues relating to the size and density issue of innovation networks, as identified as a major theme within the literature review.

This research draws upon two core points with regards to the role of innovation and its place in regional development. First, that innovation, regardless of its many sub-types, definitions, categorisations and differing levels of contribution, is of an overall benefit to innovating firms, an overall benefit to the national economy and particularly to the economy of the region in which those firms are located. This point, this thesis argues, is one that is backed up by the literature to sufficient enough degree to be accepted without significant further investigation, hence it being covered in this thesis's literature review. (Hackler, 2010; Rammer et al., 2009; Stam and Wennberg, 2009). The second point made by this thesis, is that if it is accepted that innovation is of such a benefit to regions, particularly in terms of its contribution towards delivering sustained economic growth, that a prudent and sensible approach would be for the both regional and national government to attempt to support innovation as best as it can. This is a stance that is shared by both national and regional government within the UK

context, with numerous national and regional sources highlighting the importance and role innovation-led growth may have upon a region (Mazzucato et al., 2015; Katz and Wagner, 2014). This therefore presents significant questions regarding how innovation should be supported, what the most effective approach and scale of this may be, and what the implications are of such support occurring at multiple scales and across multiple boundaries.

Related to this, the issue of scale affects regions, their characteristics, their boundaries, their dynamics and their governance (Hildreth and Bailey, 2014; Deas et al., 2013; Rossiser and Price, 2013; Shaw and Robinson, 2012). This in turn, affects how a region may come together to support innovation within it's boundaries, the assets within those boundaries, and indeed whether the boundaries of the region are the best scale at which this may be accomplished. The issue of scale is also one which has a significant bearing on the innovation systems literature, and is a significant arguing point with regards to whether innovation systems are best constructed at a national, regional, sub-regional, local or district levels (Katz and Wagner, 2014; Lundvall, 2004; Nelson, 1993; Freeman, 1987). Due to of these issues concerning the supporting of innovation and the impact of scale on such support, this section focuses upon and draws together the findings related to these issues into three broad areas. First this section looks at the evidence regarding the issues associated with the scale of the innovation systems, how this plays out within the SCR context, as well as how the rescaling of the "region" and its institutions has affected the ability of the SCR to effectively support innovation. Secondly, this thesis shall look at how the SCR attempts to support innovation at a regional level as well as the implications of such

support. Finally, this section will look at what support is offered at a national level, the characteristics of such support, and how this relates to support offered at a regional level. By focusing on these three areas, this section ultimately presents and analyses evidence given by participants around the key question of: what is the most appropriate scale to support both innovation as a system, as well as innovation within individual firms? Furthermore, this section also highlights the complexity of supporting innovation across multiple scales, and in particular the challenges of localism around innovation-led growth. It demonstrates that although devolution towards a more localist approach should, in theory, support innovation system development, in practice it has not within empirical the context of the SCR due to the complexities and challenge of localism for the support of innovation-led growth ,which has actively hindered the development of such a system. Furthermore, it highlights and examines the role of the periphery in the development of innovation systems, and the difficulties associated with creating a RIS which spans both the centre and periphery of a region. Finally, it highlights the difficulties associated with the tradeoff between network density and connectivity as highlighted in the literature review, demonstrating that the SCR has a low density of innovation assets which hinders the development of innovation systems, and that in order to bring in more innovation assets to that network its geographical area would have to be expanded to a point where difficulties in connectivity occur.

**8.2) Issues of Scale and Devolution**

The issue of scale and rescaling is one that has significant impact not only due to its direct impact on how regional boundaries are drawn and the characteristic of the

region itself, but also ties into the broader debate surrounding the scales of innovation systems and the issues associated with this (Katz and Wagner, 2014; Lundvall, 2004; Nelson, 1993; Freeman, 1987). This issue of scale therefore, given the importance of innovation systems in their fostering of innovation, and the importance of scale to innovation systems, is of significant importance in terms of supporting innovation-led growth within a region. This section therefore focuses upon the issue of scale on regions and their ability to support innovation, as well as focusing on the broader issues associated with the scales of innovation systems. First, this section demonstrates how the shift in the literature from "new regionalism" towards city regions (Hildreth and Bailey, 2014; Deas et al., 2013; Rossiser and Price, 2013; Shaw and Robinson, 2012;) draws parallels with both the shift in the innovation systems literature from national towards regional or sub-regional systems (Oh et al., 2016; Lau & Lo, 2015; Katz and Wagner, 2014) as well as how this move towards smaller levels of governance and support has been practically reflected in the context of the UK in its shift from RDAs to LEPs. Secondly, it shall present evidence demonstrating that while this shift should have in theory aided the creation of innovation systems within the SCR, in practice it has made the provision of innovation support and construction of innovation systems less local, more centralised and brings into question the concept of the SCR acting as a functional economic area. Finally, this section argues that a disconnect exists between policy and practice, with policy aiming to devolve power, a move which should have in theory aided the ability of the region to develop innovation systems, but in practice due to numerous factors from a systems and regional perspective this has hindered the ability of the region to act locally as well as its ability to create an innovation system at the level of the region.

One way in which this devolution, while in theory should have helped the development of a regional innovation system and support yet in practice does not, expresses itself, is through an identification by stakeholders, particularly from the region's peripheral areas, that the financial arrangements of LEPs are an issue hindering this. Numerous peripheral stakeholders identified that under the LEPs, due to their comparative lack of funding when compared to their predecessors, that funding was less available for them in order to tackle local issues and provide localised and bespoke innovation support in line with the specific and diverse needs of their sub-region:

> (In) *"the LEP where funding is devolved to the city region, well that is where it is devolved to and it does not go any further. It doesn't get devolved to Barnsley council to solve our own bespoke problems, so the issue we have now is to try and work with 9 other local authorities to develop a catch-all homogenised business support programme which is supposed to meet the needs of everybody, which also looses its bespokeness*(sic) *and unique selling point as well."*
>
> SBAR1

The result of this devolution therefore has been to reduce the financial resources available to institutional stakeholders, particularly in the region's periphery, to act locally, demonstrating a significant disconnect between the government's stated policy of devolving power to increase the ability of regions to act more locally and the reality of how the LEPs are currently functioning. This, in part, supports the view of Pugalis and Shutt (2012) that in some regards the RDA to LEP move, acted as a cost-cutting

mechanism by central government, rather than a sincere move to devolve power and decision making authority. In addition, it is also possible to infer that due to the role of regional institutional stakeholders in innovation systems is to act both as a connector and supporter of innovative activity, that both the reduction and de facto centralisation of the financial support available to them negatively impacts upon this, reducing their ability to act both in a bespoke manner as well as reducing their ability to engage in sizeable innovation support initiatives. This therefore not only hinders the ability of the region to come together as an innovation system but also negatively affects its ability to provide and fund innovation support initiatives, particularly on the region's periphery.

Another implication from this devolution, and this centralisation of funding within Sheffield, is that it has fostered a broader feeling by interviewed stakeholders on the periphery that they are being forgotten by the region's centre. Numerous peripheral stakeholders expressed that often the LEP over focused on Sheffield, meaning that their needs and potential contributions were felt to go unnoticed, breeding a sense of tribalism and resentment by some peripheral regional actors:

> *"From a Chesterfield borough council view, we are acutely aware that we are knocking on their door saying, remember guys we are part of the SCR too. And for example, if you look at their growth hub website, it talks about the SCR, but doesn't say that it encompasses us or Barnsley etc so there's going to be tensions, and there already are tensions between them. And I think that tribalism is going to come out a lot more in the future"*

Although the literature of regional innovation systems, or indeed innovation systems in general, does not go into details concerning the financial arrangement of such systems, all innovation systems stress the importance of connectivity between actors both between and within categories (Andersson et al., 2016; Cano-Kollmann et al., 2016; Lau and Lo, 2015). This from the stakeholder perspective demonstrates a significant disconnect in the SCR between its stakeholders and the component parts of the region due to this perception, and is a factor that significantly hinders the development of a RIS at the LEP scale. In addition, the literature also notes that the institutional stakeholder group of actors is a significant element of the innovation system, given their ability to support innovation as well as to act to create a favourable regulatory and support environment in which innovation can thrive (Abdymanapov et al., 2016; Epifanova et al., 2015). This therefore suggests that regional actors in the institutional stakeholder group need the tools in order to achieve this, which given the role of many such stakeholders requires capital to set up and implement support initiatives. This research accepts that this is not the only method in which regional stakeholders may support innovation, particularly given their potential role as network builders however from the perspective as a SCR as a whole, numerous factors have made this difficult, further hindering their ability to act to create a SCR wide RIS.

These examples therefore demonstrate one way in which while theoretically better, the RDA to LEP move due to both its financial arrangements as well as the centralisation of that finance, in practice has made the provision of support in the SCR less localised,

hindering their ability to create an innovation system on a regional level or to provide support specific to their localities needs. It also presents some evidence that, in terms of regional connectivity between the region's component stakeholders, that there is a distinct perception that the region's periphery is often forgotten about. This therefore also demonstrates an example of how a disconnect exists between the policy and practice, with policy intending the creation of smaller nodes of control, governance and support, something which as identified above should significantly help the support of innovation and development of innovation systems, yet however in practice due to a lack of appropriate financial arrangements and lack of cohesiveness between stakeholders, has actually hindered the ability of the region to support innovation and develop a regional innovation system, while also demonstrating the challenges of localism for innovation led growth.

Another issue that was raised by stakeholders concerned the "critical mass" of innovative firms within the SCR and the overall size and resourcing of the LEP. As identified throughout the innovation systems literature (Katz and Wagner, 2014; Doloreaux and Parto, 2005) dense links between innovating firms, regional stakeholders and knowledge-creating institutions are a necessity in the creation of innovation systems. However, within the SCR several stakeholders expressed a concern that the SCR as an economic area was too small and lacked the critical mass of innovative firms in order to create such a dense network. As one stakeholder expressed:

> *"We've got the potential* (to act as a city region), *but I don't think we have the size or critical mass. We don't have the commitment either, particularly in the public sector. We don't have that size or commitment to go out as SCR openly and honestly"*.
>
> SDON1

This concern was one that was mirrored by numerous stakeholders, who identified that the RDA to LEP devolutionary move not only cut funding and made the provision of innovation support less bespoke, but also reduced the overall number of innovators and innovation assets within its boundaries, therefore reducing the number of innovating firms which may network to form the learning networks essential for the development of the "system" element of an innovation system within these newly drawn boundaries, as well as reducing the overall number of innovation assets within the new regional boundaries. This infers that in the creation of innovation systems and the question of scale, a point may come where there needs to be a trade-off made between size and connectivity. As identified in the literature, larger networks are beneficial due to their potential for the building of the crucial mass of innovating firms which is required for an innovation network, however too large a network also presents its own difficulties, particularly relating to the closeness of learning networks and the difficulty in the transition of tacit knowledge (Brennecke et al., 2018; Ranucci & Souder 2015). These issues and difficulties highlighted by both the literature and interviewed respondents serves as a example of the complexity of supporting innovation at a local level, as well as demonstrating the significant challenges for localism in realising innovation-led

growth, further demonstrating the high degree of complexity involved in determining what scale is best for innovation-led growth.

One of the reasons behind the drawing of the boundaries of the LEPs as they were, as well as a stated benefit of the LEP models over their predecessors by stakeholders, is that unlike the RDAs, the LEP boundaries were believed to represent "functional economic areas" (Hildreth and Bailey, 2014; Deas et al., 2013; Rossiser and Price, 2013; Shaw and Robinson, 2012). This therefore was believed to be a better fit between the regional governing and supporting institutions and the economies in which they operated. However, the issue of the region functioning as such an area, particularly from an innovation system perspective, has been brought into question. As noted by Par (2010), a city region is typically made up of two elements, the dominant city at the centre of the area, described as the C zone, and the territory surrounding it, known as the S zone. In the case of the SCR, the city region has been described as following this model, and is described as weakly mono-centric (The Northern Way, 2009). This thesis, however, asserts that the SCR as a region being considered a functional economic area is one that is questionable from a number of perspectives, particularly with regards to its ability to act as a region, as well as in terms of its innovative activity. Several stakeholders noted that they believed that the SCR, due to the comparative strength of its peripheral region's as well as the the inability of the centre to pull the region together, meant that the argument that the SCR constituted a functional economic area was questionable at best:

*"The SCR is somewhat of an artificial construct because Doncaster when you look at it interacts probably more with Sheffield than anywhere else, but not lots. The SCR being a single* (functional) *economic area is a little more tenuous than it is for a Birmingham, Manchester idea, and there are pros and cons with that. With Manchester you have a mono-centric city region at the heart of it and it works like a circle with a political maturity that kind of gets stuff done. In Leeds and Manchester and Birmingham everyone falls in behind the city. Sheffield wants that to be true here but doesn't realise that it is a poly-centric region and that actually Sheffield and Doncaster are the twin pillars of that. Sheffield will grow more than Doncaster, but Doncaster will outperform a lot of other "brother towns" than in other regions. So its dynamics have a slightly different relationship, which has both challenges and opportunities".*

SDON2

*"If you look at Manchester, you don't see the different regions of Manchester you see Manchester. Leeds is very similar, you see Leeds. Birmingham is Birmingham. Some of the districts are 10-15 miles outside Birmingham, but it is still marketed as Birmingham… if you go to the big international development areas, to go piecemeal is ridiculous. We should go as, bang, The Sheffield City Region, as we are competing against London, Leeds, Birmingham, Manchester, etc. And its no use going with a cheap stand and saying come to Sheffield or Doncaster or wherever, you have to grab the attention of international developers… we have to be far more proactive and act as a region".*

SDON1

These quotes demonstrate that stakeholders located on the region's periphery question whether the SCR is able to work together as a region, as its history suggests that Sheffield has been unable to either connect itself and the region's periphery together into an coherent region or to be economically strong enough a centre to dominate over the region, and pull its periphery into line with its strategy. Furthermore, the question of whether the SCR constitutes a functional economic area is further complicated by the fact that many of its peripheral areas are located within multiple LEPs. Because LEPs were drawn along what was deemed to be functional economic areas, many of the peripheral regions of the SCR such as Doncaster and Chesterfield heavily interact not only with Sheffield, but with either Leeds or Nottingham, these regions were placed not only within the SCR LEP, but also within the LEPs of Leeds and Nottingham respectively. Therefore, this diminishes the argument that the SCR is a single functional economic area, as well as damaging its ability to draw together the region, as its periphery is being drawn towards not just to the core of a single city region, but towards other economic centres as well. These examples therefore present the extreme complexity concerning the support of innovation at these more local scales and suggests that in the multiscalar support spectrum, that in the empirical case of the SCR that these smaller scales are considerably less effective at supporting innovation and the development of innovation systems.

In addition, this research found in its interviewing with the region's innovative firms, that the vast majority of innovative activity, particularly the radical and frontier innovative activity which was identified in the previous chapter is one of the most

significant drivers of growth, was highly concentrated in the narrow geographical area of Sheffield, or in the case of the region's Advanced Manufacturing Park in Rotherham, but at its southern boarder with Sheffield. This research in looking for participants from innovative firms to interview was unable to find any significant concentrations of firms that were engaged in radical innovation that were not located within these two areas. Therefore, it is argued that from the perspective of innovative activity, the region based upon the boundaries of the SCR does not function as a functional economic area. This assertion is also partly evidenced by the breakdown of the city region's devolution deal due to several members preferring a Yorkshire-wide devolution approach rather than that of the city region.

These quotes and evidence therefore demonstrate two factors which highlight the complexity and significant challenges of localism for innovation-led growth, as well as bringing into question whether the SCR is the best scale at which innovation should be supported, particularly through the fostering of an innovation system. First it brings into question whether the SCR acts as a functional economic area in terms of innovative activity, as the majority of its innovative activity is concentrated on the limited area of Sheffield and Rotherham. Secondly, it brings into question the ability of the region's centre, or C zone, to act as the dominant city and to drive the direction of the region. As has been demonstrated, there is significant political tribalism and resentment which exists within peripheral regions of the SCR, as well as that many of these peripheral areas being in two LEPs and therefore not engaging solely with Sheffield. Therefore it is argued that the redrawing of regional boundaries from RDAs to LEPs has devolved power to a political and governance scale that works poorly. As

Quinn (2013) noted, the level of cohesiveness present within regional boundaries can have a direct impact on the success or failure of policy interventions, and as a result, it is important to effectively define what constitutes a functional economic area. Although the SCR may be considered a functional economic area in terms of factors such as travel to work patterns, with regards to its ability to function as a regional innovation system, or indeed function as a region by getting the engagement and buy-in of institutional stakeholders within its peripheral regions in order to act in a cohesive manner, it is not possible to assert this.

In conclusion, this section has presented and analysed findings which demonstrate the significant role that scale plays on the support of innovation, demonstrates the complexity of localism for innovation-led growth and has had a number of implications for the question of at what scale is best to support innovation systems. First, this section demonstrated that there has been a significant shift towards devolution, localism and regionalism. This shift is something which has occurred both in the literature regarding regions and city regions (Hildreth and Bailey, 2014; Rossiser and Price, 2013), as well as being reflected in the literature on innovation systems (Katz and Wagner, 2014; Doloreaux and Parto, 2005), and in a sense practically applied in the UK/SCR context by the devolution of power and decision-making authority from RDA to LEP.

Second, this section presented why this devolution of power to smaller scales should have, at least in theory, helped regions in their efforts to support businesses to innovate, as well as the development of innovation systems. Although there were

numerous mechanisms behind why this should theoretically be the case, broadly they may be summarised as increasing the ability of the region to act locally in a manner to both support innovation in line with the region's specific needs and characteristics as well as removing regionally or locally specific barriers to innovation, and to reduce the scale of the region allowing it to act in a more focused manner. Despite the theoretical benefits of this shift in scales of governance, however, this thesis has presented evidence which demonstrated that this devolution has in practice hindered the ability of the region to act locally to support innovation, increased tribalism and fragmentation between its centre and periphery, as well as causing significant challenges for localism and innovation-led growth.

This research also presented evidence that while power and decision-making authority have been devolved to the city regional level, due to the funding arrangements underpinning this move the region's sub-components are less able to support innovation and act locally in a number of ways. First, stakeholders note that in comparison to the RDAs, LEPs have less financial resources available to them, even when the new scale of governance is taken into account. The result of this is that while previously the RDA was able to devolve funding not just to the SCR, but the smaller localities within it, such localities were able to act in a more localised and bespoke way in order to support innovation within its boundaries. Stakeholders, however, identify that because of to this lack of funding, and its devolution to the SCR, that this money tends to remain within the control of the SCR, meaning that as opposed to the development of innovation support programmes on a more localised scale, now such programmes have to be "catch-alls", which encompasses the entire city region and thus

reducing the bespoke nature of the support offered. This, given the diverseness of the SCR's periphery due the path dependencies of those localities resulting in peripheral areas with significantly different economic characteristics, specialisms and needs, means that such approaches are less effective. These points therefore demonstrate that while in theory devolution of power and decision-making authority should help regions and localities to promote and support innovation, this is only possible if they also have the financial resource to act and provide these localised and bespoke innovation support programmes (Pugalis and Shutt, 2012), as well as highlighting difficulties experienced by the SCR due to its diverse periphery.

This section also demonstrated that the significant difficulties caused due to the nature of the region's periphery. Related to the financial point above, there is a sense amongst regional stakeholders in peripheral area, that the region's centre and LEP often "forgets" about the region's periphery and by extension both its needs and potential contributions to the economy of the SCR. As such, stakeholders believe that constant and sustained efforts are required in order to ensure that their area is considered. This has contributed to a sense of political tribalism within the SCR, hindering the ability of the region to function as a single coherent unit, which given the importance of the development of learning networks between stakeholders within a region (Moschitz et al., 2015; Lundvall, 2004; Hargadon, 2002) brings into question the ability of the SCR to function as an innovation system, and combined with the hindered ability of the region's periphery to support innovation locally, the ability of the region to develop a smaller LIS on its periphery. This connectivity issue is one that is further complicated by the fact that many of the region's peripheral areas are also within two LEPs,

meaning that they are pulled away from the region's centre of Sheffield, towards the centre of their second LEP, further fragmenting the already poorly connected SCR.

Another significant finding with regards to the scale of innovation support, and one which related heavily back to the literature on innovation systems, was that there was a concern by stakeholders that the SCR lacked the size and a necessary "critical mass" of economic assets to work effectively, with numerous implications. Some stakeholders expressed a belief that because of the smaller size of the SCR, combined with its disconnected periphery, as highlighted in greater detail below, the region did not have the size or the necessary unity to act as a city region, instead acting as a collection of localities, thus hindering its ability to bid for development funding and opportunities. This therefore, it was highlighted, put the SCR at a significant disadvantage when competing against other more unified and therefore sizeable regions such as Leeds/ Bradford and Manchester. While this is a significant concern in and of itself, this concern also has significant implications regarding the creation of innovation systems. As has been identified in the literature review, one of the most significant components of innovation systems, regardless of scale, is their connectivity between its triple helix of actors and institutions and the subsequent development of a learning network (Etzkowitz & Ranga, 2015; Moschitz et al., 2015; Hargadon, 2002). However, while the density of connections and networks is a significant driver in the construction and effectiveness of innovation networks, the number of innovative actors within that network also directly affects how many potential connections and networks are available to develop. This means that in terms of innovation networks, a critical mass of actors is required, as too small a pool of actors and innovative firms prevents the

development of the dense, interactive learning networks essential for the development of innovation systems. As this thesis has also highlighted in the literature review, however, if the scale at which networks are formed is too large from a geographical perspective, this also hinders the development of innovation due to the associated difficulty in the transition of tacit knowledge (Ranucci & Souder 2015). This thus demonstrates that a trade-off exists between smaller but more highly connected innovation systems and larger but less well connected systems. As the geographical size of the network increases along with the size of the network in terms of its actors, its connectivity is believed to decrease due to these difficulties. It is therefore argued that it is necessary to find scales of innovation systems and supporting institutions which strike a balance between these two opposing forces, rather than advocating that one particular scale is more effective than another, demonstrating that a consideration of the multiscalar approach towards innovation support is necessary. This finding therefore demonstrates the significant challenges presented with regards to localism for innovation-led growth as well as bringing into question whether local scale is best at which to support innovation within the empirical context of the SCR. This is further complicated by the fact that, as gone into greater detail in the next chapter, that the periphery of the SCR lacks significant networks of radically innovating firms. Therefore, in terms of using innovation as a tool for regional growth, this brings into question whether the focus on the region's centre of Sheffield, and its networks of radically innovating firms is pragmatically the best approach for supporting innovation and therefore innovation-led growth. These findings therefore raise further significant questions concerning at what scale is the most appropriate to support innovation, as well as demonstrating the significant challenges faced by localism in the attempt to

realise innovation-led growth. Therefore, based on the above evidence, the SCR is unable to function as an innovation system based upon the boundaries drawn upon it as a LEP, as well as demonstrating significant difficulties and complexities associated with the issue of scale regarding its relation to the support of innovation and the development of innovation systems.

**8.3) Policy and Support in the SCR**

Having looked at the issue of scale and how this affects innovation support from a primarily systems perspective, the below section shall present and analyse the evidence regarding how innovation is supported in the SCR both at a national and regional level, examining the role that regionally based actors and institutions may play in supporting innovation, and the implications of this from both the perspective of the SCR as well as the broader implications for research.

One of the major findings when interviewing stakeholders regarding how innovation was supported in the region was that the region's innovation offering was incoherent, and innovation specific support initiatives were difficult to identify. Related to the difficulties associated with defining innovation, some stakeholders were able to point to generic business support that was offered in the region, however they were uncertain whether such support counted specifically as "innovation support":

> *"I suppose there is some public sector funding, public sector based schemes, Regional growth fund etc, but is that innovation? Sometimes it is, sometimes it isn't".*

SSHE4

This reinforces findings from the previous chapter that innovation, through being poorly defined and understood by participants, presents significant complexities and impacts upon the development of innovation support, as stakeholders are unsure of what support they offer constitutes innovation specific support. This has further contributed to an overall lack of coherency of innovation support offered by the region. In addition to this, innovation support identified by stakeholders, or alternatively support programmes that encompassed innovation tended to be piecemeal, and not offered consistently at a regional level. Instead, innovation support identified by stakeholders tended to be provided by a subdivision of the local authority of that region. Stakeholders therefore identified a range of programmes that they considered to encompass innovation support, however were limited to businesses from within their immediate area:

*"In terms of supporting businesses, we do do a lot of innovation through a project called enterprising Barnsley. On that we have a pool of consultants some of whom can be deemed specialist consultants in innovation."*

SBAR1

*"What we have is, we will be moving into a new project which is called start and grow, which is aimed at high growth start ups, of which a high percentage will be innovative."*

SROT2

This helps to demonstrate the complex and somewhat incoherent nature of innovation support in the SCR. Stakeholders, both through having an unclear view of what innovation is, and therefore by extension what support offered to firms constituted innovation support, as well as that access to innovation support is largely based on which local authority that the firm is located within, highlights the lack of a singular coherent innovation support programme or strategy within the SCR as well as demonstrating that there is a lack of the clear vision of innovation and development required for the facilitation of innovation systems (Katz and Wagner, 2014). Although this research accepts that some cross region innovation support is available, through institutions such as the LEP, the Regional Growth Hub, as well as support offered by the region's universities, these appear to be the only significant examples of cross regional innovation support that the region has to offer. Therefore, access to this innovation support in the SCR was not standardised, and the support available to firms varied depending on their location in the region.

Another significant finding of this research was that stakeholders appeared to have a significant focus, not on innovation, but on growth. One part of the reasoning behind this, beside the previous points considering issues surrounding definitions of innovation, relates to differing goals between firms and regional stakeholders and institutions. Institutional stakeholders, particularly those in elected positions, tended to have a broad responsibility for the economic development and support over their area, as opposed to being focused on innovation solely. As such, their overall goal is often the growth of the region, meaning that their attention is focused upon metrics such as

employment, new startup rates or GVA. Innovation however, due to its being a concept that is highly difficult to measure (Rammer et al., 2009), receives less attention as it is an area in which it is considerably more difficult to quantify successes. As a result, stakeholders attention is drawn away from innovation and focuses upon growth, and resulting from this innovation support tends to be badged as growth or is a small part of a broader growth support programme:

> *"I don't think we badge it as innovation and that's the challenge. Everything we do has that growth label stuck to it… Through other programs and services we offer there are parts of that that are wrapped up in innovation but we just wouldn't call it that… For me it's networking and making contacts, I don't call it innovation even if that's what probably stems from it."*
>
> SDON2

One implication of this is that innovators focus upon the end of growth, rather than the means of which this may be achieved. As such, this both underlines the issues associated with the defining of innovation and their impact on support, and in particular demonstrates issues with regards to stakeholders understanding of the economic benefits that innovation can provide. From a theoretical perspective, it also adds to our knowledge of multiscalar innovation systems by adding the dimension of stakeholder goals and accountability, by demonstrating the focus of local stakeholders upon local growth, whereas more innovation specific support is available at national levels. As stakeholders at the regional level are measured primarily by metrics associated with regional growth, it is for this reason that growth rather than innovation

is given the prime focus, in part also explaining the lack of regionally available innovation support. This thesis argues therefore that it is necessary when attempting to construct innovation systems and innovation support that an appropriate performance metric is required when measuring stakeholder performance.

Another significant implication of the finding that there is a focus on growth and not innovation by stakeholders, is that innovation support in the region is geared towards businesses who are at the less innovative end of the spectrum, or indeed may not consider themselves to be innovative at all. It is partly for this reason that several stakeholders noted that they were reluctant to even use the term innovation in advertising their support offering, in fear that it would make businesses believe that such support would not be appropriate for them:

> *"In some way, shape or form it (innovation) seems to have become a bit of a dirty word, and so we try to avoid it… And I certainly see that from the SME business community,… they may be doing innovative stuff without knowing they are innovating, but you mention the word and it turns them off. That's why we badge our support as growth, not innovation".*
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> SDON2

Related to this, stakeholders noted that many firms that they approached and supported, although innovating in the adoptive or incremental definition of innovation, did not typically view themselves as innovative:

*"I think people (I support) are always innovating, what I think is that people don't realise that they are innovating in what they are doing"*

SROT2

This therefore has significant implications for how local and regional officials are attempting to support innovation-led growth in the region. As identified, both in the previous chapter and the literature review, in terms of their comparative contribution to regional development, innovations are not of equal value (Sorescu et al., 2004; Blundell et al., 1999). While all innovation is believed to have some value, in terms of its contribution to regional growth, radical innovations at the frontiers of their area were shown to contribute to a significantly greater degree than incremental and adoptive innovations (Sorescu et al., 2004). This therefore demonstrates that as regional stakeholders and the support they offer is targeted towards firms at the less innovative end of the spectrum, that they are by extension targeting innovation that is less impactful. In addition, this evidence has further implications for not just innovation support in isolation, but also regarding the development of innovation systems. As noted by Katz and Wagner (2014), in their assessment of practitioners elections on how Innovation Districts are created in practice, a key step in order to achieve this is to set a clear vision for growth. This vision is necessary at it "provides actionable guidance for how an innovation district should grow and develop in the short-, medium- and long-term along economic, physical, and social dimensions" (p15). This approach has been used with success in several cities in attempting to foster innovation districts, including Barcelona, St Louis and Stockholm, and although referring specifically to innovation districts, the need to set a clear vision

may equally be applied to the larger scale of regions wishing to develop innovation systems. As the evidence demonstrates, a lack of consensus and understanding regarding the definition of innovation has resulted in a system of innovation support that is incoherent, varied and in some cases supports innovation which is of a type that contributes poorly to economic growth. This therefore in turn demonstrates that the region has an incoherent and varied view of innovation, and therefore innovation support, which in turn is affecting the ability of the region to come together to form an innovation system. In summation, if stakeholders are unable to adopt a clear view on what innovation is, and by extension how it is supported, it is not possible for regional institutions to forward a clear vision of innovation, therefore hindering the development of a regional innovation system or district. Both of these findings demonstrate how the definition of innovation adopted by stakeholders has a practical and potentially negative impact both in terms of potentially supporting types of innovation which poorly contribute to growth, as well as the ability of a region or locality to work to foster and develop innovation systems, further supporting the assertions made in the preceding results chapter.

The finding that the type of support offered by the region was of greater value for businesses on the less innovative end of the spectrum was also corroborated in part by the findings that many of the firms interviewed as part of this study, which were located on this radical end of the innovation spectrum, were unable to identify any innovation specific support which they had received from the region:

*“We had the UK level grant for the (confidential) but as far as I'm aware that’s it, nothing regional.*

FSHA3

*"I don’t think there has been anything regional. We certainly haven't applied for regional funding since I've been there”.*

FSSH4

*“No we haven't had anything regional. No regional funds, it’s all been national funds.”*

FROH1

These findings, as well as demonstrating that radically innovating firms do not appear to uptake innovation support offered by regional institutions, also demonstrates that there is a focus by regional firms on the financial element of support. Although it may be argued that all firms may benefit from financial support, in the case of radically innovating firms this may be of particular benefit, as due to the risky nature of this innovation type access to grants and funding allows them to de-risk their innovation process. If talking about innovation support received by radically innovative firms, the most common form that this took was through grants and funding, sometimes as an individual firm or through a KTP engagement, and usually supported by Innovate UK. Innovate UK is the UK’s innovation agency, acting as a non-departmental public body, supported by the department for Business, Energy & Industrial Strategy (BIS) (Innovate UK, 2017). As can be seen from their stated responsibilities: to determine

which science and technology developments will drive future economic growth, fund the strongest opportunities and connect innovators with the right partners they need to succeed, Innovate UK in many regards adequately fulfils the support needs of radically innovative frontier firms, identifying with those most likely to drive future economic growth, and supporting them through both the funding of their innovation projects and facilitating connections between innovators. Due to this, it appears that one reason that the region's most radically innovating firms do not heavily engage with the region is because their needs are already adequately met at a national level. This therefore bring into question the role of regional institutions in supporting innovation-led growth, at least in a direct manner, while also contributing to theory by suggesting that a preference of radically innovating firms in terms of support is primarily funding related, as well as highlighting the complexity of the provision of innovation support across multiple scales.

It may be questioned whether if such support currently located at a national level were devolved to a regional or sub-regional one, whether this would provide added benefit or value to the supporting of radical innovators greater than the benefits currently realised. This thesis argues that although it supports both the benefits of the innovation systems concept, and the benefits of geographical proximity of actors due to the difficulty of transmitting tacit knowledge (Tan, 2018; Ranucci & Souder, 2015), due to a number of factors devolution of this aspect of support is unlikely to generate additional benefits. One factor behind this assertion relates to the issues of definition. As the SCR has both a ill-defined view of innovation, as well as one that appears to favour the support of incremental and diffusion innovation, it is argued that devolving

such functions to regional actors who hold such broad views of definition means that funds and efforts which would normally be directed towards a relatively narrow and defined group of radical innovators, would instead be more open and include innovators on the incremental end of the spectrum, reducing the level and effectiveness of support available to radical innovators. In addition, although the literature while acknowledging the merits of firms and knowledge-creating institutions being grouped together in geographical proximity to one another in order to increase tacit knowledge transmission (Katz and Wagner, 2014; Martin and Simmie, 2008; Johnson et al., 2002), there is little reference in the literature on innovation systems that looks at whether having institutions that provide grants to such firms being located geographically close to the firms that they support provides any additional benefit. Although Katz and Wagner (2014) highlight the importance of "Innovation Cultivators" in the construction of innovation systems, something which Innovate UK may broadly considered to be, the assets stated do not tend to related to the grant or funding elements of Innovate UK, nor is there mention of the benefits of the location of private sector funding organisations such as venture capital firms, close to innovators. In addition, the SCR growth hub also in part covers the funding of innovation at a regional level, and although covered in greater detail later in the chapter, is able to act to help fund innovative firms within the region. This demonstrates therefore that the literature is far from clear with regards to whether the relocation of funding bodies close to innovators provides any additional benefits to the construction of innovation systems.

Finally, having such support provided at the national level does provide several benefits to radically innovative firms within the SCR, which would be severely hindered if it were devolved to a regional level. As one of the stated responsibilities of Innovate UK is to "connect innovators with the right partners they need to succeed" (Innovate UK, 2017). As well as the financial element of support provided by Innovate UK, this is another element that is deemed to be of significant value by innovators, as it allows the transfer of knowledge and expertise, helping firms to innovate, spread risker innovations across multiple partners and to pursue opportunities which they would be unable to as a singular firm. While not wishing to understate the importance of regional interaction and collaboration, particularly with regards to the creation of spatially bound innovation systems, this thesis asserts that in some instances the best partners for radically innovating firms may be located outside of the region, or even in some cases no suitable partners may exist within the region. This is, to a degree, an issue currently experienced by radical innovators who due to their highly specialised nature and knowledge requirements often have difficulty in finding regionally based partners to assist with their innovation processes, forcing them to look nationally or internationally:

> *"No within Sheffield there's not that much here really. Because it's such specialist area, you need to look further afield to find the people that are related to you, and although there are pockets of people within Sheffield, they are people we have known previously".*
>
> FSSH6

*"The short answer is that while we do network within Sheffield because the area we are in is a global market, so networking doesn't stop there. None of our partners are in Sheffield or even the region because there's no one here appropriate to partner with".*

FSSH4

This demonstrates that although there is certainly benefit in encouraging radically innovating firms to collaborate with other firms located within the region, there is also a benefit and in some cases necessity to work with external firms, something which is currently supported adequately by Innovate UK, and sits well within the national level of support. Therefore, it may also be argued that a separate institution at the regional level would be best placed in order to encourage regional interaction and collaboration with partners, as opposed to the devolution of existing institutions. As such it may be argued that if the role of regional institutional stakeholders in supporting innovation through direct methods is of questionable impact, that instead taking on the role of a system builder and node of connectivity would be a superior approach for stakeholders wishing to encourage innovation-led growth. These factors therefore demonstrate the need and benefit for national level innovation support, as well as the role and place of regional institutional stakeholders in supporting innovation within their locality, and the sometime complementary if complex nature of multiscalar support institutions.

In addition to the finding that innovative firms on the radical end of the spectrum not take up or engage with regional support initiatives, some evidence suggests that this is not only because regional innovation support does not match their needs, but instead

that there's is little the region can do to support them in a direct manner. Several stakeholders when queried about what support they would like the region to provide, or feel that they would benefit from, were unable to point to anything specifically that they believed the region could do to support them:

> *"Maybe there's things we aren't doing like innovating in marketing or in other business areas. But I think for us innovation is what we are about and I'm not saying we can't get better at it but it's what we are. I mean the function of this company is to create IP that has commercial value".*
>
> FSHA6

> *"That's a difficult one. My answer to that would be different depending on what stage the company is at. But now, probably not… We are self-sufficient now".*
>
> FSSH6

> *"At a regional level? No, I cant think of anything that they could do that would help us in any meaningful or substantive way".*
>
> FSHA5

These findings have significant implications regarding the role played and value added by regional stakeholders when it comes to innovation support, and suggests that within the multiscalar system of innovation support that radical innovators are best supported by national institutions. As has been seen by both the above examples and other findings of this chapter, due to a number of factors stakeholders within the SCR have a

view towards innovation which is unclear, fragmented, supports innovation types which contribute poorly to economic growth, and is not accessed by radically innovating regional firms, brining into question the value of regionally-led and direct innovation support offered by regional stakeholders, with a view of creating innovation-led growth. This finding also adds to the literature around innovation systems, and the role the institutional stakeholder plays within them. As identified in the previous chapter, all innovation systems concepts have as a point of commonality, a belief that dense interaction between actors within the system is essential for its development (Katz and Wagner, 2014). In addition to this, however, a second yet related point of commonality is that all systems focus on three broad categories of actor, the firm, the knowledge-creating institution and the regional, national or local institutional stakeholder, the so called "triple helix". This finding further develops our understanding of the role that the regional stakeholder may play in the supporting of innovation for growth. It demonstrates, that instead of attempting to support innovation through direct programmes, an approach which appears to target the less innovative and less impactful types of innovation (Keizer and Halman, 2007), that instead a more effective approach for regional stakeholders would be to work to build the system aspect of innovation rather than individualised support. In the case of the SCR, this standpoint is backed by evidence which demonstrates that there is a significant desire by radical and frontier innovators to interact and work with other firms within the region, an essential component of innovation systems (Freeman, 2002; Asheim and Coenen, 2005), however due to a lack of networking and what may be termed "regional awareness", this desire goes unrealised:

*"we don't network locally as much as we should. I would like for us to do that more. I think there would be significant value for certainly us and others knowing what capabilities there are with each other".*

FROA4

*"I guess I think communication is the thing we would like more of, and making people aware of what opportunities there are in the region. The MD club is a prime example I guess where information like that could be disseminated… if there are bits of support for collaborative projects in the region."*

FSSH3

This therefore demonstrates that while the SCR has many of the components and innovation assets required for an innovation system, it lacks this connectivity as well as density or "critical mass" across the region as a whole. As identified by Katz and Wagner (2014), regional institutions may play a significant role in building this element through acting as both anchoring institutions, nodes of connectivity within the region, and also setting and contributing towards a clear vision of growth. Therefore, this research argues that the evidence demonstrates that regional institutions need to shift focus away from acting as providers of innovation support and instead work as innovation system builders. As has been seen, radical and frontier innovators who contribute most to innovation led growth (Keizer and Halman, 2007) do not appear to require the generic innovation support offered by regional institutions, instead valuing financial support and connectivity between themselves and potential partners. As the financial aspect of this support is already well covered by national level institutions,

this highlights the role that the region's institutions can play to build such connections and interactivity between firms within their jurisdiction. This both works to support innovation of a type which contributes the most to innovation led growth as well as building an innovation system which is broadly agreed as one of the best methods of increasing innovation rates in a locality (Katz and Wagner, 2014; Asheim and Coenen, 2005). This section therefore further adds to our knowledge concerning specifically the role and contribution that may be made by regional stakeholders, particularly from the innovation systems perspective.

Due to the above factors, in that there is a focus on growth over innovation, that support which is offered tends to avoid the use of the term innovation where possible and that support offered while encompassing elements of innovation is not innovation specific, this has lead several stakeholders to assert that the SCR does not have a specific innovation support offering:

> *"I don't think there are any regional innovation policies, and maybe that is a gap that we've got. There aren't any major programmes that I'm aware of that just target innovation. There are various things like innovation vouchers etc but they are fairly small scale and national. So in terms of business growth there is a more generic business growth agenda and enterprise growth agenda which probably takes you into some forms of innovation, but I don't think we have any industrial scale innovation support policies"*
>
> SSHE2

This, in combination with the previous section demonstrating the significant issues around at what scale innovation systems should be constructed tying together both the issue of innovation support, innovation systems and the scale of both. That no regional innovation offering has developed at a regional level brings into question the "buy-in" from regional actors into the concept of the SCR as a region. Despite this somewhat negative picture painted above in terms of innovation support and the creation of innovation systems, however, the SCR, and in particular Sheffield and Rotherham, has a strong portfolio of innovation assets. One major innovation asset of the region is its two universities, The University of Sheffield and Sheffield Hallam University. Although covered in greater detail later, while there is a overall lack of connectivity between the innovative firms within the region, as well as between innovating firms and regional institutional stakeholders, the regions' two Universities interact heavily with the region's firms through initiatives such as KTPs, the sponsorship of PhD students etc, and act both as the knowledge-creating institutions essential for the development of innovation systems (Katz and Wagner, 2014; Asheim and Coenen, 2005; Freeman, 2002) as well as acting as points of connectivity for the region:

> *"Sheffield University has a fabulous tribology department, we know the people there very well, but they aren't doing many seal faces. So we tend to use the universities more for investigative work, where we've got things that perhaps we don't understand that well. So perhaps we've got some new materials that fail and we don't know why, and we don't know why it does so we will ask them to do some testing for us."*
>
> FROA1

*"We were involved in a KTP, a knowledge transfer partnership with the University of Sheffield two or three years ago."*

FSHA2

*"We are doing one project, the largest innovation project we have ever done has started last year in July. And in there we have Rolls Royce, the University of Sheffield, Sheffield Hallam University, and the AMRC, TWI and ourselves, so it's the largest partnership I've ever been a part of. And its a project of £5million pounds, for 2 and a half years, and the aim is innovate and do something new that no one has ever done before".*

FSHA5

In addition, located between Rotherham and Sheffield the region is home to the areas Advanced Manufacturing Park (AMP), a significant cluster of research-led advanced manufacturers. Based within the one of the SCR's enterprise zones, the site is home to a number of leading innovators including such examples as Rolls Royce and Boing (Sheffield Enterprise Zone, 2017). In addition, the AMP shares many of the characteristics associated with the innovation districts concept, being built around the anchoring institutions, The University of Sheffield's Advanced Manufacturing Research Centre (AMRC) and Boeing. It should be noted, that although innovation districts are typically built within core cities, advanced manufacturing is a notable exception, given its specific needs with regards to the large specialised spaces required for manufacturing, and therefore is the only type of innovation district that is typically

located outside of a city (Katz and Wagner, 2014). In addition to this, the region has access and some regional innovation support through the SCR growth hub, which provides innovation support in the region, however this is done primarily through interactions with the region's universities through the RISE and the Sheffield Innovation Programmes (SCR Growth Hub, 2017).

Despite these significant innovation assets, however, it must be noted that these are confined to the core city of Sheffield, and in the case of the AMP just outside it. The description of peripheral regions as put forward by Tödtling & Trippl (2005), drawing attention to such characteristics as a dominance of SMEs within the region and that "peripheral regions are regarded as less innovative… they have less R&D intensity and lower shares of product innovations. Innovation here is more focused on incremental and process innovations" (p1208), one which has a high level of congruity with the peripheral region's of the SCR. This characteristic is also further backed up by this research's finding that firms interviewed as part of this study that were considered to be radical innovators were clustered either around Sheffield, or at the AMP.

Therefore, the SCR has many of the innovation assets required for the formation of an innovation system. This thesis argues however, that these resources are primarily located within the region's core due to it being home to both of the region's two universities and the majority of radically innovating firms. In contrast to the perspective of innovation assets, the region's periphery adds little in terms of innovation assets, with the periphery containing a high proportion of SMEs and non-innovating or incrementally or adoptively innovating firms (Tödtling & Trippl, 2005).

This therefore begs the question of whether the SCR should, instead of focusing on the formation of a RIS and the support of less impactful innovation in the region's periphery, instead be focusing on building and developing upon existing resources within the centre, in order to bring such assets together in a local innovation system, or innovation district. This thesis argues, that due to the difficulties expressed previously in this chapter around the issue of creating a connected SCR, difficulties in getting the engagement of local stakeholders from the periphery, as well as the literature that demonstrates the significant difficulty in fostering innovation systems in peripheral areas (Brown, 2016; Doloreux & Dionne, 2008) that the SCR should instead focus upon building on these existing innovation assets in the core city to develop local innovation systems and build on existing innovation districts as opposed to attempting to draw in the peripheral regions to create a region wide RIS.

This thesis therefore argues the scale of the core city is the most appropriate regional scale at which innovation should be supported, particularly with regards to innovation for growth. Additionally, such an approach, by strengthening the economic strength of the core of the region may also help overcome or in part counter the draw of other cities on the region's already fragmented periphery. In addition, this research also argues that in order to help support this development, stakeholders within the region need to move towards acting as connectors, drawing these regional assets together. As has been identified, the SCR has a number of innovation assets, however in many regards it is still fragmented, and these assets are poorly connected from an innovation systems perspective. As this thesis has demonstrated, the main point of connectivity within the region is between the region's universities and firms, however regional

innovating firms have little interactivity with each other and with regional stakeholders. Therefore, in order to develop an innovation system, regional institutional stakeholders need to move away from providing incoherent and varied direct innovation support, and instead adopt a clear vision of innovation and the region's development, acting as a system builder to forge links between these innovation assets, and to support an innovation system which in turn supports innovation that contributes the most significantly to economic growth.

### 8.4) Conclusion - The Challenge of Localism for Innovation Led Growth

In conclusion, this research first laid out that a move has occurred in two streams of literature, regions and innovation systems, away from centralised control of power and decision making authority, towards devolution to smaller regional and sub-regional scales. This move has also been reflected in the move from RDA to LEP, one that should have in theory have helped the development of innovation systems through a variety of methods. In practice, however, this research has demonstrated that this has not been the case within the SCR and due to a number of factors has actually made it more difficult for the region, and particularly its periphery, to support innovation in a bespoke manner that meets its needs. The underpinning of this chapter therefore is the theme identified within the literature that demonstrates that the drawing of boundaries is difficult, particularly with regard to the construction of innovation system, and that a trade-off exists between network density, size and connectivity.

This research also contributes to the literature on innovation systems and scale by examining the potential role of the periphery in innovation systems. As this thesis has

identified, the region's centre and periphery, also known as the C and S zones (Parr 2008) of the SCR are highly disconnected, and due to a number of complex historical and economic factors, brining the two together presents significant difficulties. This therefore leads us to argue that currently it is not possible to argue that a RIS exists at the scale of the SCR, nor is it likely that one may be created in the immediate future. This is further backed up by our findings that practically all of the region's strongest innovation assets are located within the centre of the region, brining into question the value of the periphery of the SCR from an innovation systems perspective in its ability to drive innovation-led growth. Given the difficulties present in bringing the region together at the level of the SCR, both generally and as well as from an innovation systems perspective, this research argues that instead central regions should focus upon strengthening their existing innovation assets by both setting a clear vision for growth, and acting to increase connectivity between actors at this scale. By building these networks, as well as the critical mass of innovative firms, it is argued that the strength of the centre will build, helping to pull in the region's periphery behind it, while the periphery also benefits from positive spillover effects.

Also highlighted was the disconnect between the centre and the periphery of the SCR. Due to political tribalism between institutional actors, the draw of other strong economic centres such as Leeds, and a belief that the centre of the SCR ignores its periphery, several stakeholders expressed a belief that the SCR does not perform as a functional economic area, as was intended by the RDA to LEP move. From an innovation systems perspective, this stance is supported by the fact that there is a high level of disconnect between the region's innovation assets, as well as that there appears

to be little interaction with firms in the SCR and its periphery. Another issue cited by regional stakeholders concerned the "critical mass" of the region. Several stakeholders have asserted that the region, because of its disconnected nature means that it is too small, and does not have the critical mass required for either a regional innovation system, or to challenge neighbouring economies. This therefore presents significant issues regarding the challenge of localism for innovation-led growth, in the a larger region due to the increased geographical size from an innovation systems perspective is problematic as a result of the difficulties associated with the transition of tacit knowledge. Conversely, the issue of critical mass is one of importance for the creation of innovation systems, as a limited number of actors and innovation assets limits the level of interactivity and the development of learning networks required for an innovation system. In the case of the SCR, this also adds another dimension of complexity, as while the core city of Sheffield has a number of innovation assets, as well as what may be described as an innovation district in the form of the AMP, the region's periphery does not have significant innovation assets, particularly from the view of radical and frontier innovators who contribute most significantly to innovation-led regional growth. This means therefore that from an innovation systems perspective, the periphery of the SCR is of limited value, and therefore that if the SCR were to wish to scale up its innovation system to increase its critical mass, this would have to be beyond its boundaries of the SCR. This therefore leads this thesis to argue that a trade-off may have to be made between the size of innovation networks, and their connectivity, and that when looking at the multiscalar approach to innovation support, it is necessary to take into account the broader nature and context of the region, rather than advocating for one scale over that of another. Because of this, this

research argues that given how significantly the SCR would have to expand the scale of its innovation system to bring in additional economic assets, that the best scale at which to innovation support is not the region, but at the scale of either the district or core city.

This research contributes to the literature by further examining and expanding upon the role that may be played by regional stakeholders in supporting innovation, and highlighting difficulties with this component of the multiscalar approach to innovation systems and support. As has been seen, currently due to the issues of definition, regional stakeholders have a view of innovation which is highly accepting of incremental and adoptive innovation, an area which has low growth potential for the region. Due to of this, regional support is based around this, and is targeted towards businesses who would not be typically considered innovative. This is further backed by the fact that many radically innovating businesses also do not uptake innovation support offered at a regional or sub-regional level, instead preferring national support and its role as a financial supporter and networker, adding knowledge regarding the type of support preferred by radical innovators, and suggesting that these needs are best met at a national rather than a regional scale. In addition, this research has demonstrated that despite the negative picture painted by the above evidence, the region has a good portfolio of innovation assets, through both its universities, growth hub and the region's AMP, however the region and its assets suffer from a lack of connectivity. This research argues therefore, that for stakeholders wishing to benefit from innovation-led growth in their region, that given the ineffectiveness and incoherence of direct innovation support, in conjunction with the fact such support

does not support innovation that is the most conducive for growth, that regions and localities may best assist innovation through the facilitation of learning networks and innovation systems, as opposed to the provision of generic innovation support.

In conclusion, the above evidence demonstrates that innovation support in the SCR is both highly complex and incoherent, and is something that is made more complex owing to the multiscalar levels of support. It argues that the best scale at which innovation should be supported at a sub-national level and within the empirical context of the SCR is at the city or district level, due to these areas being the concentrated area. It also argues that regional stakeholders should instead of working to support innovation through direct means, a method which appears to be ineffective given a lack of regional engagement by radical innovators, and instead act both as anchor institutions and as network builders, by setting both a clear definition of innovation and vision for growth, and making efforts to increase the connectivity of innovating actors within the region, a method which appears to be most valued by regional frontier innovators. Most importantly however, it demonstrates that there are significant difficulties in the localist support of innovation, and suggests that with regards to the scales of such networks, it is necessary to take into account better the multiscalar approach of innovation support, and rather than advocating for a specific scale of devolution, that the issues concerning network density and connectivity be also taken into account in order to create regional scales that are best placed to support innovation, rather than adopting a static viewpoint that a certain scale is superior than others.

## 9) Practice and Realities of Innovation

### 9.1) Introduction

In contrast to the regional institutional perspectives on innovation looked at in the chapters above, this section focuses upon how innovation is carried out in the SCR in practice by interviewed firms, how this relates to the literature, particularly with regards to innovation systems and path dependency, and the implications of these findings. In addition, it also links these back to the previous chapters in order to demonstrate how practice and theory of innovation support link, and identifying areas where the evidence supports previously made assertions. This chapter primarily relates to the theme identified in the literature that there is a lack of understanding regarding the multiscalar nature of innovation and how firms innovate in practice and engage with these multiple scales.

First this chapter provides context by looking at how interviewed firms in the three investigated industries innovate in practice, the implications of this innovation, as well as how the location of such firms impacts upon the region from the perspective of innovation systems. Second, this chapter relates how this type of innovation affects the type of innovation support both desired and accessed by innovators, as well as how this relates to both the literature and theory as well as the support offered by the region. Next, this chapter looks at the region through the lens of innovation systems, how firms in the region fit into and contribute to these concepts, as well as tying together findings from the previous chapters and the findings concerning firms, in order to create a holistic picture of innovation systems in the SCR and the nature of multiscalar support. Building upon this, this chapter shall then highlight the difficulties

associated with creating innovation systems within the empirical context of the SCR, as well as discussing the current role and potential future role that the region's universities may have as regional nodes of connectivity. Finally, this chapter makes the argument that the reasons behind why the region is able to create innovation systems at some levels and not others may be explained due to the region's path dependency, and that this is an under considered factor when looking at multiscalar innovation systems. This therefore develops the literature and contributes to theory by both applying the path dependency model in a different and previously unused way to explain not only the development of certain industries but also political and institutional development of an area, as well as demonstrating that it may be used as a tool to explain, understand and predict the ability of regions to create innovation networks at particular scales, contributing a useful tool in enhancing our understanding multiscalar innovation systems. It also adds significant context and understanding regarding the multiscalar nature of innovation support and networks, and why consideration a region's path dependency may help ensure that such networks and support institutions are drawn at a scale that is fit for purpose.

**9.2) How Do the Region's Firms Innovate? Characterising Innovation in the SCR**

For stakeholders and regions wishing to benefit from innovation-led growth, it is the region's firms that may be considered the most important component in innovation systems. Although all components of innovation systems have value, with institutions providing support, and knowledge creators generating new and commercially exploitable knowledge, it is ultimately the firm that is the endpoint of this process as the commercialiser of that knowledge within the triple helix of innovation actors (Katz

and Wagner, 2014; Acs and Audretsch, 2005; Lundvall, 2004). Although an innovation system would be severely hindered if there was both poor support for innovation and a lack or absence of locally based knowledge creating institutions, it would still be technically possible for firms to innovate, albeit at a lower rate, due to their role as commercialisers and their ability to acquire knowledge through internal R&D and the acquisition of external knowledge from other non-regional sources, therefore taking on a double role of both inventors and innovators (Chesbrough et al., 2006). Because of this therefore, it is argued that the single greatest priority for stakeholders wishing to realise and exploit innovation-led growth, is to both support firms which innovate in the way of most benefit to the regional economy, and to support these firms in a manner that best relates to their needs and wants. This section therefore takes a view of the firm and how they innovate in practice in order to ascertain how these firms may best be supported, and the consequences of this type of innovation.

In terms of how firms practically innovate within the SCR, the advanced manufacturing and health industries were both similar in their type of innovation, with both sharing several broad characteristics in common. Innovation undertaken by firms within these industries displayed characteristics that can be described as radical, in that their innovations involved the generation of an innovation from a high degree of new knowledge, and results in the development of a product which may be classed as either new to the market, or new on a global scale (Markides, 2006; Koberg et al., 2003). Although, due to the agreement of confidentiality and anonymity put in place with interviewed innovators in exchange for their participation makes it difficult to name and describe specific innovations without giving out identifying information, some

interviewed firms described how their innovation was radical and at the forefront in more abstract terms that may be discussed:

> *"It's based on an entirely new technology that was invented by professor* (confidential) *and he spent his entire career developing research in that area. So this company was founded to commercialise* (that research), *with our USP being that it is a technology that developed out of that research, which is entirely new and done nowhere else".*
>
> FSSH6

> *"We are at a point now where companies actually come to us, as opposed to us going out to them. The reason for that is, well we are the only company world wide doing what we do. Our* (offering) *is innovation in the sense it comes out of a lot of R&D, from us and with the university, and is totally unique to the market, so if firms want* (our product) *you have to come here".*
>
> FSHA9

Due to the radical nature of these innovators, there was a significant requirement for these firms to both gain and apply new knowledge, which was obtained from a wide variety of sources. Although some knowledge was generated internally by firms through their own internal R&D processes, interviewed firms within these industries demonstrated high levels of interaction with the region's two universities in order to expand their innovation capacity through obtaining this new knowledge, due to the region's universities being key drivers of new knowledge within the SCR and therefore

significant regionally-based innovation assets. As such, both of these industries demonstrated high levels of interaction with one or both of the region's two universities, through a variety of methods. This included both the direct paying of the universities for research, as well as more indirect and collaborative agreements, such KTPs and the sponsorship of PhD students to carry out research that they deemed to be of importance:

> *"We also involve the university in our innovation, we sponsor PhD students for example. The main stuff that we do in terms of the academics its mainly related to improving our understanding of things and very early theoretical stuff that we cannot test or do in house and with our expertise".*
>
> FSHA5

This demonstrates that firms within these two industries display many of the characteristics when innovating which are attributed to radical innovators, in particular the high degree of new knowledge incorporated into such innovations, as exemplified by their high level of interaction with the region's two most significant knowledge creating institutions in order to acquire said knowledge, and that their products are new to the market or on a global scale. Because of this, firms within these industries are engaged in a type of innovation that is considered to be an effective driver of economic growth, and therefore of importance and overall benefit to the region's economy (Forés & Camisón 2016; Keizer and Halman, 2007). Given that these two sectors were considered to be, at least by the city region itself, strategically important and innovative sectors, this demonstrates that the SCR has a view of their importance

which is in line with the role they could play in driving innovation-led growth, despite the fact that in practice little relevant innovation support appears to be available to them. Due to this evidence demonstrating the various methods in which the region's universities and firms interact with one another, this both shows significant levels of interaction between the region's innovative firms and the region's primarily knowledge generating institutions, evidencing a significant component of innovation systems (Teixeira, 2014; Lundvall, 2004), as well as further demonstrating the significant role that the region's universities play in helping to drive innovation-led growth and the construction of innovation systems.

Although there are numerous similarities in the way the advanced manufacturing and healthcare industries innovate, both in terms of process and type, one significant way in which they differ is in their formation and their relationship with the region's universities. Although there was significant interaction with universities across all investigated sectors, the case of the healthcare sector was the only one that showed evidence of direct spinouts from universities. Therefore unlike the overwhelming majority of interviewed advanced manufacturing firms, where firms engaged in, and added to, innovation and their innovation portfolio, many of the interviewed healthcare firms were born directly out of university-led and conducted research:

> *"(Our firm) is a typical university or academic institution spin out, spun out in 2006. A lot of the proof of concept work was done when it was in the "academic stable", and got to the stage where it became more exciting to take it commercially forward".*

FSHH5

This demonstrates that not only do the universities of the region contribute to the development of innovation within the region's firms, but that in the case of healthcare the region's universities are actively contributing to its stock of firms. This shows that the region's universities are therefore significant contributors to innovation, not only through assisting in the development of innovations and research as often highlighted in the innovation systems literature (Katz and Wagner, 2014; Teixeira, 2014; Lundvall, 2004), but are also responsible directly for the inception of new firms and the commercialisation of its own research. In addition, although innovation conducted by the advanced manufacturing and healthcare sectors can be classed as radical and at the frontier such innovation was primarily carried out in response to a specific and pre-identified customer need in line with the market pull, linear model of innovation (Godin, 2006):

> *"Innovation should be problem led. It should not be, I've got this really cool idea, and I'm going to come up with this thing. It should be customer driven, solving a need that the customer wants. An inventor will invent something no one wants. So thats why invention is different to innovation and different to entrepreneurship".*
>
> FSHA9

> *"Our innovation has been brought about by customer need and market research".*

FSSH4

Therefore, although innovations undertaken by these industries may be considered radical in so much that they produce a new product using newly acquired or developed knowledge, in order to reduce risk this is often created in order to meet a pre-defined customer need. This demonstrates a method used by the region's radical innovators to reduce risk when innovating in a manner that is generally considered a riskier approach (Keizer and Halman, 2007; Sorescu et al., 2004). In contrast to this however, firms that were established directly from university research instead tended to broadly follow the linear technology push model of innovation (Godin, 2006), where a firm was established in order to commercialise the newly invented technology without having a clear view of its end user or how exactly it should be commercialised:

*We are a very technological and technologically orientated company… In the first few years of the company's life we mainly were trying to understand what our commercial opportunities would be. So we then sent it off on a couple of opportunities that we identified as being commercially valuable.*

FSSH6

*"We've even done studies about whether you should make martian rovers using (our technology). I think we didn't understand perfectly where the technology had the most commercial advantage. And sometimes we didn't even understand the technology well enough to know that".*

FSHA6

Although this type of innovation was less common than the market driven approach, given the highly radical nature of this type of innovation and its overall contribution to economic growth, it is a notable characteristic of one of the alternate ways in which some radical firms within the SCR innovate. Additionally this research demonstrates that the way in which universities innovate through direct means is different than that adopted by pre-existing firms working in conjunction with universities, a finding which has significance for how such firms may be best supported and how regional and national scale can differentiate their approach based upon these characteristics.

Despite some of the above findings suggesting problems regarding firms within SCR being insular and networking poorly with one another in the region, in terms of the end market of their product all of the interviewed firms within the advanced manufacturing and healthcare industries were significant exporters:

> *"Exporting is critical to us, around 70% of what we produce is exported, and that led us to get an excellence in exporting award at the Sheffield business awards in 2013 I think. So, the vast majority of what we produce is exported."*
>
> FSHH4

> *"If I had to take an average I would say that probably 60-65% of what we do is for export. Every now and then though, clients will sign up for a particular licence or a particular project that involves a huge influx of cash as a downpayment. So that can skew the figure hugely because in one of those months*

*or years you might see our exports bump up to 90% for a period. But regardless of the exact percentages we are an exporting company, and it is very important to us"*

FROA2

These findings however, are at odds with the view of many regional stakeholders that the region is too insular, and requires significantly more exporting activity in order to draw in wealth from outside of the region to contribute to growth.

*"If you're a business and you are selling from department A to dept B and back again, eventually you go under. And if you are in a region and doing exactly that selling from one side of the region and back again, you go under as a region. So as a region our only true customers should be focused on what is outside. What external wealth are we bringing into the region? As a region we need to focus on that, because at the moment we aren't (exporting)".*

SDON1

A reason behind this disconnect is due the characteristic that stakeholders within the SCR have an open view of innovation, inclusive of many non-radical innovators and in some cases, simply non-innovators. Due to this, it is argued that as stakeholders are focusing upon what may be described as less innovative segments of the SCR's economy, they are in turn focusing on areas of the economy with the least scope for exporting, high value or otherwise. Therefore this thesis argues that this once again demonstrates that it is the region's radical innovators who contribute most to the

economic growth of the SCR, and for regional stakeholders wishing to benefit from innovation-led growth, and in particular wishing to increase export levels of the SCR, that a concerted effort should be made to support the region's most radical innovators, rather than the current approach which favours incremental ones. Given that this research has demonstrated that radical innovators are more likely to engage with support that is financial in nature, and offered by national levels of support, it is further argued that the support of this type of innovation is best suited not towards regional sources of support, but national ones.

As has been seen, advanced manufacturing, healthcare and digital sectors were selected to be the focus of this study due to their stated importance to innovation by the region's institution. However, although the advanced manufacturing and healthcare sectors innovate in a way which appears to significantly contribute to the innovation led economic growth of the region, the digital sector while evidencing some radical innovation appeared to be dominated by firms that innovated in an incremental and adoptive manner, and therefore contribute to innovation-led growth to a considerably lesser degree (Sorescu et al., 2004; Blundell et al., 1999):

> *"This sector, and the industry that we work in pretty much reinvents itself every year, so whether that's technologies our customers are using and access to those technologies. All of these different things has meant as a company we have to be, by our nature, innovative and bring on board and use those innovations".*
>
> FBAD1

*"For us innovation is about thinking about what doesn't yet exist, what may be needed next. We have to move quite quickly with the times with equipment and become experts in the field when new technologies are adopted and learn to use them in an innovative manner to do something new".*

FBAD2

This therefore has significant implications regarding the role of digital industries in the SCR delivering innovation led growth in the region, as well as a misalignment between the goals of the SCR and the strategic areas believed to deliver these goals. In addition, a surprising finding of this study was that unlike the advanced manufacturing and healthcare industries, which were highly international and all of which were involved in some degree of export and international activity, the region's digital firms were considerably more likely to only operate within the UK, or at the SCR level:

*"Most of our business is within Yorkshire. We have a few contracts outside of Yorkshire, but I would say 90% of our business is within Yorkshire, and most of that within the region."*

FBAD2

*"We will work for large blue chips who work internationally, but I would say most of our work is focused here in the UK, typically all. We do have our office in Australia, but that really just works for the local Australian business, so we aren't really international in our working in any sense".*

FSHD2

This is an interesting feature of the region's digital firms, as well as being in line with the assertions made by stakeholders that the region's firms are too insular, it is also occurring in an industry which due to advances in communications technology combined with a lack of a physical product, would have been well suited to international business and exporting. This thesis argues therefore that it is the type of innovation which is conducted by the region's digital firms, which is preventing it from exporting digital products, and by extension that one of the reasons the advanced manufacturers and healthcare firms within the region are prolific exporters is because they engage in an innovation type at the opposite end of this spectrum. The result of this finding is that it highlights that for stakeholders wishing to increase the export capacity of the region, it is not only a matter of removing barriers to export and encouraging regional firms to engage in regional activity, but also encouraging radical and world-class innovation which lends itself easily to export, and has a global appeal. This therefore demonstrates that it is necessary not only to consider strategic sectors and their support, but more importantly due to their potential for economic impact, to give greater consideration to the type of innovation that such sectors engage in.

Another reason behind why many creative and digital firms were limited geographically to the UK or smaller scales is because of the nature of the work and innovation that they would typically undertake. Although such firms may be considered innovative in that they incrementally improved services or adopted new technology, often their work was on a project or commission basis, working for an

organisation on a specific task. As such, this meant that work undertaken in the digital and creative sector often lacked scalability:

> *"The way we normally work is we get a brief from our client. The brief broadly comes to us in a myriad of forms. Sometimes they are verbal briefs, where a client sits in front of us and says we've got this idea or we've got this problem we need to fix or expand upon. So we go away either with the client contingent on how they feel about it or without the client and brainstorm the solution. So broadly speaking we spend a lot of time in spaces like this, coming up with the solution for the client. Effectively we work as problem solvers".*
>
> FSHD4

This characteristic of innovators within the digital and creative industry highlights another reason why such firms, although innovative in an adoptive or incremental sense, yet poorly contributes towards regional innovation-led growth. Through working on a project basis, even if adopting or implementing new innovations, such firms had an extremely low level of scalability, meaning that unlike healthcare and advanced manufacturing industries where innovations were both scaleable and exportable, for the vast majority of interviewed digital firms this was not the case. In addition, because this work often involved interacting closely with clients on bespoke projects, this meant that firms often only worked with clients that were geographically close in order to ensure this closeness of interactivity. This therefore reflects the issue highlighted by SBAR1 that some firms fail to bring in new wealth to the region and fail to contribute to economic growth, instead causing churn and displacement.

Therefore, the findings regarding the creative and digital industry within the SCR demonstrate: that the characteristics of their innovation is closely associated with the less impactful incremental and adoptive innovation, that such innovation is often not scaleable further limiting its impact, and that firms do not engage significantly in innovation brings into question the value of one of the region's self-identified key innovative industries. Despite these issues however, several interviewed firms did demonstrate some aspects associated with radical innovators, using high levels of new knowledge to create a (digital) product or service which was new on a global or market scale (Markides, 2006; Koberg et al., 2003) and were engaged in what can be described as frontier innovation:

> *"We are engaged in some really at the edge innovation at the moment. One of the things we are working with at the moment is with a machine learning company, down in London who are leaders in artificial intelligence… So we are working closely with those guys to incorporate their technology into what we do, which is allowing us to create a system which we can sell globally, because there's nothing else like it out there".*
>
> FSHD1

Although such digital and creative firms were in a minority within the SCR, it does demonstrate that there are a small number of firms within the SCR's digital sector engaged in radical and world innovation. This thesis argues therefore that while the SCR, by targeting certain sectors and highlighting them as drivers of innovation within the SCR is an understandable approach, particularly when it comes to the facilitation

of innovation networks of related firms more nuance is required. As industrial or sector classifications do not take into account the innovation that is carried out within them it is necessary to be aware that not all innovations from within these sectors are equal in terms of their contribution to regional economic growth and development (Keizer and Halman, 2007; Sorescu et al., 2004). Therefore a distinction must be made, particularly in the case of the digital and creative industry within the context of the SCR, that not just the right strategic industries are supported, but the right types of *innovation* within them are supported also. Therefore, stakeholders need to, in addition to having a clear vision of regional development and what core strategic industries are part of that development plan (Katz and Wagner 2014) it is also necessary be clear what kind of innovation they mean, and to be aware that innovation generated within these industries is not necessarily of the same value to innovation-led growth.

A common issue and characteristic which was shared by firms in all of the interviewed sectors was that there was a evident lack of interaction with other firms at both the local and regional level, as well as between firms and regional support institutions. The most common type of identified disconnect is that the overwhelming majority of interviewed firms did not interact with any other regionally based partner in their innovation process (excluding the region's universities), and this study could find no evidence of firms working with other firms based in the region. Despite this however, firms within the region did display significant evidence of being engaged in collaborative innovation efforts with other firms, yet these partners were not located within the region itself, but instead outside of the region. In addition, most of these collaborative innovation projects were also organised through a national level

institution, usually Innovate UK, through a variety of initiatives, as well as often including a university partner:

> *"The largest innovation project and partnership we have ever done has started this year… And in there we are working with Rolls Royce, the University of Sheffield, Sheffield Hallam University, and the AMRC, TWI and ourselves. So its the largest partnership I've ever done, and that was all put together by Innovate UK."*
>
> FSHA5

This demonstrates that the region's firms are not as insular as they may initially appear. Although firms do not appear to engage with one another within the region, it does not appear that this is due to an insular culture, as firms do collaborate with external partners outside of the region. This therefore raises significant questions with regards to why firms do not engage with regional level institutions, which this thesis seeks to answer. One factor which explains this characteristic of the region is that several firms expressed that they were willing to work and interact more closely with other firms within the region, both in innovation efforts as well as more generally, however the reason that they did not was due to a lack of what was described by SDON1 as "regional self-awareness". Although the willingness of firms to work regionally was evident, what held many of them back was a lack of awareness with regards to what is available in the region, what potential regionally based partners were located in the region, as well as what the internal innovative capabilities of such firms were. This was a feature which not only was present in firms that were located in general areas of

the city and periphery but was also evident in firms based within the AMP, what has been described as an archetypal innovation district by both stakeholders as well as Bruce Katz (Katz and Kline, 2014):

> *"We don't network locally as much as we should. I would like for us to do that more, I think there would be significant value for certainly us and others knowing what capabilities there are with each other. We do know (confidential), who are across the way. We use some of their products and we've had some advice form them. But yeah there's a lot going on locally, by which I mean really locally, i.e. walking distance, that we ought to know about and take advantage of.*
>
> FROA4

This therefore brings into question to what extent the AMP works as a true innovation district, as although it has many of the components necessary for the formation of one, it lacks the essential interconnectivity present in all innovation systems. This therefore leads us to argue that within the AMP, and as shall be seen later the SCR more generally, the components for an innovation system exist in terms of many of its required assets, but the lack of connectivity is preventing the formation of a system. However, despite this lack of connectivity in practice, firms did express that they were willing to work with other firms where appropriate, if this issue could be overcome, and that potentially they believed that if partners were well suited that this could be of mutual benefit to both firms:

*"It would be nice to know that there is somebody there that you could turn to in the region if you've got an idea. And like I said there probably is, there are probably people and firms out there but I just don't have the time to go and look for them, and even if I did I'm not sure people shout about what their capabilities and expertise are that I would find them".*

FSHA3

*"We would like to work more locally… But if somebody could offer some sort of bridging service we could work with people much more locally. For example I want to do some hardness testing on a piece of steel. It would be great if I could just email out to local business and say look does anybody have a hardness tester I could borrow rather than spending thousands of pounds on one that I might use for a week… While I know that example isn't innovation, if we got to know capabilities and had the opportunities to know one another, collaboration and innovation would probably stem from that".*

FROA4

This therefore highlights that despite the fact the region currently lacks the connectivity required for the development of an innovation system, either at a local, district or regional level (Katz and Wagner, 2014; Lundvall, 2004), that both many of the assets required are in place, and that there is a willingness to work regionally where appropriate. This therefore further highlights the need for additional innovation support to be directed towards the formation of these links. Another issue, however, which further compounds the difficulty of creating a localist innovation system is that

several firms have expressed that they do not see the value of working regionally, due in part to their specialist nature, as well as a broader commercial view that limiting themselves to the city region would limit their number of potential partners, and that they desire to collaborate with the best and most appropriate partner, regardless of their geographical location:

> *"None of our partners are in Sheffield or even the region. But then I think sometimes, and this is my own opinion, but I think sometimes in the UK we are too parochial. We are actually quite a small country so it doesn't really matter too much… I think we over emphasise the regionality within the UK. Nobody really cares if you're in Manchester or Leeds or London, and we certainly don't, we just want to work with the best expertise we can".*
>
> FSHH5

As has been seen, stakeholders within the region have expressed a willingness to work collaboratively regionally, however this is dependent upon finding an appropriate partner within the region, something which the above quotes demonstrate may not always be the case. Due to the low density of highly and radically innovative firms within the SCR, and low levels of collaboration even within the spatially restricted AMP, this brings into question whether the SCR has the resources and the density of related firms required to facilitate the development of an innovation system at a local or regional level (Katz and Wagner, 2014; Lundvall, 2004). It may be argued that the reason that firms are not aware of what is available locally is not only through a lack of regional self-awareness, but that the most appropriate partners are not located within

the region. As such, Innovate UK, and its support of innovation through the connecting of appropriate partners may already be fulfilling this need, meaning that the reason that firms within the SCR do not interact significantly with one another is because there is no partners which are appropriate within the region, and it is for this reason Innovate UK links firms within the SCR to external partners. In addition, because of Innovate UK's national reach, it is precisely more effective in encouraging collaboration and identifying potential partners, thus demonstrating the potential for complimentary institutions operating at both national, regional and sub-regional levels.

These characteristics of innovating firms within the SCR therefore have a number of implications with regards to the innovative capability of the SCR and the part that firms play in the development of innovation systems. Most significantly, from this system perspective, this evidence demonstrates that firms within the SCR do not interact with one another in a significant manner, and in particular no evidence could be found of significant interaction with other firms within the SCR. In contrast to this however, this research also demonstrates two characteristics of firms within the SCR which appear to highlight that the region's firms are actually open to interaction and collaborative innovation approaches: First, radically innovating firms despite not currently working collaboratively within the SCR have expressed both a willingness to do so, as well as in some cases expressing a belief that working with other regionally based firms would be of a benefit to them. Secondly, such firms despite not collaborating locally were often engaged with collaborative innovation efforts with other firms and institutions outside of the region, suggesting that the region's firms are not engaging regionally due to a broad insular culture of firms within the SCR, but

instead that it is some other factor which is preventing their interaction at more local and geographically close scales, and hindering the development of innovation systems within the region. This therefore presents a significant question: Do firms within the SCR not collaborate locally due to a lack of regional self-awareness, hindering their awareness of opportunities for collaborative innovation, or alternatively does the SCR lack the density and "critical mass" of firms required for the formation of a dense learning network within the SCR. This thesis argues that within the case of the SCR, although there is evidence that both of these factors appear to play a role in the region's disconnected nature, it is argued that it is most likely to be the latter factor which plays the most significance due to a number of reasons. For example, interviewed advanced manufacturing firms within the AMP did not note any instances of collaborative innovation with other firms within the park, despite their heavily restricted geographical proximity to other advanced manufacturing firms meaning that they were aware of the broad activities being undertaken by others in the area. This suggests that despite this awareness, that such firms didn't collaborate due to reasons of appropriateness rather than awareness. In addition to this, as the point identified in chapter 7 that one of the reasons that firms have difficulty collaborating is due to their highly specialist nature limiting the number of suitable partners within the region, forcing them to look further afield. This therefore suggests that the number of appropriate innovating partners within the SCR is limited, further suggesting that the reason behind why firms do not collaborate is primarily due to their being a lack of appropriate partners, particularly when the radical and specialist nature of such innovators is considered. This therefore has significant implications with regards to the formation of innovation systems at regional and sub-regional levels, given the

importance of regional interaction between actors for the formation of such systems These characteristics and issues therefore demonstrates both the difficulty in creating innovation systems, as well as the issues associated with a localist approach towards the support and facilitation of innovation led growth, particularly within regions with historically lagging rates of innovation, and from this low densities of radically innovating firms.

Another significant finding of this research relates to where the industries undertaking these different types of innovation were located within the SCR. With regards to the advanced manufacturing industry, most of these firms were located either within the AMP, located between Sheffield and Rotherham, or were located within the Sheffield-Rotherham economic corridor. In the case of healthcare, these firms were all, with a singular exception, located within the core of the Sheffield city centre, often close to one of the region's universities. This research, for these two sectors, was unable to find any significant clusters or concentrations of such radically innovative firms in the region's periphery. This therefore demonstrates an interesting characteristic of the SCR, that radically innovative firms are concentrated geographically close to the region's core city. This further brings into question the concept of a RIS at the level of the SCR, the value of the region's periphery from an innovation systems perspective, as well as having broader implications with regards to the concept and literature on RIS.

**9.3) Innovation in Practice and Innovation Support**

Having looked at how innovation practically takes place within the context of the SCR, it is necessary to look at the level of congruity between innovation support offered within the SCR, and the innovation support desired and accessed in practice by the region's innovators, as well as where such support relates within the multiscalar support spectrum.

One way in which this thesis explored how innovators in the SCR interacted with innovation support in practice, was by asking directly what innovation support they had received and engaged with, at both a national and regional level. A significant finding of this approach, in part as a result of using the semi-structured interview method, was that when queried on this, regional innovators and particularly radical innovators always focused upon support that they had received from national institutions, rather than regional ones. Such support tended to fall broadly within one of two categories. First, the most common type of innovation support accessed by interviewed firms was through financial support:

> *"Innovate UK has funded us for a couple of projects that we have had… We have had, what used to be the smart award, a national grant for early stage technology development. We've had a couple of collaborative R&D projects as well funded by innovate UK. So we've done pretty well out of that, but they are all national, we haven't really had any local ones".*
>
> FSSH6

*"We've had some Innovate UK funding, or TSB as it was at the time. So we had the smart grant and various feasibility study grants."*

FSHA9

Given the significantly riskier nature of radical innovation is a significant reason behind why such firms prefer support of this type. The provision of grants allows firms to partially de-risk their innovation processes allowing them to undertake more radical innovation at the frontier, which while a riskier approach to the firm, on the whole is believed to deliver the most economic growth to a firm or region (Keizer and Halman, 2007; Sorescu et al., 2004). It may be argued therefore, that the region's most innovative firms, because this is the type of innovation support that they would most benefit from, appear to prefer national support because it is at this level where the most appropriate grants are offered. The other type of innovation support accessed by firms at the national level is in the assistance in forming KTPs and multi-firm innovation collaborations:

*"For innovation support, the real added value is through bringing those networks together. Because, we come up with ideas, we see the people, we cover all sorts of clever arrangements, we have got people that do that. But ultimately we don't have everything we need, and Innovate UK in helping us find these partners means we can do stuff we wouldn't have been able to before, and that's a huge part of their value".*

FSHH2

As has been seen, Innovate UK is a significant driver of radical innovation both in the UK and by extension within the SCR's most radical firms. Such partnerships, however, while valued by firms tended to be with partners outside of the region. Therefore, this demonstrates that the two major needs of firms within the SCR, access to finance and assistance in partnership formation, are already met by the national level institutions of the multiscalar innovation support structure. As at the national level there appears to be a high congruity between what radical innovations require and access in support terms, this therefore brings into question how much additional and relevant support may be offered by the region if these needs are already being met, and whether the devolution of such support to regional levels would add any further value. In addition, this demonstrates that while efforts are made to foster collaborative innovation, this is at a national rather than regional level. Because such needs are met at this level, it is a further factor stopping firms from “thinking locally” and attempting to engage with other firms in a more local context.

This research also identified that in practice, there was very little interaction between the region’s most innovative firms and innovation support offered at the regional level. As has been seen, regional stakeholders tended to have a view of innovation that favoured adoptive innovation, and as such offered support which was targeted towards such firms. In addition, there was a reluctance to use the term innovation, and instead support was badged not as innovation but as growth. This therefore suggests a low level of congruity between the needs of the region’s radical innovators in terms of support, and that offered by the region, as identified by the lack of uptake by regional innovators of these generic innovation support initiatives. However, much like when

engaging with national institutions, radical innovators which were able to identify regional sources of innovation support that they had received always tended to encompass the financial perspective, having received support through sub-nationally available grants or loans:

> *"we've had scraps of money, about 10 years ago from screen Yorkshire. We once got a development loan from finance Yorkshire which we've nearly paid off".*
>
> FSHD5

> *"There are other little pots of funding and grants we tap into occasionally, and some of those are local. We've received support from the growth hub for example, as well as some assistance from finance Yorkshire".*
>
> FROA5

These quotes again demonstrate the somewhat incoherent nature of innovation support at sub-national levels within the SCR context. As can be seen, the grants received by innovative firms from non-national sources were from a range of different sources, some based within the SCR and others at larger yet sub-national levels. It is argued that it is for this reason that there is a tendency for innovative firms to appear to prefer national level innovation support, due to its centralised and clearer nature. In addition, it also argued whether there is any additional value in devolving the financial support aspect to sub-regional levels, particularly given the tendency of regional stakeholders, those in charge of the distribution of such funds, to hold a view of innovation which

fits poorly with the type of innovation which delivers innovation-led growth (Forés & Camisón, 2016).

Another feature of note to emerge from this research was that many interviewed firms did not know what regional support that could be offered which would directly aid their ability to innovate more effectively. This was a feature in all of the region's interviewed firms, however was particularly prevalent in firms engaged in innovation at the radical end of the spectrum:

> *"I don't think there is* (any additional support wanted). *This might just be my personal opinion, but its the whole thing of government… people expect when they vote in somebody in government, they expect them to change their life. But nobody is going to change the situation but you. I think a really good method of support is firms organising conferences and meet-ups, that sort of thing".*
>
> FSHD1

> *"At a regional level? No, I cant think of anything that they could do that would help us in any meaningful or substantive way".*
>
> FSHA5

This therefore further brings into question the findings of the previous chapter, that in many regards there appears to be relatively few ways in which regional institutions can directly support radical innovators. As such, it may be argued that the role of regional stakeholders should be not through supporting such innovators through direct means,

but rather acting as agents of connectivity, helping the construction of innovation systems within the region through the facilitation of interaction between its key components and firms.

These findings therefore have several implications regarding the support of innovation at a regional or sub-regional level, which in turn has implications regarding the fostering of innovation-led growth in the region and the multiscalar spectrum of innovation support. First, this research demonstrates that there is a high level of congruity between the innovation support offered at a national level, and the needs of radically innovating firms, demonstrated by their overwhelming engagement with the national level of support. Related to this, it also demonstrates that there is a lack of engagement with regional firms with regionally offered support, which it is argued is both due to the low level of congruity between radically innovating firms most well placed to deliver innovation-led growth in the region (Keizer and Halman, 2007; Sorescu et al., 2004), and the type support offered at a regional level, which is orientated towards the supporting of non-innovative and non-radically innovating firms. Due of these factors, the region's firms do not engage significantly with regionally offered support, nor as been seen previously, with other firms within the region. Due to this, the question is raised whether the region’s institutions need to shift their focus away from their current practice of support, and towards innovation support which is closer to the needs of the region’s radical innovators, in order to encourage not only the type of innovation which best contributes to growth, but also to encourage regional engagement and the development of a regionally based innovation system. However, the region’s firms needs are already being met to a large extent at a national

level, given their preference for financial and networking support, which brings into question whether devolution of such support to a regional level is necessary or provides any additional benefit or added value. In the case of the financial support for radically innovative activities, this thesis argues that such devolution would not provide any added benefit, particularly when it is considered that the regional stakeholders prevailing viewpoint of innovation is one which is unfocused, particularly from the innovation-led growth perspective. However, this thesis argues that the networking element is something which, while not requiring devolution to regional institutions, instead needs to be adopted more heavily by the region's supporting institutions as well, resulting in network building support being offered at both regional and national levels. This is due to the region's low level of connectivity between various stakeholders and partners, which this thesis argues is one of the single largest hindrances to the development of a true innovation system within the SCR. Because regional firms have explicitly expressed a desire to have more awareness regarding what is in the region, as well as to work with partners based within the SCR on innovation processes, this in combination with that networking support is the second most accessed type of support at a national level, it may be argued that helping to overcome these barriers and encourage collaboration between radically innovative firms would be the best way that supporting institutions may encourage both radical, innovation and the development of an regional innovation system within the boundaries of the SCR by fostering such connectivity.

### 9.4) Universities as Drivers and Supporters of Innovation

Before continuing, the findings of this thesis make it necessary to highlight, in looking at how the region innovates in practice, the significant role that the region's universities play, not only as knowledge-creating institutions, but also as nodes of connectivity in a highly disconnected region, and the role that they may play within the multiscalar support spectrum as institutions that may help foster inter and extra regional connectivity.

As this thesis has demonstrated, the SCR is a highly disconnected region in many regards. Firms fail to interact significantly with other firms from within the region and with regional institutions, the region's periphery fails to engage with city region, a disconnect exists between how stakeholders define innovation and how the most growth driving innovation is carried out in practice, and a disconnect exists between the type of support required and accessed by innovative firms, and what is offered at a regional level. This paints a highly negative picture of the SCR from an innovation systems perspective, particularly as it demonstrates significant disconnects between and within two of the main groups of actors necessary for innovation systems, innovative firms and regional institutions (Katz and Wagner, 2014; Cooke et al., 1997). However, the often cited third pillar of regional innovation systems is what may be broadly defined as knowledge creating institutions. In the case of the SCR, the two most prominent knowledge creating institutions are the region's two universities, The University of Sheffield, and Sheffield Hallam University. Despite the other disconnects present in the SCR from the sub-national innovation systems perspective, the connection between radically innovating firms and the region's two universities has been found to be extremely strong, and this research was able to identify numerous

examples of interaction between the two groups in their innovation processes. One of the most common ways in which this interaction occurred was through Knowledge Transfer Partnerships (KTPs), although this was often facilitated by a third party, such as Innovate UK:

> *"In terms of identifying innovation, we get involved with a number of events through the University of Sheffield. So we saw the value of a KTP, particularly with the added financial support Innovate UK provided, and the additional benefits that brings, such as the access to facilities that we wouldn't have, the ability to talk to people and share ideas, so you know scientists and engineers, links with other universities that want to do projects etc".*
>
> FSSH4

As the innovation supported by both Innovate UK and facilitated by the region's universities involved a high degree of new knowledge, often created by or in collaboration with the partnered region's university, such innovation may be described as both radical and at the frontier. This therefore, demonstrates that not only do the region's universities act as significant drivers and supporters of innovation within the SCR, but they also support the *type* of innovation that is best placed to deliver significant economic growth. This therefore highlights how the region's universities are highly significant innovation assets from the innovation-led growth perspective.

Another common way in which the region's firms interacted with the region's universities in order to benefit their innovation processes was through the direct

sponsorship of PhD students. This allowed firms to benefit from having research undertaken in a field which was considered of relevance to their innovation process, generating new knowledge which was believed to be able to be commercialised, allowing part control of the research undertaken and its outcomes, as well as gaining access to the university's expertise and equipment through the candidates supervisors and university's specialist equipment:

> *"Collaboration for is key. And you never know where it may lead, the work we did with AWE on a grant funding thing has led to us ultimately being able to sponsor a PhD student, working with us".*
>
> FFSH4

> *"We collaborate heavily with the university, but we've also got a predefined pipeline for the IP, so issues of intellectual property don't really apply in our case. We actually sponsor a PhD student in the university because its a great way to get research we need carried out, as well as accessing new talent".*
>
> FFSH6

Even in instances where firms do not collaborate with the universities in strictly innovation processes, often regional innovative firms will collaborate or make contact with the universities in other ways. One of the most prevalent examples of this is how advanced manufacturing firms, both within the AMP and further afield, interact with the AMRC in order to gain access to its apprenticeship training programmes,

something which firms rated highly in allowing them to gain the human resources required for them to remain innovative:

> *"It can be difficult getting skilled labour. And as a consequence of that we have to develop our own and are developing an apprenticeship programme. And we are doing that, we've got 8 or 9 engineering apprentices, mainly through the AMRC, which is affiliated with Sheffield University of course, so we interact closely with them".*
>
> FSHA2

> *"We have links up there* (with the university), *we have an apprenticeship program, with apprentices here coming through the AMRC. It was something I was keen to set up when I started here. I think it's important to train the future generations and broaden the pool for skilled engineers and skilled workforce for the future. So that's why we talk to the university in the main".*
>
> FSHA8

This therefore demonstrates, that even in instances where firms in the region do not interact with the region's universities from an purely innovation perspective, that firms still interact with the region's universities in a different manner. As a result of this, the region's universities, while acting as knowledge-creating institutions and contributing to innovation in the SCR in the "classical" innovation systems sense, such as through the creation of spin out companies and generating knowledge which is commercialised by firms within the region through KTPs and other methods (Martin and Simmie,

2008a), also helps to support the creation of an innovation systems network, through acting as a point of connectivity in the region for firms. In the case of the region's AMP, the closest example of an innovation system within the region, the University of Sheffield has acted, not only as a bridging node and network builder but as the key anchoring institution for the network, demonstrating the value of the region's universities through their ability to act as the core for the development of an industry specific innovation system. Such examples of connectivity, however, are not limited to the firm-university relationship. Regional stakeholders, both within the core city and its periphery have identified the value of the region's two universities from a number of perspectives and also interact with them through a number of methods:

> *"One route we have gone down before is trying to liaise with universities, so innovation futures is a programme we have tried to tap into before. So that's with Sheffield Hallam University. So the idea there is that if someone is trying, or has an issue or a product which can be developed through the university and their centres of expertise then we try and hook up with other partners".*
>
> SBAR2

> *"(we have) collaborated with the two universities to help them develop their real estate around the sectors, like around the engineering faculty, the Diamond building. That is designed to very much connect with the sector that has strong growth, strong employment and strong innovation prospects. And we have as a council taken a lot of political pain in approving that building, but one of the things that drove us is the strategic importance of it".*

This shows that the region's universities not only act as points of connectivity with firms, but also with stakeholders. As such, the region's universities act as points which draw together all of the major innovation asset groups, or parts of the triple helix, required for innovation systems, the knowledge creating institutions themselves, regional stakeholders and innovative firms (Teixeira, 2014). As has been seen, the SCR, bar the issue of lack of an absolute density of radically innovating businesses, has many of the required components for the construction of an innovation system, however these components have failed to come together to form a coherent network and system. This thesis therefore argues that given the region's universities are already acting as de-facto anchor institutions within the region, that efforts should be made to capitalise on this opportunity, in order to bring together all three components of the triple helix and to facilitate network formation. While this case and finding is limited to the SCR, the broader implication is for regions and localities wishing to form innovation systems, it is necessary to focus primarily upon the network element, and where pre-existing nodes of connectivity exist, in order to build up and further enhance regional connectivity, regardless of whether that existing node of activity is a knowledge creating institution as in the case of the SCR, or another institution acting as an anchor. As such it is important for regions to focus on where pre-existing points of connectivity exist, regardless of whether this be at knowledge creating institutions, large anchor firms, or other regional based institution (Katz and Wagner, 2014), and to expand and build upon these pre-existing assets to enhance connectivity and thus innovation-led growth. As such with regards to its addition to knowledge regarding the

multiscalar approach to innovation, it demonstrates that this also has to be at the scale of existing institutions, rather than attempting a top-down and dictated approach to scale. Therefore such systems need to be built upon pre-existing assets and areas of connection, which exist at a scale independent of theory, and necessitating a differentiated approach depending upon this, rather than attempting to build such systems at predefined scales.

### 9.5) Firms and the Innovation Systems Perspective

Having looked at innovation systems through the lens of local stakeholders in the preceding chapter, and how the region's firms within the investigated industries innovate practically within this one, this thesis now considers innovation systems from the firm perspective, in particular how the region's firms, institutional actors and knowledge creating institutions fit together within the SCR, as well as the broader implications of this for innovation-led regional growth, and the support of innovation within the multiscalar environment.

In looking at innovation systems from the firm perspective, it is necessary to address the question of what innovation systems, if any, exist within the SCR? Although the innovation systems literature does not always explicitly note that innovation systems develop in a manner which is specific to a particular industry, due to the amalgamation effects resulting in clusters of related industries, and that knowledge spillover effects often benefit the same or related industries, in practice this is most often the case. The innovation districts concept which is one that has a slightly more open view towards a multi-industry innovation system, owing to its noting that a networking asset, one

which constructs weak ties, may "focus on building new, often cross-sector, relationships" (Katz and Wagner, 2014, p14). This concept too, however, also tends to focus upon the singular industry system, with many of its key examples being focused around one industry, as well as the acknowledgement that an advanced manufacturing innovation district is likely to have its own unique characteristics compared to other systems. As such, although innovation systems are not necessarily industry specific, due to the fact that across most innovation systems literature this is the case in practice, this section shall look at what innovation systems exist within the SCR by industry.

The advanced manufacturing sector within the SCR displays the best characteristics of what may be described as an innovation system, albeit one which is geographically concentrated within two areas, and may be considered to be either a LIS or innovation district depending on theoretical viewpoints. As identified previously the location of the region's advanced manufacturers is largely within the region's AMP, or the geographically nearby Sheffield-Rotherham economic corridor. Due to the concentration of advanced manufactures, the clear vision demonstrated by stakeholders demonstrates that there is an explicit attempt to develop an innovation system under the innovation district model, as well as the involvement of the University of Sheffield, has led Bruce Katz, one of the founding academics of the concept to note that the SCR AMP is an innovation district (Katz and Kline, 2014). This thesis however, questions whether this may truly be considered the case. The AMP does have many of the assets required for the development of an innovation district, such as a concentration of related economic assets in the form of the advanced manufacturers located at the park, the necessary physical assets, the engagement of both public stakeholders with vision

of its development, as well as the University of Sheffield as both an anchor institution and collaborative partner, a significant class of assets is missing: Networking Assets. Despite the absolute geographical proximity between these firms, there was little evidence of significant interaction between those based at the park, or of collaborative innovation. Although all interviewed firms noted that they interacted with the region's universities, an admittedly important part of all innovation systems regardless of scale, this thesis argues that the lack of interaction between firms within the AMP represents the "missing piece" of the innovation system. Interviewed firms, while also noting that they did not collaborate locally, also expressed in some instances that they were unaware of what was being undertook in the AMP more broadly, further demonstrating that despite their geographical proximity, there is a significant lack of information flow and interaction:

> *"There's a lot going on locally (at the AMP), by which I mean really locally, i.e. walking distance, that we ought to know about and take advantage of".*
>
> FROA4

Due to these factors therefore, this thesis argues that the AMP within the region, although having many of the assets necessary for the development of an innovation district or innovation system, and may even be considered to be a developing system, cannot currently be described as one.

In terms of the location and concentration of healthcare firms within the SCR, once again this is geographically relatively narrow, and with a single exception all identified

and interviewed firms were confined to Sheffield. Because such firms were all highly radical innovators, this further in conjunction with advanced manufacturing, brings into question how much innovation assets are concentrated within the region's periphery. Although not a substantive network, several stakeholders were able to note networks that they tapped into, within the healthcare and health sciences industry, however the majority of these were based around the region's universities:

> *"The city council has a few networks we use, the academic health science network is another, that's been very good. We are working with the academic health science network in the north east and cumbria, as well as the one here in Yorkshire and Humber. And the universities have been brilliant, we have a secondment manager from the health gateway from the University of Sheffield, and that's help us get into networks".*
>
> FSHH3

Despite these networks, however, the issue of lack of collaboration and interaction between firms once again was highlighted as an issue, with no firms collaborating with a regional partner, with the exclusion of the university. In the case of healthcare however, it appears that the most significant issue with this concept is the density of the network, with firms noting that the low density of firms within the region was the most significant factor preventing them from being able to find appropriate collaboration partners locally:

*"The short answer is yes we do network within Sheffield, and there are a few networks we tap into but I think, the area we are in is a global market, so networking doesn't stop there… Sheffield just doesn't have that many opportunities for us really. In a collaborative sense".*

FSHH5

Therefore, it is difficult to argue that a substantive LIS or RIS exists within Sheffield or the SCR in the Healthcare sector, despite having several of the required components for such a system, both due to the issue of low connectivity and interaction between partners, similar to that identified in the advanced manufacturing industry, as well as a lack of absolute density within its network. Additionally, due to many of these healthcare firms being direct spinouts of the region's universities, primarily the University of Sheffield, this demonstrates that the region has had some difficulty in attracting healthcare firms into the region, and that the region's universities are the primary drivers of healthcare firms and healthcare innovation within the region. In addition, this demonstrates a common difficulty experienced by both healthcare and advanced manufacturing firms in the city region, that there is both a lack of business density, as well as a lack of connectivity between firms.

In the case of digital firms within the SCR, their concentration is considerably more diffuse, and less concentrated than the previous two industries. However, the location of radically innovative digital firms, although making up a low proportion of overall interviewed firms, did appear to be concentrated within the region's core city. However, such firms were rare, bringing into question the ability to create an

innovation system due to a lack of density of such firms, as well as the potential contribution of an inclusive digital innovation system to regional growth, due to their adoption of an innovation type poorly suited to economic growth (Keizer and Halman, 2007; Sorescu et al., 2004).

With regards to what networks existed within this industry within the SCR, much like the healthcare industry, digital firms were able to identify a number of ad-hock networking events and other networks that existed within the region:

> *We attend loads of little networks and networking events. We generally use the Barnsley and Rotherham chamber of commerce for those events. As well as some independent companies which offer events of well and other informal stuff".*
>
> FBAD1

Despite this once again there was no evidence of their engagement with other firms within the region from an innovation perspective. Unlike healthcare, where this issue is in large part due to the density of the network, in the case of digital, it appears that this is due to firms being engaged in primarily adoptive and incremental types of innovation, reducing their need for collaboration with external partners. Therefore, it is the type of innovation carried out by such firms that is hindering the development of an innovation system within this industry, in that they do not in practice carry out substantial radical innovation projects. Therefore, from the digital perspective, due to no evidence of collaboration with regional partners, as well as their prevalence towards

adoptive innovation, it is difficult to argue that an innovation system of any scale exists within this industry and within the SCR.

As has been seen, both from the location of radically innovative firms within the SCR, the geographical location of innovation assets within the region and the broader issues associated with regional disconnect and the tribalist nature of the SCR and its periphery, it is not possible to argue that a RIS exists at the scale of the region. This is because while the region's periphery contains comparatively strong nodes of economic activity, such as Doncaster and Chesterfield, does not have any significant innovation assets to add to a system, and is poorly connected to the region's centre. As such, from the innovation system perspective the SCR has innovation systems within it that are closest to a LIS or innovation district, due to the concentration of innovative activity within its centre, or clustered together within the region's AMP. This thesis, however, argues that this is an issue not exclusive to the SCR, and that in some respects the term "Regional Innovation System" is a misnomer, due to issues concerning how the boundaries of RIS are drawn in the literature, or not in most cases, and how the literature tends to view regional innovation systems in a manner which instead of taking the entirety of a region into account, instead focuses on a city or collection of cities.

The issue of what constitutes a regional innovation system, particularly with regards to the boundaries of that systems, has been acknowledged as an issue and is one which has yet to be resolved (Doloreux and Parto, 2005). Many studies looking at RIS do not draw clear boundaries of where the RIS is geographically located, and instead focus on

the actors within those systems, without giving adequate consideration as to the area in which those actors are located. For example, Chung, in looking at RIS in Korea, noted: "We define a RIS as a complex of innovation actors and institutions in a region that are directly related with the generation, diffusion, and appropriation of technological innovation and an interrelationship between these innovation actors" (2002, p487). While this definition is one that is in line with much of the literature on innovation systems, given the importance of interaction between actors, such definitions by failing to define the "region" do not adequately take into account the geographical element of innovation systems. Often such studies while claiming to look at RIS, instead focus heavily on the central city or cities located within the regional boundaries, and therefore instead of looking at regions in the whole, focus on a relatively narrow part of it. This was highlighted in part by Doloreux & Dionne, who noted that: "current studies on RIS usually focus on highly urbanized metropolitan areas which attained exceptional levels of prosperity with the presence of strong associative and institutional organizations, intensive sharing of knowledge and an important number of knowledge-intensive firms" (2008, p261). This therefore demonstrates that little attention is given to less urbanised areas of a RIS, or their periphery. This poses the question of whether much of the literature when looking at RIS, really looks at the region, or instead focuses on the core cities, or collections of cities. This thesis argues that this is the case, and that from the multiscalar innovation systems perspective, such systems need to be constructed at a city or multiple city level, due to the lack of innovation assets located within regional peripheries.

Therefore, this thesis argues that a regional innovation system does not exist at the SCR level, and that it is unlikely that one may be created due to the concentration of the region's innovation assets within Sheffield, in combination with the high levels of disconnect and tribalism between the region's peripheral institutions and its centre. It is also argued that the boundaries and geographical area of RIS in the literature is poorly defined and mapped out, meaning that studies that look at RIS in reality focus on singular large metropolitan cities, or collections of cities. As a result of this, this thesis asserts that the RIS concept is unclear in terms of boundaries, and that the "regional" part of RIS is often something of a misnomer, as it often focuses upon either a core city, or several cities where innovation assets are concentrated. This therefore develops our understanding of the RIS concept, as it identifies that in many cases RIS do not adequately take into account peripheral regions, and instead in practice focus on cities or collections of cities rather than the region as a whole. Within the empirical context of the SCR, this therefore presents two options: either the region can focus on the building of LIS or innovation districts, suitable concepts due to the concentration of innovation assets in the small geographical area described by these concepts; or the concept of the region be expanded to include other core cities and concentrations of innovation assets.

In addition, this thesis argues that the SCR does contain many of the assets required for the development of an innovation system, such as a two regional universities, a collection of radically innovative firms, support through the SCR growth hub etc, it is argued that these components are failing to act as an single, coherent innovation system. This it is argued, is for two primary reasons: density and connectivity.

Although the SCR has a number of radically innovative firms concentrated within its core city, there is a lack of interaction between these firms, despite their geographical proximity. This, it has been demonstrated, is for several reasons, including a lack of regional awareness regarding what appropriate partners and activities have, that some firms do not see the value of regional networking, and that some firms believe that due to the lack of density in such networks, appropriate partners do not exist within the SCR, forcing them to look further afield. Therefore, although the region has the three main pillars in an innovation system, knowledge creating institutions, institutional support, and innovating firms (Katz and Wagner, 2014; Teixeira, 2014; Asheim and Coenen, 2005), it is due to a lack of connectivity between these pillars, in conjunction with a lack of overall absolute density of radically innovating firms which is preventing it from forming an innovation system. This therefore demonstrates the difficulty of localism for innovation-led growth, as it is necessary to both connect all of these elements within the SCR, while also increasing its density.

**9.6) The role of path dependency and network scale**

From the evidence presented in this chapter, this thesis argues that although the SCR has little evidence for the existence of any regionally based innovation systems, with the questionable exception of the region's AMP, which under some interpretations may be described as an early or developing innovation district (Katz and Kline, 2014), that the SCR does contain many of the component parts for one to emerge.

These elements are, however, located in close geographical proximity to the core city of Sheffield, and therefore brings into question both the value of the periphery in terms

of an innovation system, and in turn whether it is possible to create an innovation system within the SCR at a scale larger than that of the immediate core city of Sheffield, given the lack of innovation assets located within its periphery. Alternatively given issues associated with the low density of radically innovative firms within the SCR, in order to develop an innovation system with the density of networks and actors required (Katz and Wagner, 2014; Cooke et al., 1997), should the concept of the innovation system be expanded beyond the boundaries of the SCR to a larger level, bringing in additional innovation assets from other nearby core cities, such as Leeds. This therefore creates, from the innovation systems perspective, two potential approaches that are in conflict with one another. Either, due to the concentration of innovation assets within the region's centre, efforts may be directed towards creating an innovation system at a scale smaller than the city region, building on existing innovation assets in the centre at a scale most in line with the innovation district or LIS concepts (Katz and Wagner; 2014; Bresch and Lissoni, 2001). Alternatively, given the comparatively low density of radically innovative firms within the SCR efforts may be directed towards creating a innovation system at a larger scale than the SCR, in order to draw in innovation assets to overcome this lack of density, an approach which may be considered to be related to the RIS concept, albeit one at a scale larger than that of the city region. Both of these approaches have their own unique difficulties associated with them, given that as has been seen, smaller networks may lack the density required (Katz and Wagner, 2014), whereas larger networks, particularly from a geographical perspective, have difficulties associated with the transition of tacit knowledge (Martin and Simmie, 2008a; Katz and Wagner, 2004). This therefore demonstrates the complexities associated with attempting to deliver innovation-led growth through a

localist approach, and that in areas such as the LEP, this is further complicated by a periphery which contributes towards, and fits poorly within, an innovation system.

This thesis proposes that the concept of path dependency may be used, not only as it has been previously to explain the development of industrial specialisations and regional lock-in effects, but may also be applied in a new way as a tool to explain and predict why innovation systems and learning networks may develop at some scales and not at others. To put it another way, this thesis proposes that path dependency can provide exceptional explanatory value as to why some innovation systems are able to develop over large scales, whereas others are more suited to smaller ones, helping to bridge the issue of scale across the multiscalar innovation support and system spectrum. As this thesis has identified connectivity, networking and learning are the key elements required for the construction of an innovation system regardless of its scale, in the SCR there is evidence of significant disconnects across the region and between stakeholders and firms, and that the concept of path dependency while having a primary usage in explaining regional resilience and lock-in effects, has a number of elements which relate to innovation and the formation of innovation networks within a region or sub-region. Bringing all these threads together, this research argues that path dependency may be used in a new way, and that by looking at a region or sub-regions path dependency it is possible to predict and explain why learning networks are able to develop over certain scales and not others.

The SCR presents a demonstrable case where the path dependency of the region has resulted in its development in such a way which has affected the scale over which an

innovation system may be constructed, preventing the development of a SCR-wide RIS, yet leaving the potential for the development of LIS or innovation districts at a more confined geographical scale. As has been seen, a significant degree of political rivalry and tribalism exists between stakeholders from the region's centre and periphery, as well as a broad sense that the region's periphery is forgotten:

> *"If you look at their (the SCRs) growth hub website, it takes about the SCR, but doesn't say that it encompasses us or Barnsley etc so there's going to be tensions, and there already are tensions between them. And I think that tribalism is going to come out a lot more in the future"*
>
> SCHE1

This issue, due to its long running nature, is one way in which the region's path dependency has resulted in a "lock in" effect, where regional peripheral stakeholders are locked into a mode of behaviour and attitudes, making it difficult for the development of networks between stakeholders in the centre and periphery owing to this tribalism, and resulting in the region's path dependency affecting the scale at which an innovation system may be constructed. In addition, as highlighted in the empirical focus section of this thesis, Sheffield is the undisputed economic centre of the region, albeit a comparatively weaker one than neighbouring cities such as Manchester and Leeds. This is due in part to its history, owing to its role in the steel industry placing it as an economic powerhouse. This has had several effects, such as it developing expertise in steel, manufacturing and materials, that the city established two universities owing to its position in the region, with the ultimate result being that

the region's innovation assets are concentrated within Sheffield, rather than within its periphery. This, in combination with the issues of tribalism, demonstrates that path dependency of the region has played a role in preventing the development of a RIS at the level of the SCR.

Conversely however, this path dependency has also increased the likelihood that a smaller scale innovation district or LIS may develop within the SCR. The concentration of knowledge, innovation assets, knowledge creating institutions and radically innovative firms within the SCR, means that assets and related expertise are clustered together in a geographically concentrated area, meaning that many of the assets required for the development of such a system are already in place. As has been seen, the most significant issue preventing the development of an innovation system is due to the region's lack of connectivity, and therefore it may be argued that encouraging connectivity at this smaller scale poses a significantly easier task, and that in order to create a true innovation system within the region, it is only this connectivity which is required. In addition, the concentration of such a system within this smaller scale means that the issues concerning political tribalism and a diverse periphery are considerably less likely to be experienced, making the development of an innovation system at the local or district level considerably more likely, as well as further reducing the likelihood that difficulties in the transition of tacit knowledge would be experienced. As has been seen from the above examples in this chapter, the region's universities are already acting as nodes of connectivity for the region's innovative firms, as well as stakeholders, and therefore it may be argued that all that is necessary to create a innovation system within the SCR is to overcome the issue of connectivity,

and that the region's universities owing to their significant role of drivers of innovation within the SCR and points of connectivity, are best placed to facilitate this. It may be argued that this has already been seen in part in the region's AMP, with the University of Sheffield acting as an anchoring institution, bringing in radically innovative firms within an highly concentrated area, and that it is only the enhanced connectivity and interaction between firms which needs to be encouraged to truly develop an innovation district. This therefore demonstrates how the path dependency of the region, while making it less likely that a RIS will be able to develop within the context of the SCR, also makes it more likely that an ID or LIS can develop, and therefore is the scale at which an innovation network should be encouraged.

These factors therefore demonstrate several ways in which the path dependency of the SCR has affected the development of the SCR and its networks, which has in turn has affected the scale over which learning networks and innovation systems have been able to form. Despite this however, that is not to say that a region's path dependency cannot be changed, and innovation systems cannot be built at new levels. Such a change is highly difficult, however, requiring the concerted and sustained efforts of numerous actors to overcome entrenched attitudes, patterns of behaviour, political rivalries, existing networks and interests and the redistribution of innovation assets. Due to these difficulties therefore, it may be argued that a better approach is to build, develop and shape pre-existing innovation networks at scales which are congruent with an area's path dependency, rather than attempting to construct entirely new ones. In the case of the SCR in particular, owing to the concentration of its innovation assets within its centre and poor connectivity at numerous scales which have developed owing to its

path dependency, it is argued that it is better to develop existing networks rather than attempting to build a RIS at the level of the SCR.

This thesis therefore argues that the concept of path dependency can be applied from an innovation systems standpoint, being used as an explanatory tool to assess why and how networks form between innovating actors, knowledge creating institutions and regional stakeholders, and the scale at which these networks have developed. By using this as a tool it is possible to assess why innovation networks develop over certain scales and not others, and to help assess at what scale it is most effective to create an innovation system based upon the region's path dependency. One of the main benefits of this approach is that it reduces the likelihood of regions attempting to build innovation systems based on their institutional boundaries which may not link well with the region's learning networks and promotes a unique, bespoke and differentiated approach for the construction of such networks, one which truly takes into account the multiscalar nature of innovation systems and constructs such a system with boundaries drawn based not upon static theories of innovation system but taking into account the best scale based on multiple factors. This is in contrast to attempts by some regions to create networks at scales that do not relate well to regional conditions and instead take a standardised approach, with regions wishing to construct "the next silicone valley" regardless of the industries and networks which exist in a region. As a result this approach helps to, within the multiscalar innovation systems perspective, provide a tool which allows a scale of system construction to be chosen which is adaptive to the unique characteristics of an area, rather than the adoption of a top down dictated approach to innovation systems development.

### 9.7) Conclusion - Components but not a System

In conclusion this chapter has looked at how innovation practically takes place within the SCR, and the numerous implications of this surrounding the issues of innovation for growth, innovation support and localism, how this affects the region from an innovation systems perspective, and the multiscalar approach to innovation.

First this chapter looked at how innovation took place in practice within the SCR. It demonstrated that two of the three industries looked at by this thesis, advanced manufacturing and healthcare, identified for assessment because of their identification by the SCR as important to the region in terms of innovation, were radical innovators which were primarily concentrated within the centre of the region. The third industry, however, digital and creative, tended to be incremental innovators, and therefore contribute comparatively poorly to innovation-led growth within the SCR. It also noted that the region's firms, whilst not being averse to collaboration and networking, did not do so significantly within the SCR, bringing into question whether the region has any innovation systems within it. This chapter also demonstrated that there was low congruity between what radically innovating businesses required and accessed in terms of innovation support, and what was offered at a regional level. Regional innovators tended to value support and uptake support offered at a national level, bringing into question to what degree regional institutions can support innovation within the context of the UK, particularly in the case of radical innovators.

This chapter also highlighted the significant role played by the region's universities, not only as knowledge creating institutions and drivers of innovation, but also as significant points of connectivity in the region. While helping to develop the region in the manner laid out by the innovation systems literature, creating and diffusing new knowledge, which is commercialised by regional firms into radical innovations, the region's universities also act as nodes of connectivity, being highly networked with both the region's firms through a variety of interactions, as well as the region's stakeholders and supporting institutions and national stakeholders. Therefore, this demonstrates that the region's universities are one of the most significant innovation assets within the region, contributing to the development of knowledge and therefore radical innovation in the region, but also acting as key anchors in the development of collaboration and interaction. Due to this therefore, it may be argued that the region's universities are in the best place to forge future connectivity between and within stakeholders, allowing the region to function as an innovation system, rather than a collection of unconnected components.

This research also argues that one of the reasons behind why the region does not function as an innovation system at a regional level can be explained due to its path dependency. It demonstrates that path dependency explains both why the SCR's innovation assets are almost entirely concentrated within the region's centre, as well as why the region's periphery is disconnected. It proposes therefore that the path dependency concept may be used in another manner, explaining not only the development of the region and its adoption of certain industries, but also how the region is able to develop innovation networks at certain scales and not others.

Therefore, path dependency used as an explanatory tool with regards to innovation systems scale, may be used in a new manner, helping to highlight what is the most appropriate scale that innovation systems may be constructed based on an area's unique history, helping to promote a more differentiated and contextually appropriate approach to the development of innovation systems.

Therefore, this chapter demonstrates that the SCR has many of the assets and components required for the construction of an innovation system, a collection of radically innovative firms, the support of research intensive and highly networked universities, a range of supportive regional institutions etc. These innovation assets are not however currently functioning as an innovation system due to issues of connectivity and the absolute density of the network, with regards to highly innovative firms.

# PART 4: DISCUSSION AND CONCLUSION

## 10) Conclusion & Reflections

### 10.1) Introduction

From the above findings and subsequent analysis of those findings, this research has identified a number of significant characteristics regarding the nature of innovation and innovation support within the SCR. This has numerous implications with regards to areas such as how innovation is perceived, used and supported from a stakeholder perspective, issues concerning the support of innovation at a regional and sub-regional level, the complexities of the innovation system concept and a number of other insights around the multiscalar nature of innovation systems and support. From this research, three core themes, or threads, emerged: First, this thesis discovered numerous implications concerning the definitional complexity of innovation, and its practical effects on how innovation is supported from a stakeholder perspective, how it was defined differently within national and regional institutions, which in turn had further implications for innovation-led growth in a multiscalar, but particularly regional, context. Second, this thesis through looking at how innovation was supported through a stakeholder perspective, identified the significant challenges of localism for supporting and driving innovation-led growth, particularly with regard to the development of innovation systems, and the issues associated with scale and what is local or regional. Finally, through looking at how the region innovated in practice and assessing its innovation assets, this thesis identified that while the SCR has many of the necessary innovation assets required for the formation of a innovation system, as well as some evidence of the early emergence of a system in the case of the region's AMP, the region does not currently function as a system.

This chapter will therefore first present a summative discussion around these identified themes, as well as looking at innovation. Next, this chapter lays out the contribution of this research towards enhancing our knowledge around the multiscalar innovation system and support, and areas where further research may be required or beneficial, based on the findings of this thesis. Finally, this chapter lays out its final thoughts based on the overall findings of this thesis, and its implications for both practitioners and from the academic perspective.

## 10.2) Summative Discussion

### 10.2.1) Definitional Complexity and the Issue of Innovation-Led Growth

The issues surrounding the definition and measurement of innovation was highlighted early within the literature review of this thesis, and was the first concept surrounding innovation which was looked at in-depth. The reason behind why the very definition of innovation was the first point of discussion within the literature was due to its recognition by the literature that the term is one which is exceptionally complex, with numerous papers and academics adopting varying definitions and standpoints (Acs and Audretsch, 2005; Johannessen et al., 2001). This, from the academic perspective, results in a number of issues and difficulties, as no exact consensus exists as to what is, and is not, an innovation makes it difficult to cross compare studies, as well as more broadly reducing clarity surrounding the term and concept. This further spills over into the measurement of innovation, further complicating the study of the concept as well as causing significant complications regarding the measurement of its impact on economies (Acs and Audretsch, 2005; Johannessen et al., 2001). Due to of this definitional complexity, this thesis believed that both significant value and additional

clarity could be added through an initial reviewing of the literature, and the construction based on this of a definition to be used within this study. This was intended to primarily increase the clarity of this thesis by explicitly laying out the definition used, as well as being intended to aid the comparison of this study with others that have adopted the same or similar definition.

Much of the variance surrounding the definition of innovation can be related to the question: new to who? Broad definitions of innovation are accepting that an innovation may be something that is new to an individual or at an organisational level, resulting in a view that simply adopting a new technology, business model, process etc may be considered an innovation, leading us to use the term "adoptive innovation". Alternatively, more narrow definitions give newness a more restrictive role, with an innovation requiring its construction using new knowledge, and the production of something that is new to either the market or on a global scale. This relates in part to research conducted on two broad types of innovation, radical and incremental. Radical innovations typically require a high degree of new knowledge to create, and produce innovations which are radical in nature, and new to a market or global scale, whereas incremental innovations use significantly less new knowledge and often represent step changes in existing products, processes or services.

These types of innovation are of particular significance from a regional growth perspective, as it has been demonstrated that it is radical innovation which contributes most significantly to growth, to both firms and regional economies alike (Keizer and Halman, 2007; Sorescu et al., 2004; Blundell et al., 1999; Geroski et al, 1993; Chaney

et al., 1991). Therefore, the definition of innovation that was adopted by this study was: “the creation and adoption (by the relevant unit) of new products, processes, services and organisations”. This has the benefit that it related to the type of innovation best placed to deliver regional growth, in that it is the creation of something new rather than an incremental improvement, and that it is adopted by the relevant unit, be that a market or global scale, demonstrating that the innovation is commercially accepted and successful.

It was recognised, however, that although this was the definition of innovation used by this study, it was not necessarily the same as that adopted by innovating firms or regional stakeholders. Therefore, due to the acceptance that innovation while having some points of commonality such as the general acceptance that it involved some degree of “newness” (Johannessen et al., 2001), means different things to different actors, in order to add further clarity to this study it was decided to directly ask how stakeholders defined innovation. In doing this, this study demonstrated that the issues associated with the difficulty in defining innovation is one that is also shared by practitioners, with regional stakeholders adopting a range of definitions, resulting in a lack of an overarching and coherent view of innovation within the SCR. This therefore demonstrates that the issues surrounding innovation and its definitional complexity are not ones that are confined solely to the academic sphere, but are also experienced by stakeholders.

In addition, it was identified that the prevailing definition adopted by regional stakeholders within the SCR was one that was highly open and inclusive of the

adoptive and incremental view of innovation. There was a widely held view that innovation was perceived to be an elitist activity, beyond the reach of many of the region's firms, and as such many stakeholders attempted to adopt an open approach to the provision of innovation support. In addition, many stakeholders expressed a concern that due to this elitist view of innovation, that using the term was likely to alienate those that their support was targeting. As a result many stakeholders explained that they were reluctant to use the term innovation, and instead badged their support as growth rather than innovation. The result of such a standpoint was that regional stakeholders constructed support in accordance with their understanding and definition of innovation, however this resulted in a lack of a regionally based innovation offering, the construction of generic growth support programmes rather than innovation specific support, as well as support which was aimed towards supporting incremental, adoptive and non-innovators. This suggests, that given that such types of innovation contributes the least to economic growth, that the definitional complexities of innovation have resulted in stakeholders within the case of the SCR adopting a view and support structure for innovation which is ill-suited for innovation-led growth. Therefore, this thesis argues that the issues surrounding the definition of innovation is not a purely semantic exercise, as has been demonstrated how different definitions of innovation relate to different types of innovation. This therefore in turn impacts upon both the way innovation in a region is practically supported, as well as the role which such innovation plays or may play on a region's economy. To summarise, definitions affect how stakeholders understand innovation, how stakeholders understand innovation affects how innovation support is constructed, how innovation support is constructed

affects the type of innovation supported, and different types of innovation contribute to economic growth differently.

This therefore brings into question how should we define innovation, and in particular should innovation be defined for growth? The motivation of stakeholders to adopt an open and inclusive view of innovation is understandable, given that the adoptive and incremental types of innovation are more likely to be undertaken by a larger number of firms than radical innovation. In addition, evidence suggests that such types of innovation are more likely to be adopted by SMEs. Given Sheffield's high proportion of SME's therefore, in combination with the view that radical innovation is beyond the reach of the majority of firms in the SCR, it arguably makes sense from the perspective of stakeholders to use such open and inclusive definitions of innovation. The SCR, however, historically lags in terms of innovation and growth, and given the role that innovation plays in supporting growth (Hackler, 2010), it is argued that adopting a more restrictive view of specifically innovation-led growth would be of a greater overall benefit to the region than inclusivity. In addition, it may also be argued that the current definition of innovation has resulted in stakeholders developing innovation support that is arguably more akin to generic growth support, than innovation specific programmes. As such, the adoption of a growth-driven definition of innovation may help develop understanding amongst stakeholders of the role that innovation can play in reliving growth in the region, and the development of separate innovation support as well as the more generalist and include growth-led support offered by the region. This thesis therefore argues that innovation should be defined for growth.

In addition, regardless as to whether innovation should be defined for growth, this thesis argues that the definitional complexity of innovation and its practical effects need greater acknowledgement, and that regional stakeholders need to come together in order to define a clear, coherent and regionally uniformed definition of innovation. This is in order to ensure that growth and innovation are clearly differentiated concepts, so that support is tailored to each, and to promote the clear vision of development required for the sustained and unified efforts to support the growth of innovation systems (Katz and Wagner, 2014).

Furthermore, a disconnect between the types of definitions adopted by regional and national stakeholders was identified, a disconnect with significant implications for the support of innovation across the multiscalar support infrastructure. While regional stakeholders were shown to have a definition of innovation that was poorly suited to radical innovation, national innovation supporting institutions were demonstrated to have a view significantly more restrictive, and as such considerably better suited to supporting the types of innovation that deliver economic growth. Although discussed in greater detail later, the implication of this was that the region's radical innovators did not significantly engage with regional institutions but national ones. This results therefore in regional institutions being removed from high value regional innovation, meaning that within the multiscalar support spectrum it is only the national level which is effectively supporting innovation for growth, and that in order to bring regional institutions back into regional innovation and to provide a coherent cross scale approach in supporting innovation, it is necessary for regional institutions to adopt a more restrictive definition of innovation.

In conclusion, these findings contribute to knowledge and the literature by demonstrating that the often cited issue of definitional complexity of innovation is one not only experienced in academia (Damanpour and Wischnevsky, 2006; Garcia and Calantone, 2002; Johannessen et al., 2001), but also by regional stakeholders, which in turn has significant practical implications for the way in which innovation is supported, the first research to demonstrate that definitional issues associated with innovation impact upon practice. This complexity results in numerous stakeholders adopting a wide variety of definitions and stances of innovation, resulting in a lack of coherency in the region's approach to innovation, and a lack of a region-wide approach to innovation. These several practical implications, particularly with regard to the construction of innovation systems, where a clarity in the vision of the development of such a system is noted as an important factor in driving its formation (Katz and Wanger, 2014). Secondly, issues with this definitional complexity also then affect in practice how innovation is supported. As has been seen with the empirical case of the SCR, the prevailing definition is one that is most in-line with adoptive and incremental types of innovation, and focuses on firms which are considered to be non-innovative or less innovative. As such, support is focused upon and tailored towards these groups, providing highly generic support, which arguably may be considered to be general growth support initiatives rather than innovation support. Furthermore, due to a fear that innovation is perceived by such businesses to be inaccessible and an elitist activity, efforts have been made to avoid using the term, resulting in further dilution of the region's coherency in its approach to innovation. Finally, as from such definitions, support is directed towards incremental and adoptive types of innovation, this in turn

means that regional stakeholders are supporting innovation which is less well suited towards contributing to economic growth than radical innovators (Keizer and Halman, 2007; Sorescu et al., 2004; Blundell et al., 1999; Geroski et al, 1993; Chaney et al., 1991). This therefore demonstrates the practical impacts that the issue of definitional complexity has on regional policy and support, as well as what those in turn have on supporting innovation led growth.

### 10.2.2) The Challenges of Localism For Innovation Led Growth

The second results chapter of this thesis centred on innovation programmes and the nature of innovation support within the context of the SCR, issues surrounding scale and connectivity of spatially bound innovation systems, and highlighted the significant challenges of localism for the delivery of innovation led growth.

First this research demonstrated the extreme complexity caused by the issue of scale, as well as how this has practically played out within the empirical context of the SCR. It showed that the devolution of power and decision making authority from county-wide RDA to city regional-wide LEP has created several difficulties, particularly from the view of innovation systems and innovation support. Although the move from RDA to LEP is in theory one which should have helped the support and development of innovation and innovation systems, particularly given its congruence with the literature which suggests that smaller scales of intervention and the construction of most local innovation systems is a better approach due to factors associated with the transmission of tacit knowledge and the development of industrial specialisms (Asheim and Coenen, 2005; Freeman, 2002; Johnson and Lundvall, 2002), this research demonstrated that

for several reasons this was not the case in practice. There are numerous issues with the SCR scale from the innovation and innovation systems perspective, stemming from a number of factors. One such factor with the SCR and its scale regards the issue of its density, its scale and the location of its innovation assets. Although the SCR covers a number of other peripheral towns, the periphery does not contain any significant innovation assets, and it is for this reason it is possible to demonstrate the region does not have a RIS at the SCR scale. In addition, an issue highlighted by both stakeholders and indirectly by firms regards the size of the SCR network. It is noted by multiple parties that the geographical scale of the SCR is too small and lacks the resources required for significant impacts to be made, and as well as for the development of a region-wide RIS. This therefore poses a significant problem for institutional stakeholders, in that they may either add to the network in order to increase its density, however this would involve significant expansion of the geographical scale of the region to encompass other cities owing to a lack of innovation assets in the periphery, risking issues regarding the transmission of tacit knowledge and levels of connectivity (Johnson and Lundvall, 2002). Alternatively stakeholders may attempt to build a smaller highly networked innovation system at the scale of the locality or district, however this poses different yet also significant difficulties owing to the low density of the SCR network. As well as this issue, because of the concentration of innovation assets within the region's centre, as well as it being the strongest economic node within the region, there is a perception that the region's periphery is forgotten about and ill considered in innovation and regional support programmes. This, alongside other factors has led to significant levels of tribalism amongst stakeholders within the periphery of the SCR, further complicating its ability to act in a unified manner as a

single, coherent region. In addition, the financial arrangements that went along with this shift has resulted in innovation support in practice becoming less bespoke, as the RDAs had larger budgets and the authority to support local interventions, whereas the LEP has to develop catch-all, homogenised approaches. These factors therefore demonstrate the extreme complexities associated with localism for innovation led growth, and how the region may be an impossible scale at which innovation systems may be constructed, demonstrating that while a region may function as a functional economic area in some regards, it does not necessarily reflect this in innovation terms.

This research also contributes to knowledge by looking at the role of the periphery in the supporting of an innovation system and its place within the multiscalar spectrum. This is demonstrated by the identification that the region is both highly fragmented, as well as containing few innovation assets as a whole, with he majority being concentrated within the region's core city of Sheffield. From this, it is argued that it is not possible to claim that an innovation system exists at the scale of the SCR, as the region's periphery lacks both the connectivity with the centre to be considered a "system", as well as the innovation assets to significantly contribute to such a system. This therefore has significant implications for the construction of innovation systems as a supporting mechanism, as in order to increase the density of such a network would necessitate the expansion of the system far beyond the boundaries of the SCR to include other core cities, where innovation assets are concentrated. It is for this reason this research argues that the idea of an RIS is something of a misnomer, and is better described as a collection of cores.

Much like the complexity associated with regions, localities and the support of innovation and construction of innovation systems, this thesis also highlights the complexity of innovation support within the UK and the empirics context of the SCR. Radical innovators, those best place to deliver innovation-led growth within the region, noted that the majority of their needs were met by the national innovation support agency, Innovate UK. They noted that they did not receive regional innovation support as it was inappropriate to their needs and was often too generic, validating previous findings that the region's innovation support structure is poorly orientated towards radically innovating firms. Furthermore firms, when questioned what additional support provided at the regional level that they would benefit from, most were unable to point to additional support that they required. Given this, and that firms valued primarily financial support offered at a national level, something this thesis argues would not benefit from its provision at a regional or sub-regional level, brings into question the place and role that regional institutions can play in supporting innovation-led growth in their locality. However, this research also found that firms were in theory willing to work more locally, and believed that they would benefit from interacting more locally. In addition, aside from financial support, one of the most beneficial areas of support offered by Innovate UK was stated to be its role in helping finding suitable partners for collaborative innovation. Given the broad consensus of the literature that innovation systems are the best ways in which innovation can be supported in a locality, this thesis argues that regional stakeholders wishing to benefit from innovation-led growth need to move away from direct and generic support of innovation towards acting as network builders and nodes of connectivity. In addition, this thesis demonstrates that due to this complexity of localism for innovation-led

growth, as well as the potential benefits that may be directed from the development of spatially bound innovation systems, that it is necessary for regions and nations to adopt a multiscalar approach to innovation and innovation support.

In conclusion, due to these factors this research argues that a multi-scaled approach is necessary in order to adequately support innovation, and for regions to benefit from innovation-led growth. It argues that the role of the region or local support intuitions wishing to benefit from innovation-led growth should be to act as facilitators and system builders, as within the UK context, many of the needs of radical innovations are already met at a national level, and the devolution of such support to a regional level is unlikely to add significant benefits or further added value. However, regional innovators have expressed a willingness and desire to work more closely within the region, meaning that there is space within the multiscalar innovation support spectrum for regional stakeholders to act as nodes of connectivity and support innovation in this manner, particularly given the view of stakeholders that assistance in finding collaboration partners is one of the most valuable types of support offered by support institutions. This would help regional innovators therefore support the development of a local innovation system or innovation district, which is believed to be one of the most effective methods through which innovation may be encouraged (Katz and Wagner, 2014; Cooke et al., 1997).

### 10.2.3) Innovation in practice: Components and Disconnects

Having looked at how innovation was supported in theory in the preceding chapter, and how it was understood and defined by stakeholders in chapter 7, the final results

chapter investigates how innovation in the SCR takes place in practice, and how well this meshes with the stakeholder, support and systems perspectives. It identified that the components necessary for the development of an innovation system were present in the region, however due to numerous factors were failing to act as a system. This section contributes towards developing knowledge by further expanding our understanding of the role firms and institutions play in the development and formation of innovation systems, as well as developing the path dependency model, demonstrating its usage in explaining and understanding the scale at which innovation systems develop, an effective tool for better understanding where innovation systems may fit within the multiscalar innovation system environment.

The first significant finding of this chapter regarded the innovation assets that were present within the region, their geographical location and their connectedness. Practically all innovation systems concepts typically encompass three broad categories of innovation actor, often referred to as the triple helix: the innovative firms within the system, knowledge creating institutions, and other political and support institutions within the region or locality (Katz & Wagner, 2014; Doloreaux and Parto, 2005; Cooke et al., 1997). It finds that within the empirical case of the SCR all of these assets are present within the SCR, they are primarily concentrated within the region's centre of Sheffield, and that there are significant disconnects both between and within all of these components. There is a lack of interaction between the region's core and periphery with regards to it's institutional stakeholders, and radically innovative firms within the SCR do not significantly interact with supporting institutions or other regionally based innovators. The region's universities do play a significant role in the

development of innovation and innovation systems within the region, acting as nodes of connectivity, and the University of Sheffield through acting as an anchor institution has had some success in the development of the region's AMP, which may be described as an early precursor to a full innovation system. However, this is just one part of the required interactions for an innovation system, and disconnects between other components remain problematic. This thesis therefore argues that within the case of the SCR the components required for an innovation system exist, however because of these disconnects the "system" does not. Instead the SCR can be described as a collection of components rather than a system.

One significant way in which the findings of this research help to further develop the literature is through expanding our understanding of the role of innovative firms in the creation and facilitation of innovation system development. As this thesis demonstrates, with the notable exclusion of the region's universities, radical innovators in the SCR do not interact in any significant manner within the region. Although there are several reasons behind this, two factors in particular became apparent from firms interviews: lack of network density and lack of regional awareness. Innovative firms highlighted that due to their nature as radical innovators, they had highly specific needs, which in turn meant that the number of firms with which they could create meaningful partnerships was limited. This was an issue further compounded by the relative low density of radically innovating firms within the SCR, causing further difficulties as the opportunities for local collaboration was believed to be limited. In addition, commercial imperatives meant that firms did not naturally think locally, and were significantly more concerned with finding partners that best complimented their

needs and assets regardless of their location, further causing difficulty in local and regional innovation system development. Firms did, however, express a willingness to engage more locally, but often stressed that they were unaware of what was available in the region, both in terms of applicable innovation support and other firms where collaboration opportunities may exist. This therefore demonstrated that for regions wishing to facilitate the development of innovation systems, it is necessary to remove barriers to regional interaction, to make sustained efforts to increase awareness of regional assets, as well as to make efforts to increase the overall density of the network.

This therefore adds to the literature by demonstrating the difficulties associated with the creation of innovation systems in areas with low densities of radically innovative firms, and suggests that within the multiscalar spectrum that geographically larger networks may be required. This also highlights an issue experienced by radical innovators that significantly impacts upon the formation of innovation networks, namely that radical innovators because of their radical nature are often highly specialised, meaning that finding appropriate partners which match or compliment their innovation needs and capabilities is difficult. Therefore, this further complicates the development of regional or local innovation systems, as firms struggle to find appropriate partners, without further limiting this to the region, and this is complicated even further in regions with a low density of radically innovating firms. It shows that firms are more interested in finding the best partners for collaborative innovation and therefore do not limit themselves to the region. However, this research also highlights that radically innovative firms do collaborate in their innovation processes, and in

principle display a willingness and desire to work more locally. This therefore demonstrates that the lack of connectivity from the firm perspective may be overcome, however it requires a concerted effort to help increase the awareness of firms of regionally based appropriate partners, as well as attempts to increase the density of radically innovative firms within the region.

This research also contributes by developing the concept of path dependency, and expanding its usage from a merely explanatory tool within the field of resilience to one which may be used to explain the development of innovation systems over certain scales and not others. The concept of path dependency has been used primarily as a tool for resilience, explaining how regional economies develop, particularly with regards to particular industrial areas (Martin and Simmie, 2008a) and how this may result in the region or locality "locking in" to particular industries and patterns of behaviour and interaction. This thesis demonstrates however, that the path dependency of the SCR can be used in a manner which explains why the region has been unable to create an innovation system within the SCR boundary, however has had some successes in creating innovation systems at smaller geographical scales. Within the empirical case of the SCR, due to the role of the steel industry in the region's early history, Sheffield became the economic centre of the region, and although it interacted in a limited manner with its periphery, developed an economy that specialised in a different manner to its surrounding area. The development of the region's universities in particular also contributed to the concentration of expertise in the region's centre, particularly with regards to knowledge in the healthcare and materials industries. Because of this the region's innovation assets were confined to the relatively narrow

geographic area of Sheffield, increasing the likelihood that an innovation system be created at a level congruent with its innovation assets. In addition the region's periphery, due to long running historical and political factors has developed a culture of distrust and political tribalism between themselves, and the centre of Sheffield, making interaction and collaboration between the two groups difficult.

Therefore, this demonstrates that the unique path dependency of the SCR has resulted in the concentration of innovation assets and knowledge in a confined area, as well as the development of a tribalistic and distrusting culture between the region's centre and periphery. This has resulted in the SCR being unable to develop a RIS at the scale of the SCR, however comparative success in developing what may be described as an early innovation district in form of the region's AMP. This thesis argues that while this is based on the case of the SCR, application of this concept to other regions may be used as a method for explaining why innovation systems have successfully developed at certain scales, and unsuccessfully at others. With regards to its contribution to knowledge around the multiscalar nature and environment of innovation, this provides a new tool in assessing at what scale within this spectrum an innovation system might best be constructed, allowing for more nuanced approaches in the construction of policy and approach.

In conclusion, this study of the components and disconnect has contributed to the literature in two broad ways. First it expands knowledge of the role which radical innovators play in the development of innovation systems, and the importance of network density. Although the region's innovative firms are open to collaborative

innovation, engaging in practice in collaborative innovation practices, this does not occur significantly within the SCR. Although this is down to several factors, this thesis demonstrates that the most significant of these is that there is a lack, or perceived lack, of appropriate regional partners. Radically innovating firms do not necessarily "think local,' instead preferring to collaborate with what they perceive to be the best partner, regardless of scale. This demonstrates the need for those wishing to develop regional or sub-regional innovation systems to ensure that regional firms are aware of potential partners locally, as well as to impress upon firms the benefits of working with firms in geographical proximity. In addition, this is also an issue of network density, with there being relatively few radical innovators within he SCR. This therefore highlights the issue of network density in the creation of innovation systems within a locality, an issue that is difficult to overcome. The second way in which this thesis contributes is by developing the path dependency concept, demonstrating its utility in explaining the scale element of innovation systems and their success and failure. It argues that usage of this concept may help practitioners identify and develop innovation systems that are most in line with the region's assets, history and organisational and political culture, helping to encourage a move away from artificially drawn administrative and political boundaries and towards ones that are bespoke to the region and reflect the unique development of the areas innovation assets and networks.

### 10.3) Discussion of Research Objectives

Having summarised the key threads and findings of this research, the following section shall demonstrate how the research conducted as part of this thesis has helped to

answer and develop our knowledge around the three main research objectives of this thesis.

*Research Objective 1: To develop understanding towards the stakeholder perspective towards innovation led growth.*

This thesis has contributed significantly towards developing understanding with regards to the stakeholder perspective of innovation-led growth. It finds that difficulties associated with the definition of innovation experienced within the academic sphere are also present within institutional stakeholders, which in turn filters down and affects how innovation is perceived, and by extension supported. It demonstrates that this lack of clarity has resulted in a range of definitions being adopted by the region's stakeholders, preventing the development of a coherent approach towards innovation, its support and role in delivering regional innovation-led growth. This study also demonstrates that the prevailing definition adopted by stakeholders is one which is highly open, and is particularly orientated towards adoptive innovators and non-innovators, groups which have been identified as poor contributors to innovation-led growth (Sorescu et al., 2004; Blundell et al., 1999; Geroski et al, 1993; Chaney et al., 1991). In a desire to forward this open view of innovation and innovation support, the region's stakeholders have, because of a perception that innovation is an elitist activity, attempted to avoid usage of the term in order to avoid low and non-innovators from not engaging with offered support, further demonstrating that the support offered is orientated towards firms poorly place to deliver innovation-led growth. This thesis therefore demonstrates the significant

challenge extending from this definition in developing a coherent approach to innovation, and by extension innovation support.

This research finds that while the region has many of the assets required for the development of an innovation system, including supporting institutions, a collection of highly innovative firms and knowledge creating institutions, the components do not currently function as a cohesive system. This, it is argued is due to fact that regional stakeholders view innovation support as an individualised concept, rather than taking a system-led approach. This, combined with the issues associated with the multiscalar approach demonstrated how the stakeholder perceptions of innovation-led growth has hindered the ability of the region at the level of the SCR to develop as a system.

To summarise, this research meets this objective through demonstrating that the stakeholder perspective towards innovation led growth is one that is highly unclear, and in practice is actually not geared towards achieving this. It shows the stakeholder perspectives on innovation are unclear, due to difficulties surrounding its definition leading to a wide range of definitions being adopted by stakeholders, resulting in an unclear and incoherent perspective. It shows that in an effort to keep innovation support offered inclusive, stakeholders due to a belief that innovation is seen negatively and as an elitist activity by some have actually avoided using the term, demonstrating in part the negative perception of innovation held by some stakeholders, as well as how this has resulted in support being orientated away from radical innovators best placed to deliver innovation-led growth towards lower level innovators. This demonstrates that the stakeholder perspective on innovation is one

that is not geared towards innovation-led growth, demonstrating that the stakeholders need to be made aware of the role of innovation in driving regional growth. This thesis demonstrates that issues associated with the perception of innovation and innovation-led growth have resulted in a incoherent and poorly understood picture of the role innovation can play in regional development and how it is supported, highlighting and underlining the need for further clarity in understanding and defining innovation by stakeholders, and by extension the innovation support on offer.

*Research Objective 2: To examine the nature of innovation support in the region.*

This study has generated numerous insights and implications with regard to the nature of innovation support in the region. As highlighted above, the way in which regional stakeholders perceive and define innovation for innovation-led growth has directly impacted upon how stakeholders have constructed innovation support. Innovation support is heavily orientated towards firms that may be described as low or non-innovators, meaning that support tends to revolve around generic growth strategies rather than specialised and differentiated innovation support, meaning that stakeholders appear to demonstrate a poor understanding of the role innovation may play in regional development and focusing on the ends rather than the means. This results in innovation support within the region being orientated towards firms that are ill placed to deliver innovation-led growth. In addition, the multiscalar approach to innovation has resulted in significant complications, as national support is more orientated towards the needs of radical innovators. As such a binary system of support has developed, with the region's radical innovators being drawn towards national

sources of support, and low and non-innovators towards regional ones. This also has significant implications for the development of innovation systems, as the result of such support complexities means that the region's radical innovators, those who are key assets in the development of an innovation system, are not being encouraged to interact locally. As such, the SCR has many of the required components of an innovation system, but not the interaction or "system element". As such, it is argued that there is a need for regional institutions to attempt to develop this system, as it is the most significant missing factor hindering the development of an innovation system within the region. Furthermore, this research demonstrates that the scale and the nature of the region has affected stakeholder perceptions of innovation support, and their ability to deliver that support.

*Research Objective 3: To understand how the region's innovative firms perceive and access innovation support.*

This thesis makes significant findings regarding this objective, particularly around the needs of innovators, the support accessed, the role of the region within that support, the issues of multiscalar support and the definition of innovation adapted by stakeholders, as well as how this relates to innovation systems.

This study first identified that self-identified support needs of radical innovators are relatively simplistic and tend to fall within two broad categories. The first is a need for financial support for their innovation processes. It finds that the region's radical firms most access support that has a financial element, as this allows them to de-risk their

radical innovation projects, and allows them carry out high-risk high reward innovation. Secondly, firms value support in finding and identifying partners to work with collaboratively on innovation projects, including other firms and knowledge generating institutions. These needs of these types of innovators, however, are already met at a national level, primarily through the national level institution Innovation UK, which supports innovation of this radical type. This therefore brings into question the role that the region and localism may play in supporting innovation of this type, particularly when coupled with the finding that interviewed innovators were unable to point to any specific support measures they believed that they would benefit from at a regional level. It is argued however, that while little benefit may be derived from devolving financial support to a regional level, particularly given the displayed tendency of innovators to favour support of low and non-innovators, as radically innovative firms value support which puts them in contact with potential collaborators, this suggests that regional stakeholders may have a role to play by acting as these facilitators and "bridging" institutions. This would also further help the development of innovation networks within the region, as firms currently expressed that while they did engage in significant collaboration on innovation projects, this was with partners outside of the region.

Furthermore, this research finds that the incoherency demonstrated by the region's adoption of multiple definitions of innovation and a misunderstanding of its potential as a driver of growth means that the region's firms have no real need to access regionally based support. This incoherency has resulted in some stakeholders expressing a willingness to work more closely within the area in which they operated,

however did not due to a lack of awareness of what was available within the region as a result of this issue. As such, this research argues that the region would benefit from a more coherent approach, as well as regional actors aiming to forge connections between firms in the region and develop a network to overcome this, rather than providing generic and direct support, and therefore aid the development of a true innovation system within the SCR.

In addition, the definition of innovation adopted by stakeholders resulting in innovation support being directed towards low and non-innovating firms has resulted in regional support being inappropriate for the needs of the region's radical innovators. In practice, this in combination with the multiscalar nature of innovation support means that national support supports radical innovators, and regional low and non-innovators. This has significant consequences with regards to the formation of innovation systems, as the region's firms have no need or commercial imperative to "think local", which is expressed through the fact that they do not significantly interact with other institutions within the region.

Therefore, this research demonstrates that the way in which the region's firms perceive and access innovation support may be broken down into two types. Innovators value the innovation support offered at a national level and access it to great benefit. However regional innovation support is both incoherent, meaning that firms do not necessarily know what is available in the region in terms of support and collaborative innovation opportunities, and that due to stakeholders perceptions of innovation, is not geared towards their needs. It shows that because of this and the scale at which support

is offered, firms are drawn away from engaging locally and do not think along regional lines. This thesis therefore argues that the role of stakeholders needs to be expanded to help develop regional networks within the region to encourage firms to interact locally in order to form an innovation network, as well as to review how they perceive innovation to better support innovators that most contribute to innovation-led growth.

### 10.4) Research Contributions

This research, through its qualitative use of the SCR as a case study and its empirically -led research, has generated a number of research contributions, both specific to the SCR as well as ones which help to contribute to and develop the literature. Most significantly, this research has looked at innovation, innovation support and innovation systems through a multiscalar lens, with each of its major research contributions adding to our knowledge within this area, an understudied area of the literature.

#### 10.4.1) How Definitional Complexity Affects Practice

The first significant way in which this thesis contributed to knowledge and the literature is through its highlighting of the definitional complexity associated with defining innovation, and demonstrating how this is experienced by regional stakeholders, and how this then in turn affects the support and development of innovation in practice, the first study to our knowledge which identifies that such theoretical difficulties have an impact upon practice.

While previous studies readily acknowledge the difficulty associated with the definition and measurement of innovation (Damanpour and Wischnevsky, 2006;

Johannessen et al., 2001), this thesis expands upon this and develops the literature by demonstrating that this difficulty is also experienced by stakeholders, with a number of implications in practice. Within the empirics of the SCR, it demonstrates that this complexity of definition has resulted in a lack of coherency regarding innovation and innovation support in the region owing to the adoption of multiple definitions, but in particularly due to a tendency towards an open definition of innovation, one which was highly accepting of the incremental and adoptive types of innovation. It demonstrates, that because this definition adopted by stakeholders, this has practically affected how innovation support in the region has been developed, it being targeted towards low and non-innovators, as well as encouraging incremental and adoptive innovation. As a result of this, innovation of a type which is believed to contribute poorly to regional economic growth has been supported, meaning that innovation within the SCR is not being defined for growth, and therefore has significant implications for the cultivation of innovation-led growth.

This thesis therefore demonstrates that the definition of innovation is not a semantic exercise, but instead has significant and observable impacts on the way innovation is supported, the type of innovation supported, and from this, has significant effects on economic growth, further forwarding and developing the literature with regards to how innovation is defined, and practically demonstrating the effects that such definitions have upon practice, innovation support, and by extension the construction of innovation systems for innovation-led growth.

### 10.4.2) The Complexity and Issues of Localism for Innovation-Led Growth

The second significant contribution of this research regards the highlighting of the complexity and difficulty of localism for innovation-led growth, and the need for a multiscalar approach to innovation and innovation support. The research demonstrates that there are significant difficulties and complexities for supporting innovation-led growth at the local and regional level. In the case of the SCR, this is in part due to the highly complex nature of the region, with its innovation assets being concentrated in a relatively narrow geographic area, and issues of disconnect and political tribalism between the region's centre and periphery.

In addition to this, there are numerous complexities regarding how innovation is supported within the SCR and the UK. In many regards the needs of radical innovators within the SCR are met by nationally provided support, bringing into question the role of the region in supporting innovation of this type, particularly as the devolution of many of the functions provided at a national level is not believed to add any significant additional value. This thesis argues therefore that the role of regional support in supporting innovation should move away from the provision of direct support, and instead be primarily to act in a systems building role and as a facilitator, as it is networking support which is valued most by radical innovators, is important for the development of innovation systems, and is a role that if devolved may have added value through its delivery at a local or regional level. In addition, this therefore demonstrates the importance of a multi scaled approach to innovation support, and that the devolution of support and decision-making authority while undoubtedly beneficial in some circumstances is not always the case.

### 10.4.3) Develops Understanding Regarding the role of the Periphery In Innovation Systems

Third, this thesis contributes by expanding our understanding of the role of the periphery in innovation systems. It demonstrates that due to the way in which the SCR has developed has resulted in the concentration of innovation assets within the region's centre, with no significant assets being located within the periphery. Furthermore, it demonstrates that due to a number of long running factors, the region is highly disconnected between its centre and periphery, and that a high degree of tribalism exists between institutional and political actors. As such, the region lacks both the "system" element of an regional innovation system due to this disconnect, as well as the assets to create such a system beyond the narrow geographical confinements of Sheffield.

This both brings into question the value of the periphery from an innovation systems perspective, within the context of the SCR demonstrates that no region-wide RIS exists or is likely to exist as due to this disconnect and highly centralised distribution of innovation assets, as well as disconnect between actors. As such this brings into question the value of attempting to forge such a system based within the SCR geography, as doing so is unlikely to add further assets to the system. Furthermore this, in combination with the lack of assets and density of networks within the SCR therefore demonstrates a significant problem in such regions associated with localism and innovation-led growth. Either, such regions may attempt to forge networks and grow the network based on existing assets, something complicated by a lack of density of the existing networks, or to expand its scale far beyond the boundaries of the SCR

in order to add further innovation assets to its system, which is complicated by issues with the transition of tacit knowledge. This therefore both adds to our understanding regarding the difficulty of localism for innovation-led growth, as well as brining into question the role that the periphery places in the regional elements of the innovation systems spectrum.

Furthermore, this thesis challenges the concept of a RIS, believing it to be something of a misnomer. It asserts that given the tendency of innovation assets to be concentrated within core cities, that RIS are either confined to the city within the region, or collections of multiple cities. This is complicated by the fact that often the boundaries of innovation systems are poorly drawn, and little consensus exists with regard to their actual geographical size. It is for this reason this thesis asserts that in practice regional innovation systems often do not include the periphery of a region, bringing into question whether it is truly a regional system. Instead it is argued RIS in practice are the collection of multiple cities, or single examples.

This research therefore further reinforces and highlights the significant issues of localism for driving innovation-led growth and the construction of innovation systems, as well as further expanding our knowledge of the role of the periphery in innovation systems, its potential and in particular its drawbacks from the innovation systems perspective. This is of particular relevance given, due to the issues associated with tacit knowledge transmission, there is an unmistakeable trend in the literature towards smaller scales of economic intervention and control. This therefore demonstrates that, from the perspective of innovation systems, smaller is not always better.

### 10.4.4) Develops the Path Dependency Concept

A fourth major contribution of this research is its expansion and further development of the concept of path dependency, from primarily a tool explaining resilience levels within an areas into one which can be used as a way of explaining the scale of network formation, in particular innovation networks. This, as well as having utility as an explanatory tool may also be applied in a manner to assess at what scale it is best to construct innovation systems, resulting in a bespoke and differentiated approach towards the construction of such systems based on the unique history and circumstances of the region.

Although the boundaries of the SCR were drawn in order to reflect a functional economic area, this is not the case from an innovation perspective, and it is not possible to claim that a RIS is present at the same scale of the SCR. Because of several factors, the regions path dependency has resulted in the concentration of innovation resources within a relatively narrow subdivision of the SCR, namely within the core city of Sheffield, and on its boundaries in the region's AMP. This has therefore made the construction of innovation systems at a smaller scale more likely due to this concentration of assets, something that has practically been evidenced by the emergence of an early innovation district within the AMP. In addition the region's history has resulted in a significant disconnect between the centre and periphery of the SCR, the development of diverse economies within that periphery than compared to the region's centre, as well as the development of significant political rivalry and tribalism, which has been evidenced in part by the recent breakdown of the SCR's

devolution deal. This therefore demonstrates how path dependency from the innovation systems perspective, has prevented the development of innovation at some scales, and made it more possible at others. This develops the concept of path dependency by further expanding its usage and utility, as well as bringing it together with the innovation systems literature, and provides a useful tool in assessing at what scale, within the multiscalar spectrum of innovation systems, is the most appropriate for constructing innovation systems and support mechanisms.

### 10.4.5) Drawing the Threads Together: Taking the Multiscalar Perspective of Innovation

All three themes presented in the results chapters, the definitional issues of innovation and different definitions adopted by stakeholders at different scales, the innovation practices and preferences of radical innovators and the challenges associated with the localist agenda, each contributes and adds knowledge towards and demonstrates the complexities, difficulties, realities and benefits of the multiscalar nature of innovation. Each of these chapters therefore addresses the gap in the literature through the contribution of knowledge around the multiscalar nature of innovation and innovation support.

The first results chapter of this thesis covering the definitional complexity associated with innovation, how stakeholders operating at different scales define innovation differently, and how this impacts upon innovation support and economic strategy more broadly. In this chapter, knowledge is contributed in the area of multiscalar innovation by demonstrating that multiple levels of innovation actors within different scales of

innovation systems can have significantly different definitions of what constitutes innovation, and therefore from this definition support is constructed differently. This further demonstrates that such definitional variance can cause significant complexities, difficulties and ultimately misalignment between the types of innovation supported at different scales and the best types of innovation for the economic development of the region, or a region's or locality's strategically important sectors.

The second results chapter of this thesis looks at the significant challenges associated with the localist agenda, the issues of scale and the drawing of boundaries in order to meet new geographies of innovation systems and levels of political control. This contributes towards our knowledge of the multiscalar nature of innovation by demonstrating the potential trade-offs that may be required between innovation and connectivity, which affects the scale at which these systems and levels of control may be most effective. Furthermore, it highlights the need to consider that although previously the literature advocates the use of one particular scale or another as the "best practice" for the construction of innovation systems, with an unmistakable trend towards smaller ones, in practice this is not necessarily the most effective, and a consideration of multiple scales and the innovation assets and connectivity within them is required.

The final results chapter of this thesis focuses upon the innovation practices and preferences of radical innovators within the SCR, demonstrating their lack of engagement with both other firms within the region, as well as with regional innovation support mechanisms. This chapter contributes further to the consideration

of the multiscalar nature of innovation by demonstrating that innovators in practice will make use of both support and network with multiple scales of innovation system in practice, should their needs not be met at smaller scales. It contributes by showing that in certain industries and areas, due to the highly specialised nature of some radical innovators it is difficult to find appropriate partners at most local innovation system scales, that firms are in practice considerably more concerned with "best fit" rather than geographical proximity, and therefore the barriers to constructing larger scaled innovation systems may not be in practice as sever as previously believed. This chapter also highlights how the path dependency model may be applied in a new way, through looking at an area's unique history as a tool for assessing what scales within the multiscalar spectrum that an innovation system may be most effective.

Therefore each of these themes come together in order to provide significant new knowledge surrounding innovation in a multiscalar context, their complexities, challenges and benefits, as well as how within the empirical context of the SCR how this practically impacts upon innovation and its support.

These themes serve to demonstrate that the multiscalar approach to innovation support is both complex and often lacking in coherency, yet despite this it is also in some respects beneficial, and that in spite of these complexities should the identified issues be overcome, the multiscalar view of innovation is ultimately beneficial. This research therefore demonstrates a need for multiple scales, for boundaries of innovation systems to be drawn at appropriate scales given local context, and a need for stakeholders across these scales to increase connectivity within and between these scales. It is for

these reasons therefore that significant value is to be had through an increased focus upon the multiscalar nature of innovation, innovation systems and innovation support as an area of academic enquiry.

Therefore, the ultimate contribution of this thesis is that each of the three examined themes demonstrates from this empirically-led study by contributing knowledge towards the multiscalar approach of innovation and innovation support, the complexity and difficulties associated with such approaches, as well as its benefits and the need for a differentiated approach with regards to innovation and scale. It therefore, given the significant gap identified in the literature contributes to knowledge and theory by contributes through its addition of knowledge to the multiscalar nature and approach of innovation.

### 10.5) Limitations

The below section examines the limitations of this study, with particular focus upon the nature of the methods and research approach adopted, as well as taking into consideration events that occurred during the period of this study that may have impacted upon participant responses. Some of these factors are considered to be an inevitable part of the type of research conducted, an accepted limitation associated with qualitative and inductive research, while others were considered to be limitations that were unable to be anticipated owing to the significant, unexpected and unprecedented developments in the political landscape of the UK and SCR.

#### 10.5.1) Broader Limitations of Qualitative Research

One limitation of this thesis relates to the adoption of a qualitative approach as the primary research method for this study. As highlighted in the methodology section, while the qualitative approach has a number of benefits including its role in the generation of theory, and the collection of nuanced and in-depth information, it also has several significant drawbacks. As Brymann and Bell (2011) note, as qualitative research is subject to a number of criticisms, such as that it is too subjective of an approach, there are issues concerning the generalisation of findings arising from such work, and related difficulties associated with the replication of such findings, ultimately brining into question the reliability and validity of conducted research. Despite these criticisms this research asserts that the drawbacks of this approach do not outweigh the benefits, particularly given the aim of this research in combination with practical measures taken to mitigate this limitation.

This study asserts that the qualitative and inductive approach to be the most appropriate for this study due to the factors previously highlighted in the methodology section. These factors include a lack of pre-existing information on the nature of innovation within the SCR requiring a more flexible approach to research, that there was a requirement for the in-depth approach that qualitative research provides in order to gain a deep insight into the themes being examined, something which a quantitative approach would not have been able to provide, and that qualitative research was required in order to redress the heavily qualitative bias within innovation studies. In addition, as research on innovation within the boundaries of the SCR, was sparse, it is argued that quantitive testing of theory would be too narrow as an approach as not enough data exists to have developed a robust hypothesis to test. Therefore the theory

building approach of a qualitative approach, while having several inherent drawbacks is asserted to have been the most appropriate for the purposes of this study.

In addition to the qualitative and explorative approach to research being the most appropriate for the aims of this study, several measures were taken in order to offset and mitigate against some of the most often cited limitations of qualitative approaches. First, and most significantly, in order to remove subjectivity from the analysis of conducted interviews, a thematic coding approach was used, which through multiple readings of the the transcribed interviews in combination with the coding of themes that emerged and were present across multiple interviews, stakeholders and firms acted as a method to reduce subjectivity in the analysis of the qualitative data. Other ways in which this study took steps in order to improve the validity of this research and ensure that it adequately reflects the nature of the SCR included interviewing stakeholders from all areas of the SCR in order to ensure the region in its entirety was represented, continuing the data collection portion of this study until a point of theoretical saturation was reached through the thematic coding of interviews and the use of an interview guide in order to ensure consistency in the discussion of topics. Therefore, this research argues that while the use of a qualitative research method does constitutes a limitation, it was the most appropriate for the purposes of this research and the subject matter under investigation, and was adequately mitigated against by the measures taken above. In addition, while qualitative research does have limitations, to have adopted a quantitative approach would have also brought with it a range of different limitations, and it is argued that no infallible research methodology exists which does not have its unique set of limitations and benefits. In addition, while such

criticisms of the qualitative method are valid, this research has taken numerous steps in order to mitigate as much as possible.

### 10.5.2) Limited to the SCR

Another limitation of this research is that it is limited to a single case study of the SCR. As mentioned in the methodology and discussion sections of this thesis, the approach to this study was heavily qualitative, and in particular inductive. As such it was believed that the single and focused case study of the SCR would provide an adequate source to generate insights regarding innovation, innovation systems, innovation support and the effects of rescaling from a theoretical perspective. While this study believes that this has been the case, as underlined in the discussion and contribution sections of this thesis this research has generated a number of theories and theoretical developments, it is accepted that qualitative and inductive research does have limitations in that while such an approach is highly adept when it comes to theory formation, it has a lower levels of validity (Brymann and Bell, 2011). Despite this however, the findings of this research may be applied in both broader contexts, particularly with regards to findings concerning the disconnects, conflicts and difficulties of the multiscalar approach to innovation support, or at more local contexts in regions which share characteristics with the SCR, particularly in regions with weak centre-periphery relationships. As such while this study through its focus on one area may technically constitute a limitation, the broad applicability of the findings generated from this approach suggests that it is not a significant one.

### 10.5.3) Uncontrollable Events: Two Elections, The EU Referendum and Failure of the SCR Devolution Deal

Over the period of which this research was conducted, several uncontrollable events occurred which may have influenced the responses of stakeholders, or if they were to be interviewed again now, have changed the responses that they would give now. As such, although it is argued these events constitute a limitation of the study, it is argued that they were ones which were unavoidable, particularly given the unexpected nature of several of these events, as well as being an unavoidable consequence of conducing research over a prolonged period.

During the period of this study two general elections were held, the first of which was expected, and the second of which was not. The first election held on May the 5th, 2015, and resulted in the move from a Conservative-Liberal Democrat coalition to a Conservative government. The second election was a snap election, and took place on the 8th of June, 2017 and resulted in a move from a Conservative government to a Conservative minority government with support from the Democratic Unionist Party. While these elections may be considered a limitation, in that they may have affected the opinions given by firms and institutional stakeholders in retrospect, it is argued that overall this is unlikely. This is because although both these elections triggered change in the UK, moving from a coalition, to a majority government and back to a coalition again, because prior to and after all these elections the Conservatives were the largest party, it may be argued that as no party changed, neither did the broader political ideology behind it. As such, it may be argued further that any changes that did occur after these elections cannot be attributed to a change in the ruling party, and therefore

unlikely to have changed the views of stakeholders significantly or at all. This is also particularly likely when it is considered that the component institutions and boundaries of the innovation system also remained unchanged, with the LEP system remaining in place at the same boundaries of the SCR throughout. Therefore while this thesis considered these elections to be a complicating factor in this research and therefore a limitation, it does not view it as a significant one.

Perhaps the most unexpected event to occur during this study was the holding of a referendum regarding whether the UK should remain in the European Union, and the result being that the majority of voters wished to leave. Although at the time of writing (2017), this process is ongoing, and whether the UK will leave the EU and if so under what conditions and arrangements this would occur, it is likely to have a significant impact on the funding of the region, the funding and provision of innovation support, and the broader macroeconomic conditions affecting the region's firms. Therefore, this particular event may have influenced stakeholder responses if it had occurred before interviews were conducted. However, despite this it may be possible to argue that the implications of these events although having a significant future impact on the region and the UK from a stakeholder and practitioner perspective, in terms of this research's contribution to research and theory it is unlikely to affect these conceptual developments. In addition, as this separation is yet to happen, the direct impact is still yet to be felt and therefore the previous responses by stakeholders are still likely to be relevant and valid until the change has taken place.

The final event to occur during the carrying out of this study which may have had the most impact on the view of stakeholders in the SCR is the breakdown of the SCR's devolution deal. Although at the time of writing, and as covered in the discussion section, discussion and debate regarding the exact nature and scale of the deal is still ongoing, due to the pulling out of two of the region's local authorities from the deal, it is no longer possible to assert that any future devolution deal will be at the full level of the SCR**.** This event, due to its significance and relevance to the SCR and the institutional stakeholders within it, may mean that in retrospect some stakeholders may change responses that they gave previously. In the instance of this particular event, however, it is argued that it is reasonable to assert that it is unlikely to have changed the views of interviewed regional stakeholders. As demonstrated in the results and discussion sections, it is possible to demonstrated that the SCR is subject to numerous disconnects, difficulties working together as a region on an institutional scale and a high degree of tribalism. This therefore, while an unexpected event, validates, at least in part the findings and the responses given by institutional stakeholders, meaning it is unlikely that they have changed their opinion since.

This thesis argues while in a strict sense these events, and their impact or potential impact on this study may constitute a limitation, given the unexpected nature and in the case of the UK's decision to leave the EU entirely unprecedented nature of the events, while may be a limitation is not something that this study would have been able to control for, even if the events had been expected. However, for the reasons cited above this research argues that while technically a limitation, there is evidence to

suggest that such events are unlikely to have impacted responses given in the immediate to short term.

### 10.5.4) Conclusion

In conclusion, this research does have several limitations as identified above, however, this thesis argues that some of these limitations, such as the selection bias and the uncontrollable political events that occurred over the duration of this study, were entirely unavoidable. In the case of the broader limitations caused by a qualitative research methodology, while this thesis accepts the limitations which exist in this approach it argues that ultimately qualitative research was the most appropriate method for the purposes of this study, and that qualitative research also has a significant number of limitations also. Additionally, while this research accepts that it was limited with regards to the industries and geographical area which was investigated, this was a necessary limitation to give adequate focus, as well as due to practical considerations of time and resources. Therefore, while this thesis accepts that the above limitations do exist, it argues that for the above reasons such limitations do not invalidate the findings and work of the conducted research, even through it accepts that some further research in some areas may be required, or at least would be beneficial in order to increase the validity of its findings.

## 10.6) Future Research

From the research undertaken by this thesis, a number of areas where further research would be beneficial in contributing to our knowledge regarding innovation, and

innovation systems became apparent, as well as helping to further develop the findings of this research and provide further validation of its findings.

### 10.6.1) Replication Outside of the SCR

One of the most significant ways in which further research could both further develop understanding of the concepts looked at as part of this thesis, as well as to further validate its findings, is to repeat this research in other regions, both similar and different in character to the SCR, as well as within the UK and abroad.

First, this thesis accepts that because this thesis was set within the contextual boundaries of the SCR, that the study was limited to the study of these characteristics and their effects. Regions within the UK have a wide range of similarities and differences with the SCR, with more and less developed examples of innovation systems, different core-periphery relationships, and a wide range of different support mechanisms and institutions. Therefore this research believes that replication of this research in other regional contexts within the UK would add further depth and understanding to the issues associated with the supporting of innovation at a regional level, the perception and utilisation of innovation-led growth and the construction of innovation systems within different regional contexts. Conduction of this research within regions with stronger innovation networks would also be of value. For example, as this thesis demonstrates the definition of innovation affects perception, which affects support. Therefore, in regions with these stronger and more established innovation systems and networks such as Cambridge and its biomedical innovation system, it is worthwhile investigating whether stakeholders have a view of innovation

which is more in line with radical innovations, and whether support is therefore formed upon this basis?

In addition, this study was embedded within the context of the UK, its political and economic systems and governance arrangements. Although the findings of this research can be applied elsewhere, regardless of the nation, it is accepted that innovation systems and the multiscalar approach to innovation support is to a degree contextually specific, affected by the support offered by the nation and the degree to which the nation devolves power to its regions. As such, further research outside of the UK context would serve to add further understanding of how these difficulties and complexities express themselves within different organisational and governance contexts. Therefore, while this thesis strongly defends its usage of a single case study of a single region as part of this research, in order to gain in-depth and highly contextual information regarding a range of highly complex topics and dynamics, something which would have been reduced through attempting to conduct multiple case studies in the same timeframe, it does accept the value of multiple case studies. This is both in order to gain further depth and insight into a highly complex and context-specific subject, particularly with regards to innovation systems and path dependency, as well as to further validate the findings of this research.

Replication of this research in other regions, both within and outside of the UK economic-political context would also serve to further validate this thesis's assertion that path dependency may be used as a predictor and explanatory tool for the scale at which innovation systems may or may not develop. However, it is accepted that the

best and most impactful manner in which finding could be tested would be if it were practically applied to a region undertaking a conscious effort to develop an innovation system. Therefore the best way to validate this assertion would be to engage stakeholders within another region wishing to actively achieve this goal, and use the path dependency tool to assess the region's historical development, the development of innovation assets, expertise, the geographical distribution of firms, developed networks and historical barriers to these factors, and identify the best scales for which such a system may be constructed. In addition, although it is asserted that the main findings and contributions of this research may be applied elsewhere, particularly within the context of the UK given the research's embeddedness within the political and economic framework of the nation, the conducting of further research outside of the UK context would serve to further validate the findings of this thesis, as well as in particular examine the difficulties and complexities of the multiscalar approach to innovation support in nations with different state-region dynamics. Therefore, conducting the same research in different regions would serve to add additional layers of understanding and validate findings.

### 10.6.2) The Inclusion of None and Low Level Innovators

Another area of further research would be to further assess the contribution of both non-innovators and low-level innovators to regional economies. As this research has demonstrated, within the empirical context of the SCR, innovation support is heavily orientated towards firms that were engaged in low-level innovation such as incremental and adoptive types, and firms that did not currently innovate. Although the approach of this research was to investigate the role of innovators within the SCR, it

became apparent that the focus of stakeholders and support offered was primarily focused on firms that may be described as low or non-innovators. As such, if stakeholders are to orientate support towards these none- and low-innovators, and given that it is radical innovators which are best placed to deliver innovation led growth, it is argued that the study of non-innovators may be worthwhile, in order to assess not only their contribution to the economy, but ways in which they may be supported to move from non-innovators to low-innovators, and from low innovators into radical ones.

Therefore, it is argued that further research looking at the contribution of such groups to the regional economy and development would help provide further clarity and depth. Furthermore, given the demonstrated value of radical innovation to both regional development, further research investigating why firms do not innovate, or innovate in a low level manner may be of benefit, helping to develop our understanding of such firms and help develop support and development pathways to help firms transition into radical innovation.

**10.7) Final Thoughts**

This thesis has demonstrated that the concept of innovation is a highly complex topic, with even its definition being a point of contention. This is further complicated by issues surrounding the construction of innovation systems, the place and perceptions of innovation-led growth in regional development, and issues associated with the scale of the region, innovation systems and the multiscalar approach to innovation support. Ultimately, the SCR may be described as a region experiencing difficulties of

disconnect, density and scale. Interviews with key innovation actors within the SCR have revealed that the region despite having the components required for an innovation system to develop does not act as one, lacking the connectedness between actors required to be considered a system. It demonstrates that the scale of the SCR is also an issue, as although its boundary was driven to reflect a functioning economic boundary, the relationship between centre and periphery is weak, and innovation assets are concentrated almost in their entirety within the region's core city. As such, it may be argued that a RIS at the level of the SCR does not and may not exist, as the inclusion of the periphery in such an innovation system would not significantly add innovation assets to the system. This is highly problematic, given the assertion by both firms and institutional stakeholders that the region lacks the density of assets and networks in order to form a large innovation system, meaning that in order to draw in more innovation assets the system would have to expand outside the boundary of the SCR to encompass neighbouring cities. This therefore poses a significant difficulty for stakeholders, as the options available to them mean that either innovation networks are attempted to be forged in an area considered by many to be too lacking in density to be effective, or to extend a innovation network beyond the boundaries of the SCR to include neighbouring cities in order to add additional innovation assets to the system, and risk the geographical area becoming too large to become effective. This therefore demonstrates the extreme complexities involved for localism and the support of innovation-led growth.

This study has also highlighted a number of implications for policy and practice. It shows how definitional complexity has actively shaped the way that the region

provides innovation support, how innovation is perceived as a generator of innovation-led growth, as well as reducing the clarity and coherence of innovation and innovation support within the SCR. These issues therefore demonstrates the need of regional stakeholders to gain further clarity and unity in their definition of innovation, and whether they wish to use innovation as tool through which regional growth is driven. It demonstrates that the wide variety of definitions adopted by stakeholders reduce the clarity of vision and direction needed for the development of innovation systems (Katz and Wagner, 2014), and that their current conceptualisations of innovation poorly fit with those necessary for innovation-led growth.

This research also through the expansion of the path dependency tool as one for explaining and predicting the scale at which innovation systems may develop has significant impact for practitioners. It demonstrates that due to the region's unique path dependency, numerous characteristics and factors develop over time that prohibit and hinder the development of learning and collaborative networks at certain scales within the region, and make it more likely that such networks develop at others. This tool may be used by stakeholders to assess how their region has developed and at what scale is the most appropriate to facilitate and support, and develop a bespoke and contextually appropriate strategy to development. Alternatively, this tool may be used by stakeholders wishing to construct larger innovation systems to identify and tackle the barriers that have developed preventing the development of innovation systems at certain scales.

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## 12) Appendix

### 12.1) Appendix 1: Ethics Approval


Downloaded: 10/02/2019
Approved: 15/01/2015

Joel Capener
Registration number: 130239781
Management School
Programme: PhD Research

Dear Joel

**PROJECT TITLE:** Innovation, Resilience and Rescaling: Lessons from the Sheffield City Region
**APPLICATION:** Reference Number 001813

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 15/01/2015 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 001813 (dated 13/01/2015).
- Participant information sheet 004573 version 1 (13/01/2015).
- Participant consent form 004574 version 1 (13/01/2015).

The following optional amendments were suggested:

*Please consider removing the wording about taking hand written notes from the sentences below. This is because the participant may agree to hand written notes but not recording and the form does not capture this. Data Collection Information: During this interview I intend to record through both taking notes and making an audio recording. Please initial below if you consent to me taking notes and recording this interview. Initial.. I would suggest asking for their agreement to audio-record the interview only.*

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Yours sincerely

Harriet Godfrey-Holmes
Ethics Administrator
Information School

**12.2) Appendix 2: Stakeholder Interview Guide**

# Stakeholder Interview Guide

1. Please describe your role in this organisation, and how it relates to encouraging economic development in the Sheffield City Region?

2. Do you/does your organisation see innovation as important, and how do you understand it

3. What are the local strengths of the city region? (with regards to key sectors, infrastructure, skills, historical strengths?

4. What do you believe the key priorities are in encouraging businesses to innovate.

5. What policies are currently in place to help facilitate innovation, and who are they targeted at?

6. What additional measures do you think would help to foster innovation?

7. (Define economic resilience) What do you believe are the key components of economic resilience at both the level of the city region and firm, and how would you go about improving it?

8. How would you assess the city regions current level of economic resilience as well as its relative strengths and weaknesses, and what are the key priorities for its improvement?

9. What specific barriers exist that are currently preventing businesses from being innovative and more resilient?

10. What strategies and programmes are being currently provided by your organisation in an effort to foster economic resilience amongst businesses in the city region?

11. Has the rescaling of institutions from the regional to city regional scale (For example from RDAs to LEP if applicable) affected your organisation, and what challenges has this shift created?

12. Are there any industries that are currently not in the SCR that you believe should be encouraged to develop in the area?

13. Finally, is there anything we have not discussed that you would like to add?

**12.3) Appendix 3: Firm Interview Guide**

# Firm Interview Guide

1. First, would it be possible for you to describe your company, and tell me briefly about its development/story/history?

2. How important is exporting to your company?

3. For you/your company, how do you view and engage innovation?

4. Would it be possible for you to talk me through how your firm approaches and implements innovation?

5. Can you give some examples of how your company has innovated in the recent past?

6. When innovating, is this an entirely internal process within your company, or do you collaborate with external partners and institutions?

7. How integral is innovation to your business?

8. Has your business ever received innovation support? If so, when receiving business support, particularly for innovation, who do you tend to approach and why? ***(This question is designed to lead onto the LEP/national level support issue)***

9. Is there any support at the regional level that you believe would help you to be more innovative?

10. How would you say that the recent recession effected your company, and why?

11. Did the recent recession make it necessary to make any changes to how the business operated?

12. Prior to the recent recession, was there any aspects of your business which made you more or less resilient to the problems that this brought?

13. Do you believe that innovations in your company have made you better or less able to cope with periods of economic hardship?

14. Are there any factors which currently limit your ability to innovate or reduce the company's level of risk?

15. Finally, is there anything further that you would like to add to this discussion?