Regional Innovation Policy and Economic Development: The Case of Wales

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A thesis submitted in fulfilment
of the degree of
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I declare that the work submitted in this thesis is the result of my own investigation and the views expressed are my own. No portion of this work has been submitted for any other degree of award at this or any other university or place of learning, nor is being submitted concurrently in candidature for any degree or other award.

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Summary

This thesis presents a case study of Welsh innovation policy from the period of political devolution (1999) to the present day (2014), exploring the role of regional government as a driver of innovation and economic development. It proposes a multi-theoretical framework to be employed in the study of real world innovation interventions, to illicit nuanced insights into the Wales case study, and also to test the applicability of key regional innovation theories in a weaker region context. The four regional innovation theories identified as the most prominent in both academic literature and policy, and incorporated into the conceptual framework of this study are: systems of innovation, clusters, the learning region, and the triple helix.

The case study presented consists of a systematic review of Welsh innovation and related policy since devolution and in-depth interviews with key stakeholders in the Welsh innovation system. The Welsh approach to innovation is found to have evolved in three distinct phases, whereby innovation is prioritised differently relative to other policy spheres, and the dominant approach to innovation varies over time. Innovation interventions have met with varying levels of success, and, interestingly, the most prominent approaches have been, on the whole, less successful in Wales.

This thesis argues that no one theory is ideally suited to the analysis and development of innovation policy in weaker regions; instead it draws on the strengths of the four key theories identified. It argues against a "one-size-fits-all" approach to innovation policy, premised on exporting models from exceptional leading regions in a manner that is geographically, historically, and culturally blind. It supports a move away from normative approaches to the study and practice of innovation policy, instead drawing on the different theoretical elements that are particularly relevant to the case in question.

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List of Abbreviations

BIS	Department of Business Innovation and Skills (UK)
DCELLS	Department for Education and Skills (Wales)
EAP	Entrepren**e**urship Action Plan
EC	European Commission
ELWa	Education and Learning Wales
ERDF	European Regional Development Fund
ERP	Economic Renewal Programme
EU	European Union
FDI	Foreign Direct Investment
HEIs	Higher Education Institutions
IAP	Innovation Action Plan
IP	Intellectual Property
NAFW	National Assembly for Wales
NISCHR	National Institute for Social Care and Health Research
NSI	National Systems of Innovation
RIS	Regional Innovation System
RTP	Regional Technology Plan
SI	Systems of Innovation
SMEs	Small and Medium-sized Enterprises
WAG	Welsh Assembly Government
WDA	Welsh Development Agency
WEFO	Welsh European Funding Office
WG	Welsh Government
WO	Welsh Office

1 Introduction

"One of the most difficult and challenging questions in economic development is: To what extent, if at all, can peripheral regions innovate?" (Morgan, 2007, p.109)

1.1 Justification

This thesis sits at the confluence of two distinct but interconnected bodies of literature: regional economic geography and innovation policy studies. It contributes to both fields by examining a particular case study of innovation policy in a weaker region: Wales in the United Kingdom (UK). Garretsen and Martin (2010, p.2) set out the fundamental question in economic geography as "how to explain the riddle of uneven spatial development?", and the present work contributes to wider attempts at answering this. The underlying premise of the study is that innovation is important because it can lead to economic growth, providing a means through which weaker regions can achieve the dual goal of a stronger economy and better quality of life outcomes. To borrow Nauwelaers and Wintjes (2003, p.194) point of departure from their own innovation policy study:

> *"Innovation is a good thing, at the level of the firm and the region, and there is a call for public intervention to get more of it."*

Indeed, innovation policy has become a key policy sphere for governments worldwide, which are attempting to drive economic growth and development in the knowledge economy (Bellini and Landabasso, 2006, p.273; McCann and Ortega-Argilés, 2013; Piccaluga and Cooke, 2007, p. 231). This thesis contributes to our understanding of how, and indeed whether, innovation policy can be leveraged by governments in weaker regions to pursue their goals of economic development. It is important that we study and interrogate innovation policy efforts in order that they become more effective and

appropriate, and our understanding of how to best design and implement innovation policy advances. As such, this study paints a detailed picture of the role government is playing as a driver of innovation in Wales, and suggests how this can be improved. It is also vitally important that we continue to debate and question the academic theories proposed for studying innovation, which also function as policy blueprints, to ensure that these are relevant and applicable to the contexts within which they are being applied.

There are two main rationales underpinning this work. The first is straightforward: to undertake an in-depth study of innovation policy and programmes in Wales. There have been several studies of particular policies or programmes, or certain periods, but there has been no comprehensive review encompassing the broad sphere of innovation and economic development from devolution to the present day. The second rationale stems from an identified gap in the literature: there are a number of theories proposed to explain regional economic development through innovation but these have been overwhelmingly developed in leading regions. There are relatively few studies that apply innovation theory to weaker regions and explore how appropriate it is in this context. As such, this thesis develops a theoretical framework to aid in the analysis of the Welsh case, and to reflect back on the innovation theories and their applicability.

1.2 Empirical Approach

1.2.1 Case Study Methodology

A case study methodology was considered the best fit for this study because it allows for a combination of methods to be used, and takes account of the wider context. The view is taken that a study of innovation policy should not be conducted in a vacuum, isolated from and ignoring the political contexts and sensitivities within which policy is

practiced and implemented. A methodological framework is required that takes account of the nature of the Wales case: that of an economically weak and peripheral region within Europe, with a degree of self-governance. In line with the understanding of innovation as an evolutionary and interactive process, innovation policy is examined and understood within its geographical and historical context.

Within a case study approach, mixed methods can be employed to collect data through a variety of different means; a full discussion of the methodological considerations of the study can be found in Chapter 4. A mixed methods approach is deemed to be both practical and appropriate for this study because it allows a richer body of data to be collected, and triangulation between different sources leads to more robust findings. The two methods selected as the most appropriate for the purposes of this study are policy review and interviews with key stakeholders in the innovation system.

1.2.2 Policy Review

The first stage of the empirical work was the policy review, to explore how the Welsh Government's approach to innovation has evolved since devolution. The rationale behind this is that policy is the means through which government expresses and codifies its approach. The Welsh level of policy is the main focus, but the links between the three main levels – Wales, UK, and Europe – are considered. The timescale for the study is the period following devolution (1999) to the present day (2014); this is the point at which we can see a distinct Welsh approach to innovation policy developing.

1.2.3 In-Depth Interviews

The second method employed is interviews with key stakeholders involved in the various stages of the policy process from design and implementation, to end users. Interviews can provide a deeper understanding of the role the Welsh Government plays

in driving innovation, the rationales behind the policies and programmes, and whether those involved perceive the efforts to be successful. In-depth interviews were conducted with stakeholders from government, university, business, third sector, and intermediary spheres. A balance of the different groups was sought, in particular the three main triple-helix spheres: government, industry and universities. Intermediary actors were also interviewed to access as wide a range of perspectives as possible. Interviews were designed to take one hour, and schedules were prepared for the different stakeholder groups, with variations on similar questions tailored to the respondents. The interviews were semi-structured due to the need to achieve comparability across the different groups and with the policy review for data triangulation. These methods are explained fully in Chapter 4, alongside the epistemological and practical considerations.

1.3 The Wales Case Study

In Chapter 3 a comprehensive introduction to the Wales case study is provided, which examines the important historical, political, and geographical contexts. This section provides a brief introduction and highlights the important characteristics that set the backdrop to the study. Wales is one of the four "home nations" of the UK, alongside Scotland, Northern Ireland and England. The population of Wales is 3,006,430 (StatsWales 2010), concentrated primarily in the South with 1.4 million people living in the city region surrounding the capital, Cardiff (Barry, 2011), with a smaller population concentration in the north east. The west, central, and north west areas of Wales are rural and sparsely populated. There are two official languages in Wales: Welsh and English. The Welsh Language Use Survey of 2004 found 21.7% of the Welsh population to be Welsh speakers but the 2001 Census revealed that this applies to 40.8% of Welsh children between 5 and 15. The issue of the Welsh language is not central to

this study, but it is important to highlight the cultural, as well as political and economic, differences between Wales and the UK as a whole (see Chapter 3).

Wales is considered a peripheral and weaker region within the European context because of its location and rurality, and the fact that half of the region receives Convergence funding. Figure 1.1 is a map of Wales, with the Convergence area of west Wales and the valleys highlighted. Although the Convergence round ends in 2013, the west Wales and valleys region has retained its status as one of the poorer regions of the

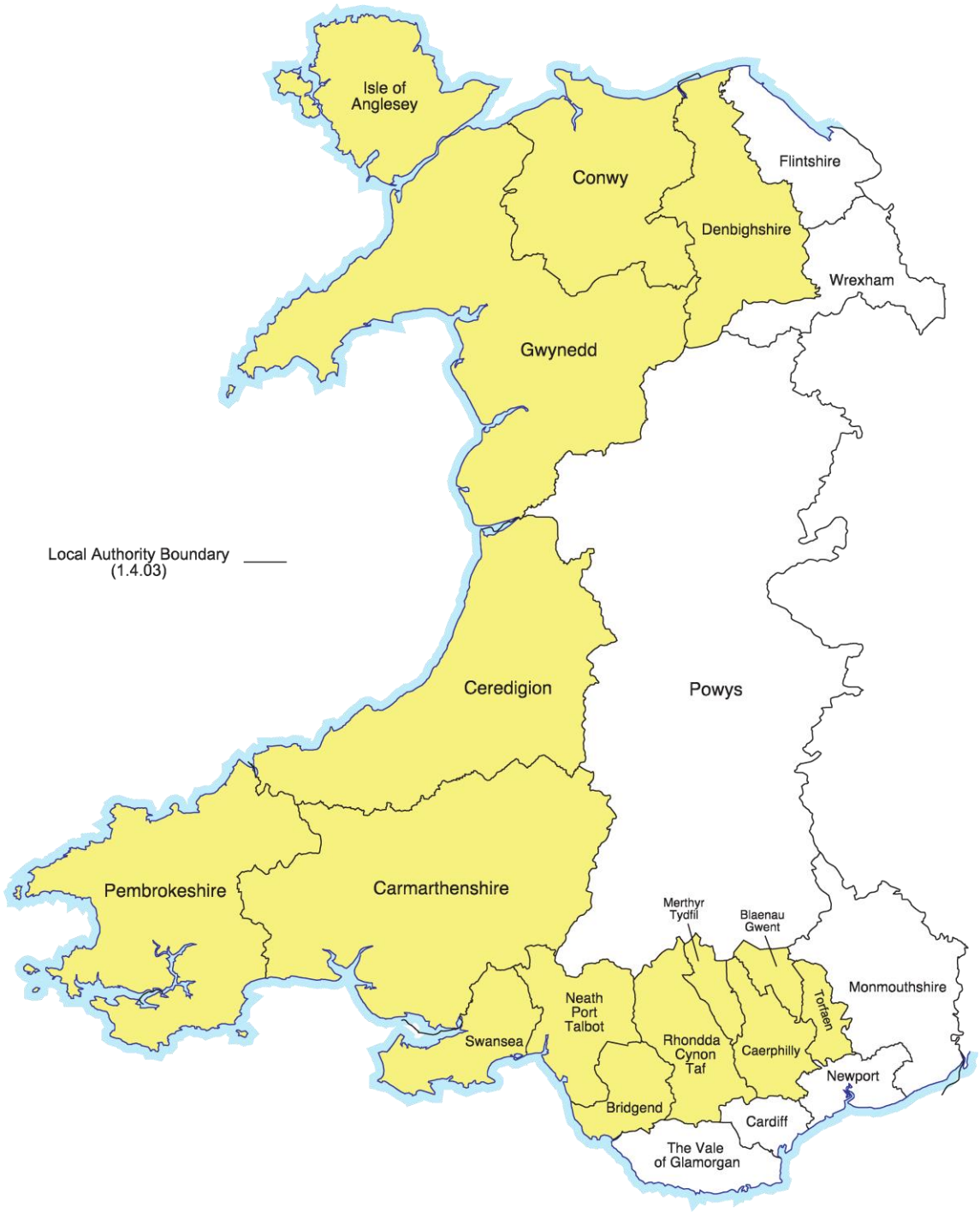

Figure 1.1 Map of Wales[1]

EU and will again receive the highest level of support in the 2014-2020 phase[1]. The south east and north east areas are relatively well-connected to England, with the main transport routes running east to west; connections between the north and south of Wales are relatively poor. Whilst Wales is discussed in this thesis as a "region" in its own right,

[1] Accessed 05/2/2014 from http://www.wefo.wales.gov.uk

it is important to appreciate the heterogeneity of the different sub-regions economically and culturally. It is also important to recognise the problems in categorising Wales; for the purposes of this study the terminology of "region" is used in reference to the economic status (as opposed to political or cultural) of Wales within the wider UK economy.

1.4 Structure of Thesis

As explained in section 1.2 above, the various chapters of the thesis contribute different elements to answer the research questions proposed. This short overview will introduce the themes dealt with in each chapter, explaining how the logic of the document will progress. It consists of nine chapters, including this introduction and the conclusions, and in addition a bibliography and appendices. The first four chapters set the scene for the study – the introduction (1), literature review (2), context (3), and methodology (4). These are followed by three empirical chapters (5, 6, and 7) that provide a chronological study of the evolution of innovation policy and programmes in Wales. A final empirical chapter (8) ties the chronological analysis together and applies the theoretical framework, producing a map of innovation interventions. The final chapter (9) presents the conclusions, theoretical contributions, and policy recommendations of the study. The theoretical framework is developed over the course of the study, beginning with a purely theoretical consideration resulting from the literature review, and culminating in a comparative analysis of the Welsh approach to innovation.

Four research questions are derived as a result of conducting the literature review and identifying the potential for further research. These four questions guide the thesis, and provide the rationale for the methodology chosen and the empirical investigation conducted. They will be returned to in the conclusion chapter also, to structure the contributions of this work. The four questions are:

How has regional innovation policy in Wales evolved since the period following political devolution from the UK?

What is the nature and the outcomes of innovation interventions implemented in Wales since devolution?

How can regional innovation theory be employed in the empirical study of regional innovation policy, and what insights can it provide us?

Which theoretical regional innovation models are most relevant and applicable to explaining and understanding policy and programmes in weaker regions?

These are presented in more depth at the end of the following chapter, with some an explanation of how they were arrived at, and how they will be answered throughout the thesis.

2 Literature Review – Developing a Theoretical Framework

2.1 Introduction

As Florida (2005) explains: "the world is spiky and not flat", and it is the wider body of literature addressing regional economic development to which this thesis aims to contribute. This literature review sets the foundation for the study, and begins to answer the research questions posed. It begins broadly, by reviewing the wider debates within economic geography: the region is identified as the key locus of economic disparities, with innovation situated as the key driver of economic growth and disparities in the modern knowledge economy. It identifies the importance of knowledge and learning, and networks and proximity as the means through which these are enabled at the regional level to drive economic development. Having reviewed these wider debates, the topic of innovation policy is introduced as the means through which governments address innovation. The growing importance of innovation policy is discussed, and prior approaches to its study are introduced, upon which this work builds. Finally, the main theories explaining how innovation functions at the regional level are presented, which exist both as conceptual and practical tools for studying innovation policy and creating best-practice blueprints. A theoretical framework is proposed, which assimilates the different insights gleaned from the literature and provides a conceptual model for the study of regional innovation policy. Whilst building directly upon prior work, it makes an academic contribution by integrating theories of innovation to better understand the Welsh case study, and fundamentally questions the applicability of key innovation theories in the weaker region context.

2.2 The Knowledge Economy and Regional Disparities

Some nations thrive economically whilst others lag behind, and the same is true for regions within countries. The richest, high growth regions change over time and some flourish whilst others fade and decline. In light of this, an understanding of wider changes in the global economy is important; we cannot focus on one region in isolation. Many scholars have attempted to explain changes that have taken place in the global economy, and have proposed different theories to do this. The general consensus is that the global economy has fundamentally changed compared to the post-war era of "Fordist" production, and these changes have affected regions and nations in different ways.

Some regions have been quick to adapt and have seen boom periods, the typical example being Silicon Valley in California. Others have been less successful in the face of these changes, experiencing periods of decline such as the old industrial heartlands of the UK including the north east England and Wales, and areas in the US "rustbelt" (Cooke, 1995). Sometimes, major shifts in economic development patterns, known as "shocks" (Storper, 2010, p.8), send economic development onto a different trajectory. Authors agree that profound change has taken place, but use different terminology and have different understandings of this. According to Castells (1996) we live in a network society interacting with the "informational" economy, and Florida (1995) sees economic transformation to a "creative economy". Other authors see the current mode of economic organisation as "post-Fordist" (Amin, 1994), referring to the "knowledge based economy" (Drucker, 1968; OECD, 1996). Lundvall and Johnson (1994) define post-Fordist societies as "learning economies", where innovation is viewed as socially and territorially embedded, and as an interactive learning process that cannot be understood independent of its institutional and cultural context (Asheim, 2012).

There is a strong geographical rationale to these ideas about the new economy, centred around the fact that different places have been more or less successful in the knowledge economy. Castells (2010, p.3) describes the process whereby some regions have thrived and others faltered as being "switched on and off" by global networks of instrumental exchanges; global networks include some people and territories whilst excluding others, thus inducing a geography of social, economic, and technological inequality. McDowell (1991, p.417) has reached similar conclusions: certain groups are excluded from highly skilled jobs in the post-Fordist economy, such as women and "Third World people", who are "exploited *in situ* in their own countries, as the workers, sectors and regions of an earlier round of accumulation are rejected". Conversely, other regions have benefitted from these changes, such as those highlighted by Amin (1994, p.107-8) as centres of flexible specialisation: the Third Italy, Jutland in Denmark, LA, and the eastern Valles near Barcelona. Dicken (2001, p.2) explains how these changes do not happen in geographical isolation; different parts of the world are inextricably linked in the new economy:

> *"What is happening in one part of the world is deeply- and often very immediately- affected by events happening in other parts of the world."*

This undermines Friedman's assertion that the world is "flat", and the "hyper-globalist" views that the end of geography is upon us; instead "geographies of production, trade and FDI remain highly uneven and strongly concentrated" (Dicken, 2001, p.25). Storper (2009, p.1) agrees that there are "increasingly fine geographic divisions of labour...that affect regional patterns of specialisation". Within the knowledge economy, geography matters, and Storper (2009) explains that economic geographers tend to see spatial economic development as the result of "unique, context driven, place specific combinations of forces", which cannot be modelled or subject to large scale causal

enquiry. However, many attempts have been made to do just that (Storper, 2010). Within debate about the changes in the world economy, innovation has a key role to play as the utilisation of knowledge and learning as the main drivers of growth. According to Lundvall and Johnson's (1994) definition of post-Fordist societies as learning economies, innovation is seen as a socially and territorially embedded interactive learning process which cannot be understood independently of its institutional and cultural contexts. Castells (1996, p.77) underlines the importance of knowledge:

> *"The key source of competitiveness for agents in this economy is their ability to generate, process, and apply knowledge based information"*

Ideas about the knowledge economy are not confined solely to the academic sphere; it has become a key concept in the policy sphere. The World Bank, OECD, EU, and indeed the Welsh Government, all refer to the knowledge economy and view knowledge and learning as key drivers of economic growth (e.g. European Commission 2008; OECD, 1996; Welsh Government, 2009; World Bank, 2012). However, not everyone is convinced by the idea of the knowledge economy. Lundvall (2004) sees a large amount of hype surrounding ideas about the new economy, and criticises the concept for its "simplistic understanding of what is going on". However, he agrees with its basic ideas about wider and deeper use of ICT representing a fundamental change in the economy and society. For Smith (2002), the concept's problems hinge around the lack of definition of the knowledge economy meaning it is more of a rhetorical concept than analytically useful. But "the consensus", according to Rutten and Boekema (2007, p.5), "is that we live in a globalized, knowledge-based economy, which, at the same time, is also a regional learning economy".

2.2.1 Regions, Regionalism, and Regionalisation

There is a huge amount of literature and academic debate surrounding regions, regionalism, regionalisation, and any number of terms that describe a process whereby regions have become increasingly important. As Uyarra (2007, p.244) explains: "...global economic restructuring is reinforcing the region as a fundamental locus of economic governance". Whilst it would be impossible to discuss the whole body of regional studies here, some salient points are elaborated that are particularly relevant to this study.

Economic geographers and innovation scholars are interested in regions as the focus of economic growth and innovation processes in the knowledge economy. Likewise, political and cultural geographers also study regions, the concept of the region itself, and processes of regionalisation, especially across Europe. Both of these dimensions are relevant; whilst it examines innovation and economic development at the regional level, the focus of this study is on policy and the role of government. Political factors are of central importance. As Keating (2004) explains, the last half a century has seen the rise of an intermediate level of government across Europe, which is usually referred to as the region, but there is little agreement about what and how important the region actually is.

Economic geography literature tells us that changes observed in the global economy have altered patterns of economic growth and development, and brought on societal changes resulting in prosperity for some parts of the world but decline for others. Many authors have emphasised the importance of regions within this new economic geography; for example, Florida (1995) sees the importance of the region growing as globalism and regionalism evolve as part of the same process of economic transformation, and regions function as effective points of entry into the global economy. Agreeing with this viewpoint, Scott and Storper explain how regions are

crucial due to the importance of agglomeration in the globalized world: "Large scale agglomeration and its counterpart, regional economic specialisation, is a worldwide and historically persistent phenomenon that is intensifying greatly at the present time by forces unleashed by globalization." (Scott and Storper, 2003, p.588). Ohmae (1995) goes even further, seeing the nation state becoming obsolete because it is no longer the optimal unit for organising economic activity; he sees region states as representing authentic communities of interest, meaningful flows of economic activities, and true synergies and linkages between economic actors.

It is not only academics from the economic and innovation traditions that emphasise the role of the region; several authors have highlighted the shifting power dynamics at a geographical level, finding power increasingly transferred to the regional level, especially in the EU (Keating, 2004). For example, evidence from the UK, Norway and Denmark presented by Asheim and Gertler (2005) finds authority increasingly transferred to the region through national and EU level policies. In the UK, a "hollowing out" process has been observed whereby the power of sub- and supra-national actors has increased, thus decreasing the power and influence of the nation state (Bache and Flinders, 2004; Holiday, 2000; Hooghe and Marks, 2001). Paasi highlights the role of the EU in strengthening and re-defining the role of regions across Europe and elevating them to important actors:

> *"Regions are highly significant in the EU, where both the political making of the Union itself and the "Europe of the regions" are examples of the re-scaling of state spaces and of the new meanings being assigned to territories" (Paasi, 2009, p.145).*

This has resulted in the growth of a regional level of government or governance. According to Keating (2004), "regional government has become quite a fashion in Western Europe", a phenomenon encouraged by the EC's requirement for mechanisms and instruments to manage and deliver structural funds at the regional level. The innovation studies literature also has a keen interest in the region, particularly because learning and knowledge are thought to have regional context and characteristics (Asheim and Gertler, 2005) and regions have individual knowledge capabilities and resources (Asheim and Gertler, 2005; Cooke et al. 1997; Cooke et al., 2007, p.199; Morgan, 1997; Nauwelaers and Wintjes, 2003). In the literature on innovation processes and policies, Arnkil et al. explain, the local and regional dimension has grown in importance in post-Fordist learning economies (Arnkil et al., 2010, p.9; Asheim, 2007; Asheim et al., 2003; Cooke et al., 2004). Considering the context of this study being a region with a degree of self-governance, an interesting thesis is put forward by Paasi (2009, p.139), who links the increasing political influence of regions to regional identity and regional economic development. He highlights the central role of EU Cohesion policy in the increased regionalisation of Europe, which is concerned with a just redistribution of opportunities in space and was developed to motivate regions to exploit their cultural characteristics, skills, and social capital for ultimately economic goals (Faludi, 2007; Paasi, 2009).

This growing "new-regionalism" (Bristow, 2005; Lovering, 1999) has numerous and influential proponents, but are others who are less convinced by the thesis. They question the centrality of the region and argue that other territorial levels and geographical scales of analysis are equally or more important, or that knowledge and innovation are not spatially bounded rendering a geographically based view fundamentally problematic (Hadjimichalis, 2006; Harrison, 2006, 2013; Lovering, 1999;

MacLeod, 2001). Lovering (1999) is especially critical of the "new-regionalism" and uses insights from his study of Wales to contest the two key ideas that the region has become the "crucible of economic development", and the normative basis that "the region" should be the prime focus of economic policy (1999, p. 380). Instead of empowering regions and their citizens, Lovering sees the new-regionalist discourse obscuring and diverting attention away from the fact that national systems of regional redistribution have "withered" and resources for investment in regions have declined; the Welsh economy is in fact being supported and driven by the activities of the national (British) state and the British "core" is still powerful and capable of securing the outcomes it seeks (Lovering, 1999, p. 382; Holliday, 2000, p.175; Martin and Sunley, 1997; Murphy, 2011). At the European level, Elias (2008, p.483) asserts that despite much talk of the "Europe of the Regions" during the 80s and 90s, the notion seems to have fallen out of favour, and the limitations for regional mobilisation have become apparent. The debate often boils down to binary opposition between those who see the region or the nation as the most appropriate geographical unit of analysis.

A major problem with the "new-regionalist" approach is that there is still no general understanding of how to define a region (Harvie, 1994; Keating, 2004; Uyarra, 2007). There are multiple definitions and understandings of regions, such as geographical, functional, economic, institutional, or cultural, and these definitions may coincide but may also be in conflict with one another (Keating, 1998, 2004; Paasi, 2009; Uyarra, 2007). There is confusion over the term, and territories of varying size and status have all been researched under the banner of the region; some authors use the term region to describe sub-national territories, and others use it in a supra-national sense (Freeman, 2002; Lorentzen, 2008). Also, as Uyarra (2007, p.251) points out, the internal diversity within regions is often overlooked because regions are typically complex and messy

entities, and even successful regions (such as Baden-Wurttemberg) are actually politically and economically fragmented. Despite these criticisms, this study takes a regional perspective because of the interest in regions as shaping economic growth and competitiveness (Rutten and Boekema, 2007, p.2), and the increasing policy interest; what Martin and Sunley refer to as the "spatial turn" (2011, p.358).

This thesis investigates innovation in a weaker region, and tests theory in this context. There are a number of different terms used to describe weaker regions, but the premise behind the idea is that:

> *"For every successful region there exist a number of average, lagging, or what can be termed "ordinary uncompetitive" regions" (Huggins and Johnston, 2009, p.278).*

There are numerous expressions of weaker regions in the literature, such as: uncompetitive, peripheral, lagging, less favoured. Huggins and Johnston (2009, p.278) explain that "peripheral" regions are uncompetitive due to a lack of strength and depth in the very factors that give leading regions their competitive edge; a high density of knowledge-based firms and a networked business culture. Bristow (2005, p.291) sees regional competitiveness as a "somewhat chaotic and ill-defined discourse based on a relatively narrow conception of how regions compete, prosper and grow", whereas in reality, regional competitiveness can be defined in different ways such that it is not clear when a situation of competitiveness has been achieved.

In this study, Wales is categorised as a "weaker region" based on its status as a Convergence area of the EU (West Wales and the Valleys) and its position at the bottom of the tables of regional competitiveness within the EU (Huggins and Thompson, 2010). As well as geography, this study takes into account the role of history in shaping

regions. Many authors refer to "path dependence" in the literature, which explains how "technologies, organisational forms and habits of thought continue to shape practices and actions of key actors and organisations" (Mackinnon et al. 2007, p.1). Path dependence assumes that previously existing routines and competencies of firms, labour, and institutions shape their ability to innovate, and capture new activities (Storper, 2011, p.342). A theoretical framework that can take into account historical and geographical factors, and is appropriate for a regional perspective on innovation and economic development is required.

2.3 The Key Drivers of Economic Growth in the Knowledge Economy

Despite Storper's (2010, p.1) claim that "regions have complex economic development processes that are shaped by an almost infinite range of forces", this thesis identifies key concepts presented in the literature which explain the ability of certain regions, and the relative failure of others, to grow and partake in the knowledge economy. These are: innovation, as a driver of growth; knowledge, as the most valuable commodity in the new economy; learning, as the process that allows firms and individuals to create and access knowledge; networks, as the vehicle for sharing this knowledge; and proximity, as a key factor in facilitating learning and innovation processes. As explained above, knowledge and learning processes are seen as being geographically embedded at the regional level, and the regional embeddedness of networks means that interaction within them is subject to regional conventions (Rutten and Boekema, 2007, p.131). Uyarra (2007, p.249) draws together the three key elements of innovation, knowledge and learning to explain how regions can achieve competitive advantage in the knowledge economy. These three separate concepts are inextricably linked in the sphere of regional economic development, as:

> *"There is a widespread agreement in academic literature that knowledge, learning and innovation are key to economic development and competitiveness for firms, regions and nations." (Tödtling and Trippl, 2005, p.1203)*

To these three factors this thesis adds networks as the means through which knowledge is shared, and proximity, as the factor determining whether and how these networks form and function.

2.3.1 Innovation

Over the last two decades, researchers have increasingly appreciated the role of innovation in driving economic growth, whereas previously growth was primarily understood in terms of a neo-classical growth framework (McCann and Ortega-Argilés, 2013). However, the study of innovation is not new; it has a strong foundation in economic literature, and is usually traced back to the work of Joseph Schumpeter (1934). Schumpeter defined different types of innovation, and separated the concept from that of invention; he wrote about product innovation, but also innovation in methods of production, sources of supply, exploitation of new markets, and new ways to organise business. Schumpeter's ideas still underpin much of our understanding of innovation and its importance to economic growth, and his ideas have been updated by academics often referred to as Neo-Schumpeterians. As Morgan (2007) explains, this school of evolutionary economic theorists has done much to enhance our understanding of innovation and technological change (Dosi et al.1988; Freeman, 1994). Innovation has increasingly come to be recognised as an interactive process and our understanding has moved on from the linear model, in which innovation was understood as a sequential process from research to marketing, as a result of technology push or market pull pressures. We now understand that innovation is shaped by a variety of institutional routines and social conventions (Morgan, 2007, p. 103/104). A good definition of

innovation is provided by Haskel et al. (2009), which this study will use as a departure point:

> *"[Innovation is] the contribution of all forms of knowledge to growth, as opposed to the contribution of investment in physical inputs and labour"*

An even wider definition of innovation is provided by Borras and Edquist (2013, p.3), who look beyond the purely economic aspects of innovation:

> *"Innovations are defined here as new creations of economic and societal significance, primarily carried out by firms (but not in isolation)."*

This study takes the former definition; whilst the societal aspects of innovation are recognised as important and warranting further study in weaker regions this is beyond the remit of this thesis, which focuses on innovation as a driver of economic development. Innovation can be radical or incremental, and the work on systems of innovation (Edquist 1997, 2001, 2005; Lundvall, 1988, 2007) made key strides correcting perceived wisdom and defining innovation as interactive rather than linear (Cooke, 1998, p.24). Storper (2009, p.3) sees long term growth as depending on "local learning, innovation, and adjustment" and draws links between innovation and uneven spatial development. As he explains, innovations emerge in certain places and organisational settings and this geography often reflects what are called Marshall-Arrow effects of proximity, and localised learning and innovation (Storper, 2009).

Innovation lies at the core of growing regions; an argument can be made that if a region can innovate it will be more competitive than a region that cannot (see Howells, 2005). Geography has become central to innovation discussions, and regional innovation systems logic now underpins much of the current thinking about innovation (McCann

and Ortega-Argilés, 2013 p. 211). Underpinning this link between innovation and geography is the place dependent nature of knowledge, as the commodity of the knowledge economy, and learning, as the process through which knowledge is created and accumulated.

2.3.2 Knowledge and Learning

As previously explained, there is a general consensus that the current economic mode is that of a knowledge economy, and it is knowledge and learning that underpin innovation processes (Rutten & Boekema, 2007, p.5). According to Lundvall (1994), knowledge is the most strategic resource, and learning is the most important process in economic development. Geography is key because spatial proximity to knowledge can bestow competitive advantage (Audretsh and Aldridge, 2009, p.201). Emphasis is placed on tacit knowledge, which is seen as particularly location dependent, context specific and embodied in people, and so does not travel easily; it cannot be removed from its social context (Morgan, 2007). The locational stickiness of tacit knowledge can explain why certain knowledge intensive industries cluster together (Morgan, 2004, p.7), and the importance of tacit knowledge and know-how in the innovation literature is part of a wider argument about the role of intangible and invisible factors in economic development (Morgan, 2007, p.105). In terms of the geographical scale of this embeddedness, Asheim and Coenen (2005, p.1176) see knowledge as both nationally embedded due to sector specialisations, political and cultural organisations and institutions, and regionally embedded due to historically produced territorial divisions of labour. Others question the locational stickiness of knowledge; knowledge can be infinitely reused and spread among communities of users and geographic areas, so it can become a limitless source of growth (Storper, 2009, p.4).

Learning has come to be thought of as so important for the economic development of regions and cities that Malmberg (1997) has noted a "learning turn" in economic geography. According to Hassink (2004, p.4):

> *"The capacity of both individuals and organisations to engage successfully in learning processes is regarded as a crucial component of economic performance in the knowledge-based economy"*

There is a wide body of literature on how organisations and individuals learn in the knowledge-based economy, especially at the interface between innovation and entrepreneurship studies (Harrison and Leitch, 2005; Wang and Chugh, 2013); the present work is concerned with the wider geographical perspective on learning for innovation and economic development. Central to this debate is the idea of the "learning region", discussed in section 2.5.3. The fact that learning takes place through organisations and individuals means that there is a strong interest in human capital, and the importance of individuals in the knowledge economy. Romer (1990, pp.97-99) goes as far as to say that "the stock of human capital determines the rate of growth" and "low levels of human capital may help to explain why growth is not observed in underdeveloped economies". Florida (2002) also emphasises the importance of human capital, arguing that the distribution of talent (high human-capital individuals) plays a fundamental role in the distribution of high tech firms and thus regional economic outcomes. He sees diversity of a city or region as key in attracting talent, and measures this diversity according to the number of "bohemians", gay, and foreign born people living there, which he classifies as the "creative class". They key to attracting diversity is a high degree of systems openness, with low entry barriers for talent (Florida, 2002, 2006).

2.3.3 Proximity

Agglomeration or clustering effects are often explained by the perceived embeddedness of tacit knowledge in regional or local clusters as a source of competitive advantage (Uyarra, 2007, p.248). The wider idea that spatial agglomeration leads to economic growth has a long history within economic geography, since Marshall (1920) recognised the benefits of spatial clustering due to external agglomeration economies. The new economic geography literature builds on this, emphasising the importance of local information and knowledge spillovers, local supplies of non-traded inputs, a skilled local labour pool, and inter-industry spillovers (Fujita et al. 1999; Iammarino and McCann, 2010, p.185; Krugman, 1991; Martin and Ottaviano, 1999). However, the importance of geographic proximity as a determinant of growth and innovation is contested. The arguments and counter-arguments of taking a geographic proximity based view are examined below.

A key argument for viewing geographic proximity as important is the occurrence of knowledge spillovers - the patterns through which flows of public, private, or academic R&D happen, and how knowledge leaks out from these sources (Breschi and Lissoni, 1997). Knowledge has been found to have a high propensity to spill over, and locating near to these knowledge sources can have a positive effect on innovation (Anselin et al., 1997; Jaffe et al., 1993). These spillovers can be intended, where voluntary knowledge exchange between actors takes place through either formal or informal relationships, or unintended, where the regional stock of knowledge influences innovation (Rondé and Hussler, 2005, p.1152/54). However, it is not clear whether geographic proximity is necessarily a pre-requisite for knowledge spillovers. For example, Rondé and Hussler (2005, p.1160/61) find the impact of regional knowledge stocks to be overestimated;

with external networking activities mattering more to improving regional innovative levels.

Several studies show positive relationships between spatial clustering, knowledge spillovers, and firms' innovative outputs (Audretsch and Feldman, 1996; Baptista and Swann, 1998; Guiliani, 2007), and these are discussed in more detail in section in the cluster theory section (2.5.3). The essence of this argument is that the greater the proximity between actors, the higher the probability that learning by interacting will take place (Hassink, 2007). However, other studies do not find geographic proximity to be a sufficient explanation of processes of localised learning and innovation (Boschma, 2005). Instead, they emphasize market and social-institutional relationships as important vehicles for the diffusion of knowledge, through local business networks, and also the role of the local community (Guiliani, 2007, p.142). MacLeod (2001, p.813) warns that caution is needed against "over-extending theories of agglomeration and "proximity" to be a full- blown explanation of local/regional competitive advantage". Also, some scholars see the importance of tacit knowledge as over exaggerated in explaining the phenomenon of localization; it is overly simplistic to correlate geographical dimensions and knowledge tacitness (Cowan et al., 2000; Uyarra, 2007, p.249).

Other forms of proximity, such as organisational, cognitive, institutional, or social, are proposed as important drivers of economic growth and advantage (Boschma, 2005; Cohen and Levinthal, 1990; Maskell and Malmberg, 1999; Oerlemans et al., 2007; Zukin and DiMaggio, 1990). Knowledge can be transferred by migration and personal relationships; geographic proximity is not always necessary (Hassink, 2007, p.255). Boschma (2005) also questions the assertion that knowledge spills over locally, in fact it is shared between "epistemic communities" or "communities of practice", wherever they are located (Breschi and Lissoni, 2001; Gertler, 2003). The balanced view between these

two extremes is that geographic proximity can facilitate interaction and cooperation as an enabler of interactive learning rather than a necessary condition (Boschma, 2005). As Howells (2002) explains, the influence of geographical proximity on knowledge and learning is not straightforward. Regular face to face contact builds up trust and forms the institutions (norms and habits) that enable learning and innovation (Boschma, 2005, p.61/70), but it can be less important than organisational or relational proximity within communities of practice (Amin and Cohendet, 2000).

2.3.4 Networks

Interwoven with the proximity debate is the topic of networks, and their centrality to the innovation process. Authors have highlighted networks as important for facilitating knowledge sharing and transfer, leading in turn to innovation and economic growth in the knowledge economy. The growing interest in networks as enablers of economic development accompanied increasing appreciation of interactive innovation and social capital as they key factors driving growth (Morgan, 2007, p. 102). Perhaps the best known study of networks for innovation is Saxenian's study of Silicon Valley (1994), which finds that industrial systems built on regional networks are more flexible and technologically dynamic than those confined to individual firms. She also finds that geographical proximity promotes the repeated interaction and mutual trust needed to sustain collaboration and the continual recombination of technology and skill (Saxenian, 1994, p.161). Amin (1994, p.116) also highlights the advantages of network systems as a form of industrial organisation: familiarity between actors facilitates co-operation whilst maintaining autonomy, allowing each to benefit from novel experiences of others. He sees networks as optimal learning systems because they diversify participants' risks, and also minimise transaction costs by fostering high trust relations. Boschma and Martin (2007, p.542) call for an evolutionary perspective to understand how networks

are formed and how they change in space and over time; places can produce knowledge, and condition and constrain how knowledge and rules develop.

Indeed, there are negative elements of networks and proximity, despite their centrality to regional economic growth. Networks can be exclusive, and "valuable, specialised information is not universally available" because costs and barriers exist (Storper, 2009, p.11). Also, "trust based networks are prone to lock in" (Semlinger, 2008,p.557) and Hassink (2004) explains how old industrial regions can suffer from a combination of three types of negative lock-in; functional lock-in, cognitive lock-in, and political lock-in. Collaboration is not necessarily a good thing; Rosenbusch et al. (2009) found that whilst internal innovation projects increase performance substantially, projects involving external collaborations do not. Knowledge and power asymmetries can make collaboration problematic: smaller participants can become dominated by large incumbents (Porter 2004, cited in Rosenbusch et al. 2009); knowledge does not flow evenly within networks (Guiliani, 2007, p.144). The geographic proximity debate is also reflected in the networks literature, and Boschma (2005, p.69) asserts that "there is nothing inherently spatial about networks".

Huggins and Johnston (2009) disagree. They find that the importance of local networks depends on the type of firm; those with low levels of absorptive capacity tend to network locally whilst those with higher absorptive capacity are often connected to global networks. As well as creating and sharing knowledge, actors within a region or network need to access and assimilate knowledge from elsewhere to remain competitive. As Rondé and Hussler explain (2005, p.1150);

> *"The core of innovative capacity resides in efficiently combining different, sometimes complementary or conflicting, small pieces of knowledge offered by external agencies."*

Cohen and Levinthal (1989) developed the concept of absorptive capacity to explain how a region's firms need this ability to identify, assimilate, and exploit knowledge from the environment; absorptive capacity is an important factor at both the firm and regional level. An interesting question that these authors ask of absorptive capacity is whether it can be bought in or must be developed indigenously, and this has important implications for policymaking. Another useful context to help us understand how these various drivers and facilitators of growth can be understood at the geographical level is to view social capital as the "residue" that can explain regional economic differences after other resource endowments have been taken into account (Lorenzen, 2007). Social capital refers to the social relations among agents, resting on social institutions that allow for cooperation and communication (Lorenzen, 2007, p.208). Despite being an important facilitator of learning, social relations alone are not necessarily beneficial, collusion and stagnation can take place, and it is in combination with particular social institutions such as laws, conventions and regulations that it becomes capital.

To conclude, Uyarra's (2007, p.256) assessment of the new regionalist approach to innovation and economic development provides some useful insights: these approaches tend to overemphasise the importance of tacit knowledge, the notion of competitiveness and the proximity imperative, somehow neglecting the diversity, multidimensional and multilevel nature of innovation. This thesis considers proximity in its wider sense, including organisational, social, institutional, and cognitive dimensions, whilst retaining the geographical focus at the regional level.

In summary, innovation has come to be seen as an essential element for regional economic development, alongside knowledge and learning. Unsurprisingly, as our understanding has evolved and increasingly recognised the vital role innovation has to play, it has become increasingly interesting to policymakers, especially those at the regional level. In parallel, the study of innovation policy has become increasingly interesting to academics in order to better understand the factors involved and to develop frameworks for more effective policymaking. The following section turns to the body of literature surrounding innovation policy.

2.4 Innovation Policy

Innovation policy is the means through which governments at different levels set priorities and define approaches to innovation and economic growth. According to Howells (2005), innovation policy has a role to play in relation to science and technology, and also more general implications for economic development and regeneration at both national and regional levels. Indeed, innovation has become an increasingly important policy sphere at the regional and national levels (see: Edquist, 2005; Flanegan et al, 2013; Lundvall & Borrás, 2005; Oughton et al, 2002; Tödtling & Trippl, 2005 etc.).

This section will: outline the growth of innovation policy as an important dimension in the overall policy mix; provide some definitions of innovation policy and how it is recognised; discuss the overlapping policy areas; and provide some examples from previous studies of innovation policy. This will inform the direction taken in this study, and the theoretical framework developed. The final section will introduce the theories of innovation that will be utilised to create a framework for the analysis of regional innovation policy.

2.4.1 The Growth of Innovation Policy

As our understanding of innovation and its crucial role driving economic development has grown it has become an increasingly important area of policy making. Indeed, McCann and Ortega-Argilés (2013) consider regional innovation policy to be accepted into the "mainstream" of public policy today, as a result of over four decades of analysis that has reshaped our understanding of the role innovation plays in economic development. Piccaluga and Cooke (2006, p.273) note that policymakers all over the world have come to realise that regional policies for research and innovation are "absolutely necessary in the current international economic scenario". Innovation policy has been embraced as a key priority by the EU:

> *"Following the Lisbon agenda, there has been a general trend towards policy experimentation at the regional level in the field of the economic exploitation of knowledge and technological innovation as a means of promoting economic growth" (Bellini and Landabasso, 2007, p. 231).*

Whilst it has recently gained prominence, innovation policy builds upon previous policy areas that introduced many of the themes that characterise it today. Leydesdorff (2012) points to the "institutionalisation of science and technology policies" in OECD countries during the 1970s and 1980s, and Nauwelares and Wintjes (2003, p.198) see innovation policy evolving out of science and technology policy because traditional policies could not offer the "unique response needed to support innovation practices". As a discipline, innovation studies has been "extraordinarily successful" in recent decades in persuading policymakers of the importance of innovation and the need for active innovation policies (Flanagan et al., 2011, p.702). A recent iteration in innovation policy studies is that of "broad based innovation policy" (Edquist et al. 2009; Viljamaa et al., 2009), which

improves upon traditional R&D based approaches by also incorporating non-technological innovations as innovation policy targets (Arhail et al. 2010).

Innovation policy has evolved with our understanding of the innovation process and "we understand innovation as an interactive, rather than linear, process" (Nauwelaers and Wintjes, 2003, p.193). Originally, innovation policy focussed narrowly on pre-competitive research and technology, but has come to be broadly defined to include multiple aspects of business and the economy such as design, training, knowledge management, and intellectual property rights (Bellini and Landabasso, 2007, p.231). A key rationale often given for innovation policy is addressing market failure and also system failures such as "lock in", "fragmentation" and "organisational thinness" (McCann and Ortega-Argilés, 2013; Tödtling and Trippl, 2005). As Nauwelaers and Wintjes (2003, p.196) explain, the key question for innovation policymakers is "How do I recognise where and when markets fail so that I know where and when to intervene?".

Innovation policy is especially important to weaker regions, but a "regional innovation paradox" exists whereby there is a greater need to spend on innovation in lagging regions but they have a lower capacity to absorb public funds and invest in innovation-related activities compared to more advanced regions (Oughton et al. 2002, p.98). Regional innovation policymakers have a difficult task on their hands, because "the broad framework of regional innovation policy is continuously changing", and regions have to be particularly flexible in their approaches and ready to use trial and error (Piccaluga, 2006, p.274/273).

2.4.2 Defining Innovation Policy

Despite the growing importance of innovation policy at national, regional, and indeed supra-national levels, there is still some debate over how innovation policy is defined.

There are many different types of policy initiatives undertaken across different countries and regions under the heading of "regional innovation policy", and a variety of regional innovation policy actions and interventions have been employed (McCann and Oretga-Argilés, 2012, p.198/199). The European Commission states:

> *"Innovation policy is about helping companies to perform better and contributing to wider social objectives such as growth, jobs and sustainability" (European Commission, 2012).*

Borras and Edquist (2013, p.3) provide a wider definition:

> *"Innovation policy comprises all combined actions that are undertaken by public organizations that influence innovation processes...Innovation policy thus includes actions by public organizations that unintentionally affect innovation."*

This thesis takes the latter definition, which accounts for other policy areas and actions affecting innovation but which are not necessarily labelled as such. Based on the growing body of literature around innovative regions, clusters, and knowledge spillovers, a new model for policy has emerged stressing: high-tech, knowledge-based, or creative industries; building up research excellence; attraction of global companies; and stimulation of spin-offs (Tödtling and Trippl, 2005, p.1204).

A fundamental debate within the literature on innovation policy is to what extent a "copy and paste" (Piccaluga, 2006, p.273) approach can be followed whereby regions adopt best practice from elsewhere (usually stronger regions). Whilst recognising the potential strengths of this innovation policy approach, Tödtling and Trippl (2005) argue that it is used in an undifferentiated manner for all kinds of regions rather than taking into account the specific strengths and weaknesses of different places. These authors

assert that “policy conclusions which are drawn from the analysis of “success stories” are only of limited use for less favoured regions”, as their innovation capabilities deviate in many respects from these “role models”. They call for more differentiated innovation policies dealing with specific innovation barriers in different types of regions (Tödtling and Trippl, 2005, p.1204). Piccaluga (2006, p.273) agrees; whilst it is certainly necessary for regions to analyse and replicate best practices, especially as a starting point, each territory has its own history and economic, social and technological trajectories that have to be acknowledged in policy design. Nauwealers and Wintjes (2003, p.218) are strong advocates for a regionally differentiated innovation policy, but they do recognise the potential usefulness of importing best practice from elsewhere:

> *“Similar SME problems need to be tackled differently according to the regional context, but also there is scope for importing elements of good practices from one context to another”.*

Uyarra (2007, p.256) is more critical, and sees a “productivist and top down approach” to regional innovation policy prevailing, which places a “naive emphasis on benchmarking and imitating from other successful regions and experiences”. She calls for better investigation into the formulation and implementation of innovation policies in a multilevel, multi-actor context, to which there has been dedicated thus far little critical analysis. It is not clear whether the alleged elements of regional success, such as societal spatial or institutional thickness are outcomes or preconditions for successful regional innovation policy (Uyarra, 2007, p.254), causing us to fundamentally question how appropriate innovation policy is for lagging regions which do not have these pre-requisites in place. Regional governance structures are crucial for the innovative capabilities of a region and are composed of: a control and regulatory structure that brings governmental and societal actors together, with both formal and informal aspects,

characterised by hierarchical, competitive, and cooperative inter-actor relations (Benz, 2001; Heidenreich and Koschatzky, 2011, p.534). Certainly, different regions have their own needs and priorities, and different forms of governance structures to address innovation; this means that a policy or programme that works well in one region may not be applicable or useful in another setting. This thesis explores how useful or appropriate are theoretical approaches to studying and designing innovation policy in a weaker region that originate from stronger regions.

2.4.3 Overlapping Policy Areas

Innovation policy overlaps with other policy spheres to a large degree, and it can be difficult to define the boundaries of what is and is not innovation policy. There are a number of overlapping policy areas highlighted in the literature as relevant to the broader innovation agenda; in particular, science and technology policy, and enterprise and entrepreneurship policy. These are often grouped together with innovation policy in academic studies, and researchers have found a high degree of overlap between the different agendas (Laranja et al., 2006; Lundvall and Borras, 2005). Table 2.1 summarises the overlapping policy spheres, as identified from the literature, and explains why they are important to the innovation agenda.

Table 2.1 Overlapping Policy Spheres Identified in the Literature Review

Type of Policy/Programme	*Role in Driving Innovation*	*Examples*	*References*
Entrepreneurship- Supply side: ensuring that high numbers of people have the motivation, financial means, and skills to launch a new business. Demand side: stimulate technological development, competition policy, bankruptcy policy, and labour market policy. E.g. Entrepreneurship schemes specifically aimed at minority groups, funds are made available for start-ups, and governments can assist through creating venture capital funds or business angel networks.	Governments have a role in ensuring that there are low barriers of entry and exit to the market for businesses, that labour market laws are not too stringent, and that there are no "quiet disincentives" especially in welfare states, where those considering starting a business are hindered by risking losing their benefits or paying more tax. All these issues overlap significantly with the innovation agenda.	USA (Congress of the Small Business Innovation Research Program), Germany (EXIT regions) Sweden	Audretsch (2003) Dodgson and Bessant (1996) Reynolds et al (2005) Stevenson and Lundström (2001)
Hard infrastructure- Development is often seen as key to economic growth and development, and governments in weaker regions often focus heavily on improving the physical and technological infrastructure as a necessary precursor to innovation and growth. Creating the right facilities for innovation activities to take place e.g. creating science parks.	Means of creating clusters/agglomerations of firms and an attractive business environment. In terms of innovation, science parks are important elements of this approach because they aim to develop clusters and strengthen the triple helix interactions. But wider infrastructure development is also important to innovation.	Stanford, CA Cambridge, UK Sophia Antipolis, France, China, Taiwan	Bakourous et al. (2002) Lai and Shyu (2005) Massey et al. (1992) Quintas et al. (1992) Tan (2006) Toth and Szues (2010)
Business support services- As well as providing financial support to firms, almost all EU countries have variety of advisory services to assist SMEs covering legal, accounting, managerial advice, and scientific and technological expertise. Some schemes focus on different sizes of firms, others distinguishing between different types of support whilst other schemes provide the full set of services to any type of firm.	These programmes seek to diffuse technological information to enterprises, which might otherwise have difficulty accessing services either because of cost or knowledge asymmetry about the usefulness of services on offer. These services may be important to the innovation system because they can help raise the innovativeness of firms.	Across Europe; Germany, UK	Bennett and Robson (2003) Czarnitzki and Speilkamp (2000) Storey and Tether (1998)

Type of Policy/Programme	*Role in Driving Innovation*	*Examples*	*References*
R, D & I support- Increasing capacity and spending on research, development and innovation in firms, HEIs and research organisations. Linear model of driving innovation. Different policy tools are used to help raise R&D- direct grants are often used to fund academic research, and sometimes private sector research. In the UK, tax credits have been the main way of increasing the amount of private sector R&D. EU has strong drive to raise levels.	Increasing the actual amount of private sector R&D may help to raise the innovation count and also, a greater R&D capacity will allow firms to better absorb innovations from elsewhere. Government intervention to raise private R&D spending, and to provide assistance to firms at the early stages of a project is often justified through market failure- because R&D, in particular basic research, is risky, due to the unknown returns on investment, private firms are disinclined to carry it out.	Sweden UK Norway Limburg, Netherlands Japan Korea	Cohen and Levinthal (1990) Garofoli and Musyck (2003) Isaksen (2003) Mathieu and Van Pottelsberghe de la Potterie (2008) Nagano (2006)
Education and training- Government can play a significant role in providing the human resources requirements of innovative firms. Entrepreneurship education is an important element because it can provide the capabilities and motivations for individuals to become more entrepreneurial. EU is encouraging member states to upgrade their innovation policies and develop national framework conditions for the "knowledge triangle" of innovation, research, and education.	If we look at the innovation system from a broad perspective, it is clear that education is crucial for providing the human capital and absorptive capacity necessary for innovation. Highly educated people contribute to the economy by pursuing regular activities more efficiently that the average worker and are more competent in exploiting new technological opportunities in the economy.	Education (and entrepreneurship) are priorities at European level; Sweden, UK,	Bassanini (2005) Lundström and Stevenson (2001) Lundvall (2008) Mariotti and Rabuzzi (2009) Møller (2010)
Regulation (including tax system)- Can be either a source of unnecessary restraint upon enterprise or a necessary element in enabling firms to compete more effectively. OECD identifies framework conditions arising out of national regulations as influencing innovative performance. Within this category we can include competition laws, intellectual property rights, planning regulation, free riding regulation. Within	Regional dimension- successful regions in Europe where regulation is dealt with at a subcentral level. Cooke (1992) found that countries that view regulation in its proactive sense have been more successful economically than those that see it in its negative sense. Policy towards piracy has become especially important in China recently because a balance needs to be maintained between protecting and enabling	Smaaland, Sweden Jutland, Denmark Emilia-Romagna, Italy Baden-Württemberg, Germany	Cooke (1992) Courvisanos (2009) Jasingh (2009) Zhu and Shi (2010)

Type of Policy/Programme	*Role in Driving Innovation*	*Examples*	*References*
labour market regulation also fall immigration policies.	innovation.	Japan China	
Inward Investment- Regional governments (and national) have long focussed on attracting MNEs through incentives etc. because of the perceived benefits they bring to the economy and innovation system.	MNEs are important to the innovation system and regional economy because they are creators of new technology and can establish internal and external networks for innovation. Indigenous firms may benefit from localised knowledge spillovers from MNEs, giving them access to knowledge developed in other regions or clusters.	Wales UK	Cooke (2003) Iammarino and McCann (2010) Johnes (2012) Morgan (2002) Pickernell (2011)

The main difference between *innovation policy* and *science and technology policy* is that the former takes a more interactive view and takes account of the complexities of the innovation process, whereas the others see innovation more as a linear process (Isaksen, 2003, p.50). Innovation and science and technology policy are often grouped together and used interchangeably. For example, Shapira and Kuhlman (2003) talk about RIT policies (research, innovation, and technology) and the goal of these policies - to enhance the performance of national and regional economies - is hard to distinguish from the goals of 'straight' innovation policy. Laranja et al. (2006; 2008) and Lundvall and Borras (2005) use the acronym STI (science, technology, innovation) policy to explain the mix of policies that affect the innovation system and Martin (2012) refers to SPIS- science policy and innovation studies. Lundvall and Borras (2005, p.4) plot the historical development of the different policy types from science, to technology, to innovation policy, and highlight the fact that "in the real world" the different forms overlap and mix.

Entrepreneurship policy is another overlapping sphere, which is primarily concerned with creating an environment and support system that will foster the emergence of new entrepreneurs and the start-up and early stage growth of new firms (Lundström et al. 2008). Both innovation and entrepreneurship policy are concerned with creating a wider environment or system that is conducive to business start-up and growth (Audretsch, 2003, p.20). Entrepreneurship policy emerged as an important sphere around the same time as innovation policy; policymakers starting paying much more attention to SME policy after Birch's 1979 study that found that 80% of new jobs in the US were created through small rather than large firms (Stevenson and Lundström, 2001). Thurik (2009, p.227) suggests that the shift towards the knowledge-based economy is the driving force

behind the refocus from large to smaller businesses, and that different governance is needed for the entrepreneurial economy compared to the old managed economy.

As well as the policy itself, the importance of the wider governance of innovation and the capacity of the state to design, implement, and evaluate innovation policy is key. Good governance of innovation, and also a high level of state competencies and capabilities has been found to be vitally important in regional economic development, as has the strength of regional institutions (Rodriguez-Pose, 2013). The importance of "state capacity", including impartial bureaucratic practices, corruption, the rule of law (Charron, 2013) to innovation and economic development is recognised. Rodriguez-Pose (1999, p. 363) agrees with this viewpoint:

"The analysis of the evolution of regional disparities in Western Europe over the last two decades uncovers the emergence of growth patterns that are closely related to the capacity off every space to respond to the challenges generated by the processes of socio-economic restructuring."

2.4.4 Frameworks for Identifying and Analysing Innovation Policy

In line with Borras and Edquist's (2013) definition, this thesis argues that when studying innovation and government, it does not suffice to look only at that policy labelled "innovation policy". Indeed, innovation policy represents a "messy and complex, multi-level, multi-actor reality" (Flanagan et al., 2011, p.711); we must examine industrial, entrepreneurial, science and technology, general economic policy and more, and build up a realistic picture of how local, regional, national, and even supra national policymaking interact. The concept of "policy mix" has been employed by scholars attempting to conceptualise the interactions and interdependencies between different policies and how they affect the extent to which policy outcomes are achieved (Flanagan

et al. 2011, p.702). Innovation academics have developed frameworks to deal with this complexity, map out what they consider to be innovation policy, and conduct analysis. A framework for policy analysis can be developed building on previous work, and other studies can be used to guide the policy selection and identification process.

Elder and Georghiou (2007, p.953) provide a taxonomy of innovation policy tools based on a distinction between supply and demand side measures, with the supply side further divided into finance and services. Under the supply side these authors group grants for industrial R&D and public sector research, fiscal measures, equity support, support for training and mobility, information support, and networking measures; they see systemic policies, regulation, public procurement, and support of private demand as demand side measures. These authors argue for increased focus by on demand side measures with greater potential to drive forward innovation than supply side measures, with a particular emphasis on public procurement (Elder and Georghiou, 2007). Gil et al. (2003) also recognise supply and demand side instruments, but have not categorised them according to this rationale. Instead they see five groups of innovation policy instruments: direct support schemes for R, D & I projects; technical personnel introduction schemes; technology centres and schemes fostering technological diffusion to SMEs; mobility schemes for researchers; innovation brokers and advisors. These categories are useful to guide and inform the search for innovation instruments in Wales, but because their study was geared specifically towards policy supporting innovation in SMEs we must also look for interventions supporting innovation beyond this sphere.

Nauwelaers and Wintjes (2003, p.212) have developed a different approach to categorising innovation supports; they divide supports two ways based on whether they are oriented towards the firm or the regional/system level, and whether the mode of support is aiming to input resources or to support change in behavioural and learning

processes. These authors divide interventions based on the linear approach to innovation, and those with an interactive basis more attuned to the theories discussed below. They also distinguish between proactive and reactive policy, recognising four groups of policies aimed at: raising the endowment of the firm and of the region, stimulating behavioural change at the firm level, and supporting cluster formation at the regional level (Nauwelaers and Wintjes, 2013). Their framework has been applied to innovation policies and programmes in twelve European regions, and so has been empirically tested. However, due to the multi-dimensional nature of their framework, which differentiates between firm and regional level, and also by the mode of support, it is found to be quite complex. Also, because it is specifically geared towards SME innovation supports it is not quite ideal for the purposes of this study.

Garofoli and Musyk (2003, p.119/120) have a similar but slightly simpler categorisation and group the innovation supports according to whether they are firm-oriented, system-oriented, or process-oriented. Firm oriented support includes grants and loans for R, D & I and the introduction of research or technical personnel into SMEs. System-oriented support includes policies based around technology centres and technological diffusions schemes, innovation brokers, and researcher mobility schemes. The process-oriented support category is somewhat less straightforward; it consists of "pro-active actions and initiatives" and the upgrading of local and regional innovation systems (Garofoli and Musyk, 2003, p.120). The premise behind these two approaches (Garofoli and Musyk, 2003; Nauwelears and Wintjes, 2003), that innovation interventions can be viewed either as firm or system oriented, is an interesting one, but is not ideal for this study because it is not only innovation interventions aimed at the firm that are being examined.

McCann and Ortega-Argilés (2013) introduce yet another approach to classifying innovation policy, organising interventions according to the type of region based on needs (see Table 2.2). These authors also distinguish between "traditional" and "networking" innovation policies. The former are those which focus on particular sectors, often high-tech, and are based on a market failure argument; the latter take a "systems-type" view and focus on building "linkages, networks, and synergies" between existing actors in the different sectors (McCann and Ortega-Argilés, 2013, p.204). Whilst the organisation of support based on regional characteristics is interesting in the context of studying a weaker region, it is not clear where Wales would fit due to the strong presence of both industrial and service employment, and a strong public sector presence.

Table 2.2 Innovation Policy Interventions to Meet the Needs of Different Regions

Type of Region	*Priorities/Needs of Region*	*Policy Interventions*
World-class performing regions.	Strengthening the private-public sector relationships. Attraction of global talents. Maintaining existing knowledge-related strengths.	Enhancing collaborations, promoting knowledge exchanges, engaging local SMEs in networks, strengthening existing links with local universities and research centres.
Industrial employment based regions.	Increasing the number of firms engaging in innovative activities. Diversifying the region's activities. Establishing/building up collaborative networks. Establishing/fostering emerging knowledge exchanges.	Policy interventions are starting at a much lower level than in advanced regions. Emphasis on direct interventions to stimulate innovation in the hope that cultural change will emerge naturally from innovation successes.
Service sector and public R&D based regions.	Major challenges related to better exploit and commercialise existing research.	Finding ways to link the public and private sectors, developing a strategy for regional innovation via linking stakeholders, aligning local institutions with each other and with national institutions, and encouraging new innovators.

(Source: Author's elaboration of McCann & Ortega-Argilés, 2013)

Flanagan et al. (2011, p.707) discuss the concept of innovation "policy instruments", which are the actual actions taken under the innovation policy banner; the example studied in their paper is the innovation voucher, and they examine the variety of schemes implemented in different locations under this bracket. Their study highlights some of the problems in studying innovation policy instruments: there will always be uncertainty about which aspect of the instrument is responsible for any observed effect; instruments are not necessarily stable over time and space in terms of rationales, goals, or means (Flanagan et al., 2011). Policy instruments can "harden" over time into new

actors and institutions, and fundamentally change the context within which future policy and innovation processes occur (Flanagan et al., 2011, p.707). Indeed, policy is ever shifting and unfolding over time, and that policy must be analysed in "a context of pre-existing policy mixes and institutional frameworks that have been shaped through successive policy changes" (Uyarra, 2010, cited in Laranja et al. 2011, p. 708). Ringeling (2005, p.192) explains that we cannot examine single instruments in isolation because "their actual state is influenced by the fact that they always come in a mix". In light of these insights, this study is designed as a longitudinal one, so that the evolution of innovation policy and interventions can be examined; rather than seeing them in isolation from their geographical and temporal context, and in isolation from one another.

These different frameworks and approaches employ innovation theory to a greater or lesser degree in helping us to understand and analyse innovation policy. This chapter will now turn to the key theoretical approaches to the study of innovation dynamics and policy that are influential in both the academic and policy spheres. There is disagreement over whether the four theories selected should really be considered as such, and in the literature they are sometimes referred to as theories, but also as concepts, approaches and frameworks. This thesis uses the term "theory" because they are all lenses through which we can examine innovation and policy, each eliciting different understandings and insights, but appreciates the contested nature of this terminology.

2.5 Theorising Innovation

The previous section has explained how innovation as a concept has become increasingly important in our understanding of economic growth, and how our understanding of innovation has evolved over time towards a more evolutionary and

interactive view. Knowledge and learning are recognised as the key factors driving innovation, and networks and proximity as the key enablers. Theories are proposed that examine these phenomena and provide frameworks or best practice scenarios for innovation policymakers to follow and aspire towards (e.g. Etzkowtiz & Leydesdorff, 1997; Florida, 1995, 2006; Porter, 1998; Rutten & Boekema, 2007); theory and policy learning can be seen as an integrated, co-evolving and interactive process (Mytelka and Smith, 2002). This section examines the most prominent of these, and explains how they have emerged to function both as analytical tools and policy guides simultaneously. Specifically, four theories have been identified as the most relevant and influential in contributing to the academic understanding of innovation at the regional level and have influenced policy. This follows the precedent of Laranja et al., who examine innovation policy from the perspective of "theories associated with spatial dynamics and territorial relationships" (2008, p.823), such as those selected for this study. Indeed, the separation of theory and policy practice is inappropriate because "the theory-policy link has been central to the development of [the innovation studies] field" (Mytelka and Smith, 2002, p.1467).

The study of innovation has moved from viewing it in a linear fashion based on "market pull" or "technology push", for example through the chain linked model or model of trajectories and regimes, towards more interactive and evolutionary approaches (Dosi, 1982; Kline and Rosenberg, 1986; Lundvall, 1988; Leydesdorff, 2012, p.26; Nelson and Winter, 1982). There are several important ideas identified through the literature search, such as open innovation, innovative milieu, the creative class, the entrepreneurial university, innovation networks, user-driven innovation (Breschi and Lissoni, 2001; Chesborough, 2003; Florida 2002, 2005; Wise and Høgenhaven, 2008) that fit within this broader interactive approach. These ideas have evolved alongside one another and

overlap to a large extent, but the four that have been selected to inform the theoretical framework of this study are: systems of innovation, the learning region, the triple helix and cluster theory. The reason for this is fourfold: they all are prominent ideas in the academic literature on innovation; they are relevant to the study of innovation at the specifically regional level; they all deal with the role of government; and have all strongly influenced the policy sphere.

These theories have been applied to the study of "real world" innovation policies and programmes, and have influenced approaches to innovation policy at various government levels (Edquist, 2005; Lundvall, 2007). This section examines theory and policy application in turn, firstly giving an overview of each theoretical approach and then discussing how it has been applied to the study and practice of innovation policy. The cases examined here are to provide examples of the way in which the theories have been practically applied to policy analysis; the aim is not to provide a comprehensive review of all studies in the field. At the end of the section, a table is provided which summarises the key characteristics of policies and programmes that have been identified as following the various theoretical approaches, which will be a useful tool to analyse the Welsh case. This thesis is especially interested in how the various policies and programmes are categorised theoretically as well as the lessons for policymakers that each theory provides.

It is important to recognise the similarity of the theories being discussed; they all view innovation as evolutionary and interactive and emerged in recent years as a result of the convergence of the previously distinct fields of innovation studies and economic geography (Rutten and Boekema, 2007, p.3). This section looks at them individually but places them in a chronological structure and explains how they co-evolved and developed alongside one another with both overlapping and contesting elements. Whilst

there are distinct bodies of literature dealing with the various theories there is a high degree of overlap in terms of the academics writing about them, and the concepts often feature simultaneously or even interchangeably in policy. The theories examined here are both descriptors and normative policy frameworks; they can be seen as providing both an answer and a challenge to the issue of regional innovation and economic development (Asheim, 2012, p.995). However, they have been empirically tested predominantly in the "stronger" or "leading" region contexts within which they were developed. Due to their influence on innovation policy (especially across Europe), they warrant further investigation in the context of a weaker region. This thesis argues that using only one theory normatively could miss key ideas and insights. The four theories share many ideas and can be seen as being underpinned by the common themes identified above; however, they also provide unique insights into the innovation process at the regional level and the role of government. As such a multi-theoretical framework is proposed, which will be elaborated and developed throughout the thesis.

2.5.1 Systems of Innovation

Over the past three decades the systems of innovation (SI) approach to innovation and economic development has gained prominence in both the academic and policy spheres so that it is now a dominant lens through which we examine innovation processes and dynamics, and is an influential best practice framework for innovation policy (Edquist, 2005; Lundvall, 2007). The approach first emerged in the academic literature with work on National Systems of Innovation (NSI) (Lundvall, 1988, 1992; Nelson, 1993), and has since evolved into several variations all with the underlying conception of innovation as interactive and evolutionary. The systems approach was developed to challenge mainstream economics and prevailing economic policy practice (Lundvall, 2007) and it is important to recognise the role of the concept in driving shifts in our understanding of

innovation and economic development towards a more evolutionary and interactive direction, influencing economic and innovation policy at various levels. The essence of systems theory is that interactive processes between varied and diverse actors, networks, continuous leaning processes and innovation-conductive institutions such as policy incentives and trust, will give rise to economic growth, technological dynamism and competitiveness (Caniëls and Van den Bosch, 2011).

Lundvall (2007) provides a comprehensive overview of the variations present within the systems of innovation literature, and Edquist (2005) refers to a "family" of SI concepts underpinned by common understandings of the innovation process as evolutionary and interactive. The key variants that have evolved from the original (national) concept are: regional systems of innovation (Cooke, 1996; Maskell and Malmberg, 1997); technological systems (Carlsson and Stankiewitz, 1991); and sectoral systems of innovation (Breschi and Malerba, 1997). The geographical variants of the SI approach are of particular interest to this study, which investigates the Welsh innovation system and follows the understanding that "innovation is fundamentally a geographical process" (Rutten and Boekema, 2007, p.3). Innovation systems can be defined broadly, including the "wider organisations and institutions affecting and supporting learning and innovation", or narrowly, examining the "R&D functions of universities, public and private research institutes and corporations" (Asheim, 2012, p.995). According to Lundvall (2007), it is the wide understanding that is most useful and appropriate, but policy often conceptualises innovation systems narrowly. "The systems of innovation literature conceptualizes innovation as an evolutionary and social process" (Doloreux and Parto, 2005, pp.133-153), and conveys the idea that innovations do not originate as isolated, discrete phenomena, but are generated by means of the interaction of a number

of entities or actors and agents (Saviotti, 2005), in a system of interconnected players (Isaksen, 2003).

The systems approach "transcends the linear view of technical change" (Edquist, 2005, p.21) and so can help us understand how innovation actually takes place in reality, situated within its wider geographical and historical context. As Freeman (2002, p.194) explains, the "broad" approach recognises that "narrow" institutions are embedded in a much wider socio-economic system in which political and cultural influences as well as economic policies help determine the scale, direction and relative success of all innovative activities. Also, the "emphasis on economic and technological history of countries" (Lundvall et al., 2001) means that we can use the framework to place the current innovation system within its historical context and gain a better understanding of how the current situation has been arrived at.

SI theory emphasises: the importance of links between firms based on trust, reciprocity, exchange, and the role of networking as a competitive strategy (Cooke, 1998, p.5); the importance of knowledge and information as the drivers of innovation (Doloreux, 2002); and the crucial role of learning within and between the various actors in the system (Edquist, 2005). The two underlying foundations of the systems approach are the importance of knowledge and the role of institutions in the functioning of the system. An innovation system consists of elements and relationships that interact in the production, diffusion, and deployment of new and economically useful knowledge (Lundvall, 1992); institutions are seen as the central elements in enabling innovation but can also be a hindrance in certain contexts (Edquist, 2005, p.24/26; Gregerson and Johnson, 1996, p.8).

The systems approach takes a broad view of the actors involved in innovation: as well as the usual actors (firms, universities, technical institutes), it factors in a wide array of intermediate institutions such as trade associations, chambers of commerce, professional associations etc., which can "function as learning laboratories for their respective firms and industries" (Edquist, 2005, p.17; Morgan, 2007, p.105). The SI concept is employed as a label, an analytical tool, and to derive policy implications, but by far the most common usage is the former (Edquist, 2005, p.192). The value of the SI theory lies in its broad understanding of innovation as interactive and evolutionary; it does not condense the complexity of innovation into a simple checklist for policymakers to follow in the manner of the triple helix or cluster approaches (discussed below).

The systems of innovation literature branches into two main geographical approaches – national (NSI) and regional (RIS) – with other levels also proposed, such as local and supranational systems. Some scholars view the national level as the most appropriate at which to analyse the system of innovation, and others assert that the regional scale is the most applicable. Somewhat confusingly, an innovation system can be supranational, national, regional and even sectoral within a country at the same time (Edquist, 2005, p.11/12). NSI work sought to establish the existence of convergence or divergence among different nation's innovation systems given increasing internationalisation of science and technology (Cooke, 1998, p.2). Academics studying regions were already studying different components separately and began putting them together into an emerging Regional Innovations System (RIS) concept. The RIS school of thought was also boosted by the literature on Post-Fordism, industrial clusters, and the rise of the region state, already discussed (Cooke, 1998, p.3).

The NSI and RIS approaches are in fact very similar, and Lundvall (2007, p.4) sees the RIS variant as the perspective most resembling the original NSI because both are based

on the understanding of knowledge as local and tacit, view innovation systems as localised, and attempt to explain economic performance in geographical terms. Some academics see the national level as the most useful or appropriate for examining and trying to understand innovation processes and performance (Edquist, 1997; Lundvall, 1988) because: different countries have different knowledge stocks due to levels of inputs devoted to innovation (Furman, Porter, and Stern, 2002); interactions take place within specific national contexts of shared norms, routines, and established practices (Isaksen, 2003); and the innovation process is organised according to the national level of governance (Ronde and Hussler, 2005). National innovation cultures are seen to exist, and the regional level is not seen to be sufficient for firms to stay competitive (Asheim and Coenen, 2005; Isaksen, 2003).

The RIS school of thought is premised on the understanding that the regional level is the most important in understanding processes of economic growth and development in the globalised knowledge economy. It was established as an alternative to counterbalance and highlights the limits of the original NSI approach. For example, Dodgson et al. (2011, p.1) see the NSI variant as problematic because of the relevance of global, regional, sectoral, and technological influences on innovation performance. The key argument underpinning the RIS approach is that learning has a specifically regional context; knowledge is hard to exchange over long distances being heavily imbued with meaning arising from the social and institutional context in which it is produced, and regions have individual knowledge capabilities and resources (Asheim and Gertler, 2005; Cooke, 2007, p.199; Cooke et al. 1997; Morgan, 1997; Nauwelaers and Wintjes, 2003). Many of the criticisms of RIS theory equate to those levelled at the new-regionalist school as a whole and are discussed in length above so are not repeated here. Bellini and Landabaso (2007) criticise the regional approach because they see

innovation policy as too small in resources to tackle the macro dimensions of innovation.

The choice between the national and regional approaches should be made based on the case in question, and which is most appropriate for that specific context (Edquist, 2005). This study does not specify the regional or national variant of the approach at this stage, and will use the empirical observations of the case study to explore which is the most appropriate variant for studying and providing a policy framework for Wales. Wales was found by Cooke (2003, p.12) to warrant being denoted a regional innovation system due to the policies at regional level promoting interactive innovation among firms and between them and universities and economic development agencies or ministries.

The strengths and weaknesses of the wider SI approach have been much discussed in the literature, and so will be briefly reviewed here. Edquist (2005) provides an overview of the strengths and weaknesses of SI garnered from his own research and also through assimilating other authors' perspectives. He finds the strengths of the SI to be: the holistic and interdisciplinary perspective; the historical and evolutionary perspectives it encompasses; the interdependence and non-linearity of the approach; and the central role of institutions in explaining the innovation process (Edquist, 2005, p.185). The weaknesses identified revolve around the "fuzziness" of the approach (Markusen, 2003); for example the lack of a definition for an institution, and the lack of specification over what should be included or excluded from the system and where the system boundaries are (Edquist, 2005, p.186). Doloreux and Parto (2005) find the RIS approach especially problematic because we cannot determine what exactly a region is, how it might look in reality, and how much and what type of innovation must occur within a region for it to be considered a RIS.

There is a fundamental disagreement in the literature over how well-defined and theorised the systems concept should be. Some authors believe that its openness and flexibility are central strengths of the systems approach (Lundvall, 1992, p.13; Nelson and Rosenberg, 1993, p.5-6) so that it can be usefully applied in a variety of contexts with a range of variables considered (Edquist, 2005, p.186). Others see the approach as under-theorised and needing to become more "theory-like" (Fischer, 2001; Lundvall 2002, 2003). Lundvall et al. (2001) believe that the systems concept needs a stronger foundation in neo-Schumpeterian and evolutionary economic traditions, and to be based more on processes of learning and competence building. Also, they underline critical views about the theoretical status of the concept questioning the extent of its explanatory powers, and the methods used to assess how national systems work; the policy debate is seen as focusing too much on pursuit of "optimal" innovation systems whilst empirical analyses reveal great varieties of systems (Lundvall at al., 2001). In summary:

> *"Applications of the NIS approach are often too static, descriptive and mechanical, and focus disproportionately on science and technology as opposed to other loci of innovation." (Dodgson et al. 2011, p.2)*

2.5.2 Systems of Innovation Empirics and Policy

Innovation systems thinking encouraged a shift away from a science policy approach to a much broader systemic approach to national or regional innovation policies, which can be seen in the "most important international documents on the subject" (McCann and Ortega-Argilés, 2013, p.197). Lundvall (2007) and Edquist (2005) give examples of systems influenced regional, national, and international innovation policy: OECD (the Directorate of Science, Technology and Industry), UNCTAD and UNIDO, VINNOVA (the Swedish Agency for Innovation Systems), to which we can add World Bank reports (World Bank, 2010, p.3). Whilst innovation policy has traditionally been premised on a

market-failure logic, it is increasingly becoming based on a systems-failure logic over recent years (McCann and Ortega-Argilés, 2013, p.206). This section presents the discussions in the literature surrounding the policy usefulness and applicability of the systems approach: how it has been applied to the empirical study of innovation policy, and the insights it provides about how government can encourage innovation.

In the academic literature on the subject, numerous scholars have discussed the systems approach(es) in terms of their application and usefulness to the study of policy. Many have found it to be a useful framework; for Nauweales and Wintjes (2003, p.198), the concepts of systems seems a more realistic model to follow in innovation policy making than the traditional concepts of markets and hierarchies. For Edquist and Hommen (1999) the SI approaches provide better frameworks for developing public policies for innovation than the variants of the linear approach. As is discussed in section 2.5.5, the RIS and cluster approaches are often grouped together and Asheim (2007) considers clusters and RIS being incorporated into policy frameworks or models for initiating learning-based processes of innovation.

The RIS has been utilised by Cooke (2008, p.17) to create a typology of different types of regional systems based on their characteristics, which can be used to identify and analyse "real world" RISs; he finds that "very few regions have all the attributes of an RIS", but finds six varieties based on empirical observations of actual regions in Europe (Cooke, 1998, p.20-23). In their analysis of different Nordic clusters, Asheim and Coenen (2005) found that different types of RIS were accompanied by different types of policies. These authors provide some insights as to how governments can achieve the ideal (networked) type of RIS (Asheim and Coenen, 2005; Cooke, 2008) with the assistance of policy interventions to increase innovation capacity and collaboration, helping SMEs access pools of knowledge at the national or global level, and

collaborating with R&D institutes to provide knowledge to support firms' locally derived competence. However, it is not enough for governments to establish one particular type of RIS; because "innovation creates uncertainty and is destabilising", governments "must develop highly refined sensitivities to change" in their regional systems (Cooke, 2003, p.8).

The crucial role for government in the innovation system is as a co-ordinator and facilitator of connectivity between actors in order to enable the system to produce and deliver new products and services; governments should support dynamic and evolving national institutions and infrastructure, and the development of organisational skills and capabilities (Dodgson et al. 2011, p.9). An interesting debate within the systems literature is whether a system of innovation is consciously designed or not, with researchers assigning a greater or lesser role to government in this. Carlsson et al. (1992) consider a prominent role for technology policy in improving the function of existing technological systems and enhancing the creation of new ones; systems of innovation are, partly, built by the state. Nelson and Rosenberg (1993) disagree, and do not consider national systems of innovation to be consciously defined. Edquist (2005, p.14) bridges the gap between these two stances and views the situation as being somewhere between the two extremes, with some elements of the innovation system consciously defined and other elements evolving spontaneously over time; he asserts that a technological system may be influenced at policy level, but not a whole national system.

There are some examples provided in the literature of policies and programmes that follow the approach advocated by the SI theory. One of these is a programme emanating from Europe and implemented in Wales: the RTP, later known as the RIS (Cooke, 2003; Cooke et al. 1998; Cooke and Morgan, 1998). This is discussed in detail in Chapter 5, suffice to say it is a programme that aimed to build regional innovation systems across

Europe, taking a broad view of innovation; there is precedent in Wales for studying innovation policy and programmes through the RIS prism. Edquist (2005) also provides some examples of "real world" innovation systems, and the role that governments can play within these. Edquist (2005) gives examples of different varieties of NSIs, finding that the Japanese NSI is driven primarily by company based research organisations, whereas in the US universities play a much stronger role. The OECD (1999) identifies different NSIs in Austria, Belgium, Finland, Germany, Spain, Sweden, Switzerland and the UK; each with different characteristics and policies (Edquist, 2005). The systems approach, as compared to the other theories discussed here, leans more towards the theoretical and is harder to apply practically in a policy setting. There are numerous examples of the systems discourse featuring in innovation policy documents (Edquist, 2005 and Lundvall, 2007) but to identify programmes and interventions that actually follow the approach in practical terms is harder.

Through studying innovation policy, researchers have found some problems or limitations to the SI approach in its practical application. Nauwelears and Wintjes (2003, p.215) find an issue with RIS based policy approaches is that a certain level of internal resources and learning experiences are required before these types of tools can be effective. They suggest that policy should address three problems in the innovation system in the first instance; organisational thinness, fragmentation, and lock-in. Dodgson et al. (2011) warn against one-size-fits-all policies due to the complex and evolutionary nature of the economic system, explaining that policy needs to operate effectively in many different idiosyncratic settings, designed in close consultation with industry and other stakeholders. Regional differences in innovation capabilities call for a tailored mix of policy instruments (Nauwelears and Wintjes, 2003, p.215).

2.5.3 Clusters

The crux of cluster theory is that clusters are environments able to stimulate the productivity and innovativeness of firms and the formation of new businesses (Isaksen, 2006, p.45; Porter, 2002; Scott and Storper, 2003). Porter (1998, p.78) defines a cluster as a "geographic concentration of interconnected companies and institutions in a particular field". Clusters are seen as driving the direction and pace of innovation, and stimulating the formation of new businesses, which in turn expand and strengthen the cluster (Huggins and Izushi, 2007). The economic analysis of clusters is perhaps one hundred years old, but the phenomenon of clustering is much older and is recognised by historians of the industrial revolution; Alfred Marshall is seen as the first writer to explain how the geographical concentration of production is the distinctive characteristic of industrial organisation (Baptista, 1998). The work of Michael Porter (1990) attracted much attention from governments and consultants, and the cluster concept became popular in the policy sphere. Porter (1998) combines his analysis of clusters with the concept of "competitive advantage", explaining how gaining an advantage in the global economy lies increasingly in local factors such as knowledge, relationships, and motivation. By marrying competitive advantage with the phenomenon of clustering, Porter delivered a pre-packaged concept that has proved attractive to policymakers worldwide (Martin and Sunley, 2003).

Many of the ideas about spatial agglomeration that the cluster concept is based on are not confined to cluster theory alone, and form the basis of the other territorialised theories of innovation. Firms in clusters are thought to gain competitive advantage from "hard" economic and market related conditions, or from "soft" socio-cultural and institutional ones (Isaksen, 2006, p.46). Malmberg and Maskell (2002) explain how co-location increases competition between firms in the same area because firms can

monitor and observe each other, and copy each other's solutions thus stimulating innovation activity. Clusters are seen to enhance firm collaboration beyond market transactions by encouraging trust, social consensus, and shared aims amongst local players (Amin and Thrift, 1994).

Table 2.3 presents some examples of clusters that feature strongly in the literature; they are the cases upon which the cluster model was built. It is a theory that has emerged out of leading regions, and has become influential as a policy approach to innovation and economic development in a wide range of different regions, including Wales.

Table 2.3 Prominent Clusters as Identified from the Literature Review

Cluster	*Details*	*Reference*
Silicon Valley, California	Often cited as an example of the cluster ideal. Key role of government in founding and developing the cluster through military spending. Also, key role of individual entrepreneurs (e.g. Robert Noyce, founded Fairchild Semiconductor and Intel), of Stanford University as a source of knowledge for the region, also graduates. Role of entrepreneurs often overstated; industry always turned to government during difficult times.	Huggins and Izushi (2007) Lee et. a.l. (2000) Massey et al. (1992) Saxenian (1994)
Italian Industrial Districts	Some of the first modern cluster studies carried out here, based on Marshallian ideas of agglomeration and also stressing socio-economic dimensions of the locality. The phrase "flexible specialisation" coined to explain the mix observed here. Example of Sassulo where 85% of Italy's ceramic tile industry is based in one town.	Asheim et al. (2006) Piore and Sabel (1984)
Cambridge, UK	IT cluster, much smaller in scale than Silicon Valley but significant on European scale. Similar to SV in the entrepreneurial concentration, IT firms, and strong role played by the university. The Cambridge cluster has not produced large high growth firms in the manner of SV. As well as the IT cluster a life sciences cluster has been observed.	Athreye (2001) Casper and Karamansos (2002) Castells and Hall (1994)

There is still disagreement over whether clusters drive economic growth, and Noteboom (2006) asserts that it is not clear that clusters do always contribute to innovation. Baptista and Swann (1998, p.526) ask the important question "do firms in clusters innovate more?" and find that a firm is considerably more likely to innovate if own-sector employment in its home region is strong and that strong clusters are more likely to attract new entrants, and firms in strong clusters tend to grow faster. They find that firms in industries where competition is more intense have a greater probability of

innovating (Baptista and Swann, 1998). Iskasen (2006, p.45) reviews the evidence on whether cluster firms achieve competitive advantage, and find that this assertion is based on theoretical considerations and analyses of fairly few, successful and well- known clusters.

Cluster theory has become widely accepted and applied, but Asheim et al. (2006, p.16) do not see it as rigorously tested and evaluated; despite a high degree of policy take up, dissatisfaction with the concept is appearing. They highlight some of the problems that clustering can cause, such as congestion, soaring property prices, pressure on services, and social inequality (Asheim et al. 2006 p.22). These are problems which Silicon Valley is facing, and as some workers thrive, others experience insecure work, and inferior working conditions and arrangements (Benner, 2002). The beneficial effects of clusters on growth and innovation are not automatic, and sometimes the positive effects of clustering can be offset by the costs, such as congestion (Swann, 2006). Swann (2006, p.267) sees these problems as "shadow" effects of cluster policy on the hinterland, and that any policy which strengthens one cluster may do so at the expense of weaker areas. Hassink (2004, p.1/2) questions the appropriateness of cluster concept for weaker regions because it explains the rising part of clustering of industries being based heavily upon exceptional regional economies (Silicon Valley, Baden-Württemberg, Third Italy) but has little to offer regional policies focused on the specific problems of the falling part of clustering.

2.5.4 Cluster Empirics and Policy

Numerous policies have been implemented following the cluster model, aimed at building the economic strengths of regions over others by developing geographical agglomerations in certain sectors. Indeed, the cluster concept has been extremely successful in translating from academic theory to policy blueprint, studies have been

conducted of individual case studies of regional cluster initiatives, and researchers are increasingly utilising large data-sets to undertake "cluster mapping" exercises (Ketels, 2013, p.273; Porter, 2003). Rather than attempt to discuss this vast body of work, this section will focus on the policy lessons that have been derived and the insights about the role government should take.

Cluster policy attempts have achieved varying levels of success, and the literature is divided over whether or not cluster presence has a positive impact on economic outcomes (Greenstone et al., 2010; Kerr et al., 2013; Martin and Sunley, 2011). Ketels (2013, p.275) explains the divergent results by the lack of a commonly used empirical definition of clusters. By reviewing the body of cluster policy studies, Ketels (2013, p. 276) summarises the main lessons for regional policymakers: cluster policy initiatives are most effective when the underlying cluster is strong, there is trust with regional government, and there is a solid organisation to run the initiative. Ketels (2013) argues that cluster policy is effective when it attempts to upgrade the underlying competitiveness of clusters rather than trying to create them from scratch or increase their size. If we apply Porter's (1990, 2003) recommendations, that policy should build on existing clusters rather than trying to develop them from scratch, this may not be a particularly useful concept for a lagging region which shows little sign of existing clusters. On the other hand, Christiensen et al. (2012) see a relevance of cluster policies for weaker regions, suggesting different types of cluster policies for different regions; programmes for emerging clusters need to be different to those for established clusters.

Studies of particular regional interventions can provide some useful insights into how policy can best encourage cluster development and what pitfalls regional governments should try to avoid. Uyarra's (2007, p.253) study of English regional economic strategies found a mismatch between policy actions and the actual industrial

specialisation of their regions; policymakers were attempting to create clusters where they were neither necessary nor appropriate. In this case, policy was too focussed on high tech sectors and did not consider the potential of traditional industries; there is a tendency for cluster based policies to do this, which can be problematic in weaker regions that tend to have more traditional industries (Uyarra, 2007, p.254). For an example of a case study that tells a cluster policy success story we can look to the study by Hoyssa et al. (2004) of the biotechnology cluster in Turku, Finland, which provides a good example of where regional institutions and organisations worked in harmony to achieve their regional development goals. These are only two examples but they illustrate the varying success of cluster based policies in different contexts. However, it is not clear how useful such approaches are for weaker regions.

The downsides of cluster theory are well documented; Martin and Sunley (2003) find no clear rationale for cluster interventions because not all sectors engage in collaborative relations and cluster together, and not all firms in a given sector need to be clustered. Because of the problems associated with free entry into a cluster, and incumbents not benefitting from new entries but suffering from increasing congestion costs, Swann (2006) concludes that justifications for proactive cluster policy do not work. He criticises policy that encourages clusters to become bigger uncritically and instead calls for policy which fosters richer aspects of clusters (Swann, 2006, p.269). Martin and Sunley (2003, p.5) assert that the cluster concept should "carry a public health warning".

Despite these criticisms, the cluster approach, as presented by Porter (1990), sets out a clear blueprint for policymakers to follow in order to achieve competitiveness, and has proven to be incredibly popular (Hospers, 2006). Porter (1990, 1998) conceptualises clusters and national competitiveness into a "diamond", which posits that economic success relies on a number of inter- related factors consisting of: firm strategy, structure

and rivalry; demand conditions; factor conditions; related and supporting industries. A strategy or overarching framework to enhance competitiveness for policy can be created from this model through the interaction between these four factors in a mutually reinforcing system, which can still exist lacking one of the factors but will be compromised. This policy framework is, in some senses, a more defined and constricted version of a NIS that focuses more on firms and on a narrow geographical scale; it has proved popular amongst policymakers and is arguably the theoretical approach that has had the most wide ranging impact outside of the academic sphere.

2.5.5 Learning Region

The learning region approach places the region as the key element of global knowledge based capitalism, and is the focal point for knowledge creation and learning (Florida, 1995). The concept's origins are in Storper (1991), Florida's (1995) work responding to the rise of the knowledge economy, Lundvall and Johnston's (1984) advocacy of building a learning economy in response to the same phenomenon, and Morgan's (1997) paper on the concept (Cooke and Boschma, 2011, p.530; Rutten and Boekema, 2007, p.1). It was with Florida's 1995 paper that the term became "en vogue", according to Rutten and Boekema (2007, p.1). Morgan's 1997 article soon established the concept as a policy relevant one, and "highlighted the significance for regional development of the interactive model of innovation" and directly aligned the concept to the problems of regional development in Europe (Rutten and Boekema, 2007, p.3). The learning region concept has proved popular within both policy and academic spheres, and a useful tool for analysing and understanding regional innovation policy.

In summary:

> *"[The Learning Region] reflects the definition of post-Fordist societies as learning economies, where innovation is seen as basically a socially and territorially embedded, interactive learning process that cannot be understood independent of its institutional and cultural contexts." (Lundvall and Johnson, 1994; cited in Asheim, 2012, p. 994).*

The concept is underpinned by the importance of learning within the knowledge economy and emerged from three main literatures: regional learning; clusters and networks; and institutions of innovation (Rutten and Boekema, 2007, p.4). It views the region as a collector and repository of knowledge and the underlying infrastructure to facilitate the flow of knowledge, ideas and learning (Doloreux, 2002, pg.255; Uyarra, 2007, p.245). A successful learning region relies on an educated and specialised human infrastructure and the coincidence of social, cultural, and spatial proximity to enhance interactive learning processes (Doloreux, 2002, pg.255). Within these learning regions we see "knowledge workers who can apply their intelligence in production" (Florida, 2007, p.65) and a physical infrastructure able to facilitate the movement of people, information, goods and services on a global basis. Rutten and Boekema (2007, p.3) note a difference in the two learning region approaches developing in the United States and Europe: the former focuses on the extent and quality of the institutional infrastructure and the presence or absence of a dense network of research institutions and a broader set of environmental and social amenities that attract highly skilled workers to a locale and keep them there; the latter focuses more on the role of social capital and trust in supporting dense networks of inter-firm relationships and processes of interactive learning (Florida, 1995).

There are two different uses of the concept: as a descriptive tool, "to describe a region characterised by innovative activity based on localized, interactive learning" (Asheim,

2012, p.994), and as a normative policy framework. It can be used to describe already successful regions and also to provide a road map for how weaker regions can achieve "economic growth and job generation as well as social cohesion" (Asheim, 2012, p.995). In terms of how innovation takes place, the learning region takes away the role of isolated innovators and places innovation in a spatial context; the environment is the innovator rather than the individual or firm (Oerlemans et al., 2007, p.167). The boundaries of the learning region are defined by the system rather than by administrative or geographical boundaries (Rutten and Boekma, 2007, pg.136). Learning is an inherently social process, and networks are the key organisational forms within which learning takes place; because the functioning of these networks is subject to conventions, they are wedded to specific locations (Rutten and Boekema, 2007). The emphasis on interactive learning stresses co-operation as an important strategy in order to promote innovations, and this idea is not confined only to the learning region theory; ideas about different types of knowledge, learning, interactions, and networks feature in much of the literature on innovation but are given a particular importance within this approach.

For Hassink (2004, p.6), whilst the learning region approach draws strongly on ideas from the new economic geography, new regionalism, and the family of territorialised innovation theories, it provides a framework for regions to learn from past institutional errors and avoid problems associated with path dependency. We can distinguish between regional learning, which is all types of co-operation between actors in a region, and a learning region composed of networks that develop and implement a regional innovation strategy (Boekema et al., 2002). The learning region is both a practical concept which can help promote the innovativeness and competitiveness of firms and regions (Asheim, 1996; Morgan, 1997), and can also be used to describe regions

characterised by “innovative activity based on localised, interactive learning” (Asheim, 2012, p.994).

A problem with the learning region theory is that it makes assumptions that common cultural backgrounds exist within networks, and interactions and flows between actors are often assumed rather than measured (Oerlemans et al. 2007, p.167). Also, definitions of learning regions are vague and diverse; Hassink (2004, p.4) suggests that policymakers have been eager to use the concept as a label for their development plans and have not made efforts to define what they mean. Martin (2001) sees the idea, and untraded interdependencies and institutional thickness that underpin it as “fuzzy concepts”, and for Hassink (2004, p.5) the theory is problematic because it is not possible to identify examples of actually exiting learning regions. Rutten and Boekema (2007, p.5) agree:

> *“Although a wealth of literature has been published about learning regions, we are nowhere nearer to saying what a learning region is than we were 15 years ago.”*

Cooke and Boschma (2011, p.531) summarise the various criticisms levelled at the concept, that it is “fuzzy”, and “impressionistic neologism”, “unlikely”, “over-localised”, and challenged by “learning asymmetries”. They add that “the kind of conceptual and policy instruments needed to achieve endogenous regional change are nowhere specified” in the learning region literature. Summarising these, a major problem with the learning region as a framework for analysis of a weaker region is that it assumes a level of learning and innovation is necessarily taking place within the region (Rutten and Boekema, 2012). In fact, some regions may achieve economic growth through the transfer and adaptations from elsewhere. The learning region theory

only allows for a narrow range of successful regions, and is prescriptive because it assumes that certain institutions and characteristics are necessary for innovation. In lagging regions the existing knowledge infrastructure may be weaker and so it may be unrealistic to attempt to study them as "learning regions". This theory is also elite focussed, privileging the knowledge intensive sectors and workers, which may be lacking in post-industrial regions such as Wales. Despite these criticisms it has become an important concept within both the academic and policy spheres, and has found its way into European innovation policy making.

2.5.6 Learning Region Empirics and Policy

For Nauwelears and Wintjes (2003, p.198) the learning agenda is at the heart of innovation policy:

> *"The main role for innovation policy... is to foster interactive learning within the firms and within the region. This calls for an interactive mode of policy intervention."*

The learning region idea has become influential at the European level and has been amalgamated into policy practice (Rutten and Boekema, 2007). According to Morgan (2007, p.110), Europe suffers from stark regional inequalities, weak regions may be characterised by an absence of physical infrastructure, a lack of qualified labour, little R&D activity, low institutional capacity, a poor problem solving disposition, and a low calibre of political establishment. The learning region is seen by Morgan (2007) as a useful policy framework to address some of these problems. Hassink (2004) sees it as a promising concept for weaker regions due to its focus on overcoming and avoiding lock-in in old industrial areas. By focussing on transforming lagging regions into learning regions, policy can be better geared towards fighting the causes rather than the

symptoms of problems; the learning region approach pays greater attention to the social and institutional rather than just the R&D dimensions of innovation (Morgan, 2007, p.110).

Policies have been implemented in the vein of the learning region approach, which focus on the human capital elements to attract people with knowledge and skills lacking in the region. Nauwelaers and Wintjes (2003, p.213) compared two such schemes: the RIT (Responsible Technological Innovation) scheme in Wallonia and the KIM (Knowledge Carrier in SMEs) scheme in Dutch Limburg, both of which take a learning region approach. In the former, funding was provided to businesses for particular innovation projects to attract people with technical expertise previously lacking. The Limburg scheme was similar but not project specific; funding was provided to attract people with expertise currently lacking and this could be technical, commercial, or management expertise. These schemes represent a practical approach to developing learning regions through enhancing the human capital endowments. The Regional Innovation Strategies actions of the European Commission are an example of a policy that utilises the learning legion concept in practice (Asheim, 2012; Bellini and Landabaso, 2007).

The role of government within the learning region is more pro-active than in the triple helix and cluster approaches; long term policy making is required to create sustainable advantage at both regional and national scales (Florida, 1995, p.67). The type of government and governance required for the learning region is different from that of traditional manufacturing regions, involving co-dependent relations, network organisation, decentralised decision making, flexibility, and a focus on customer needs and requirements (Florida, 1995). The learning region approach has a more vague and diverse prescription of the role of government compared to some of the other approaches, which could make it problematic to implement in practice. In trying to

create learning firms in learning regions there is a need for learning governments (Nauwealers and Wintjes, 2003, p.218). Hassink (2004, p.4) finds that policymakers have been eager to use the concept as a label for their plans, but have not made efforts to define what they mean by a learning region; he questions whether so many regions can all realistically become learning regions. Asheim (2012, p.995) suggests linking up the learning region and RIS concepts to expand their "political usefulness" (2012, p.995).

2.5.7 Triple Helix

The triple helix was proposed by Etzkowitz and Leydesdorff (1997) as a model for explaining structural developments in knowledge-based economies alongside the other interactive innovation theories discussed here that developed around the same time (Leydesdorff, 2012). At the heart of the triple helix theory of innovation is the premise that the interaction between three key actors in the economic system - government, industry, and academia - can lead to an innovative environment, and that the role of "entrepreneurial universities" as innovation drivers is key. The triple helix is not the first theory to focus on universities' contribution to economic development, for example Gibbons et al. (1994) have proposed "Mode 2 knowledge production" to explain this phenomenon. The key feature of the triple helix is that "the key to the whole innovation process is interaction and partnership among firms and between firms and various other actors" (Inzelt, 2004, p.977). For Leydesdorff (2012, p.26) the triple helix improves on SI approaches because it does not rely on an assumption of national or regional systems but can be used to analyse the degree of or emerging "systemness". The triple helix is not territorially specified in the way that the other theories discussed here are; it could potentially be applied at different geographical levels but it is most commonly situated within regional and national studies, as per the examples provided below.

The creation and consolidation of knowledge based regional innovation systems is the objective of triple helix theory and practice (Etzkowitz and Ranga, 2010); a system can be expected to remain in transition and is not expected to be stable; "the three interacting dynamics may generate highly unpredictable effects" (Leydesdorff, 2000, p.252). In the triple helix model, chasms between research, market, and policies are crossed (Cooke, 2007, p.186) and there are ongoing transactions in each of the helices (Etzkowitz and Leydesdorff, 2000). Etzkowitz and Ranga (2010) develop the idea of "Triple Helix spaces", which are consensus spaces where knowledge can be shared and innovation can take place. These spaces are both the process and the mechanism by which the different institutional spheres interact and co-evolve over time and a "cross-fertilization" of different perspectives will occur in the consensus space; the goal is that firms, academic institutions, and local government actors begin to see themselves as part of a larger whole (Etzkowitz and Ranga, 2010, pg.17). The ideal type of triple helix Etzkowitz and Ranga (2010) present is one where the spheres are overlapping, interacting, and taking on each other's roles. Leydesdorff (2012, p.28) disagrees with this viewpoint; the three spheres "do not need to be co-ordinated into a central overlapping zone" and we cannot predict the interactions that will take place between them because as soon as more than two spheres are involved "all bets are off since various kinds of chaotic behaviour become possible".

Unsurprisingly, the two originators of the triple helix theory are keen to extol its virtues as a theoretical model and a policy blueprint. For Leydesdorff (2012, p.25) a key benefit of the triple helix relative to other approaches is that it can be used to measure the interactions between the different spheres and to what extent innovation has become systemic rather than assuming the existence of regional or national systems of innovation "on *a priori* grounds". In short, the triple helix does not restrict analysis to a

purely geographically defined perspective. Etzkowitz (2008) has a somewhat more normative perspective, and uses lessons learned from analysing successful case studies through the triple helix to make a series of policy recommendations. The ideal type of triple helix is considered "laissez-faire", modelled on the American version whereby the government takes a back-seat role, as opposed to the more interventionist "statist" (Soviet-style) model (Etzkowitz, 2008).

On the other hand, several authors have discussed shortcomings of the concept, and have highlighted a possible need to expand the triple helix concept, to make space for other important actors including NGOs, society, and consumers of innovations (Bunders et. al, 1999; Marcovich and Shinn, 2010). The concept of a "quadruple helix" has emerged as a popular extension of the triple helix model, which takes various forms. Arnhal et al. (2010) review the quadruple helix literature, finding a range of different views as to what this fourth group is, with suggestions ranging from intermediate innovation enablers to different users of innovation. Leydesdorff (2012) recognises suggestions to bring "society" or "the public" into the model as the fourth helix, and indeed envisages the possibility of n-tuple helices (suggesting up to twenty) as more actors and institutions become integrated into the model. The pertinent question is whether a conceptual framework with twenty different "helices" can still reasonably be considered a variation on the triple helix or whether the SI framework is then more appropriate. If we see innovation in its wider context as providing a social good, as well as enhancing economic performance, it is possible to see why adding society or the public to the model may be useful, as the end users and main beneficiaries.

Another criticism of triple helix theory, expressed by Asheim and Coenen (2005, p.1179) is that the model is too top down, and its definition of innovation too narrow primarily incorporating R&D functions. For this reason, these authors see strength in the

learning region approach, which is a more bottom up, interactive model. Questions are also asked about whether a framework with the university at the centre is the most appropriate or useful (OECD, 2001; Sotaruta, 2004), and this study asks to what extent it is a useful framework to conceptualise the actors and institutions driving the Welsh innovation system or whether a broader framework is necessary.

2.5.8 Triple Helix Empirics and Policy

As with the other theories addressed here, the triple helix has been applied as both an analytical framework and a "blueprint for innovation policy" (Irawati and Gebhardt, 2013, p.233). As Cooke (2004, p.2) explains, the concept operates at two levels: one is the "high-level abstraction" in which "macro institutions" (university, industry, and government) engage in more systemic interaction for innovation; the other is a "quite local" view of universities' impacts on local and regional economies, such as the "exemplars" of MIT, Stanford, Grenoble, Washington, Linköping, and Oulu. Indeed, Leydesdorff (2012, p.27) is at pains to differentiate between the triple helix as an "analytical model for explaining knowledge-based socioeconomic development" and the "metaphor of stimulating university-industry-government relations proclaimed by state agencies in political discourse" citing the example of VINNOVA. Within the model there is a clear role for government; active policymaking is a necessary ingredient of a triple helix system (Leydesdorff, 2000, pg.253). One of these roles is to facilitate a greater frequency of interactions and upgrade their level to sophisticated collaborations (Inzelt, 2004). Governments can intervene in the system by creating new markets or changing the rules of the game (Etzkowitz and Leydesdorff, 2000), and the development of a new technological trajectory invokes the support of national government, or perhaps the EU. Government intervention is also seen by these authors as essential in encouraging the development of entrepreneurial universities.

As a theoretical approach, the triple helix has practical application to "real world" policy studies, and there are several examples from the literature of studies that have examined actual policy interventions and programmes through the triple helix lens, and have gained insights relating to the usefulness of the policy approach. These focus on programmes and interventions involving the three key stakeholders of government, industry, and university and efforts to encourage links and interactions between them. Etzkowitz and Ranga (2010, p.18) have studied several programmes that have successfully fostered university-government-industry leadership and collaboration and give the examples of: Pittsburgh's High Tech Council, Recife Brazil Science Park Board, the Knowledge Circle of Amsterdam, and New England Council. Etzkowitz (2008) presents a number of different case studies of economic development as a result of triple helix functions, with examples provided from Mexico, Brazil, the US and the UK. The Japanese triple helix has been studied by Leydesdorff and Sun (2009), who find that university-industry collaborations have declined during the past two decades despite explicit policies to address this issue, as is the case in Korea.

Li et al. (2013) have conducted a policy impact analysis utilising the triple helix as a "blueprint" for innovation policy in their examination of the Beijing Science and Technology Resource Platform, from which they have provided a number of success factors for the design of innovation platforms. They highlight the importance of the management capacities necessary to create and maintain innovation platforms and the importance of creating a "consensus space" for the different actor groups to come together (Etzkowitz and Ranga, 2010; Li et al., 2013). Todeva (2013) has studied the governance of innovation using the triple helix in the context of the health technology cluster in the South East of the UK. Todeva's (2013) analysis highlights the key role of the state and its agencies in intermediating, co-ordinating, and supervising interactions

between the partners; problems in the innovation system are found to occur when there is a lack of management and communication between the various people and interests involved.

From these examples we can see that government's ideal role within the triple helix is as facilitator, manager, or enabler, taking a "hands off" approach to setting up the programmes and platforms for the other innovation actors to interact. As Etzkowitz (2008, p.74) explains, it is necessary to find "the appropriate balance between too little and too much government", and when this balance is successfully achieved we see the creation of "triple helix quasi-governance models in which actors from the three spheres...co-operatively create and implement policy initiatives". The key policy lesson is the importance placed on universities as sources of wealth creation, innovation, and competitiveness (Nelles and Vorley, 2010, p.158). Universities have become increasingly the focus of public policy in this sphere and as a result their purpose has been expanded to include a heightened entrepreneurial role (Godin and Gingras, 2000; Nelles and Vorley, 2010; Olssen and Peters, 2005).

Etzkowitz (2008, p.144/145) provides a check-list of six recommendations for policymakers: to spread entrepreneurial education; develop network incubators and incubator firms; incentivise regional actors to collaborate and co-operate; create an array of venture capital; develop multiple knowledge bases; and create an entrepreneurial academic entity, such as MIT. The triple helix is a prime example of a theory developed with leading regions in mind, which may not be particularly relevant to a weaker more peripheral region. As highlighted by Cooke (2004), the triple helix theory draws heavily on the experience of leading regions, and in particular leading universities (such as MIT and Stanford) and it is not clear how relevant this is for more average universities and regions. Gunasekara's (2004) analysis of Australian regions suggests that it may not be.

2.5.9 Criticism

Whilst these four theories have proved highly influential in both the academic and policy spheres, they are not without their critics. The criticisms ranged against the various theories are discussed in the respective sections above, but there are some wider criticisms of the whole body of work devising theories about innovation and regional growth. One major criticism is the problematic nature of the region, related to the difficulty in pinpointing and recognising the phenomena described in practice. Markusen (2003) broadly criticises work within regional studies for being plagued by "fuzzy concepts", which she defines as concepts lacking conceptual clarity and difficult to operationalise, and that possess two or more alternate meanings and so cannot be reliably identified or applied by different readers. Some authors dispute the underlying assumption that the territorial logic is the fundamental lens through which innovation should be understood. The arguments surrounding geographical proximity have already been discussed (Lorentzen, 2008), and Semlinger (2008) underlines the fact that territorialised innovation theories focus on the local or regional factors whilst ignoring the global factors and the fact that innovation requires international co-operation.

Another problem with the suite of territorialised innovation theories is that they are often conflated and used interchangeably both in the literature and policy settings. As explained above, they all share the same understanding of innovation – as interactive and evolutionary – and address issues of regional economic growth. However, there are also important differences between them, as this chapter has endeavoured to draw out. Nevertheless, there is a high degree of overlap between the different approaches, and they evolved concurrently; the relationships between the concepts are complex and messy.

For example, Irawati and Gebhardt (2013, p.232) refer to the triple helix approach as "an interdisciplinary and systemic approach to innovation....which allows for further insight into innovativeness based on so-called *systemness*" suggesting a very high degree of overlap with the systems school of thought. Similarly, in their examination of innovation policy, Nauwelaers and Wintjes (2003) move back and forth between RIS and clusters, utilising both concepts in their study of regional innovation dynamics. Asheim and Coenen (2005) also link up the two concepts of clusters and RIS, seeing RIS as an integral part of a cluster, and asserting that they both co-exist in the same territory. We are told that the learning region concept was introduced to emphasise the role played by cooperation and collective learning in regional clusters and networks (Asheim, 1996, 2012, p.994; Morgan, 1997); again a mixture of concepts are used conjunctively. Leydesdorff (2012, p.25) explains how the triple helix and SI approaches are interwoven, and suggests that the triple helix can be used to "measure the extent to which innovation has become systemic" rather than assuming the presence of national or regional innovation systems "on *a priori* grounds". There is a strong overlap between SI and learning region approaches; "when learning regions are defined as regional development coalitions they resemble a RIS" (Asheim, 2012, p.995). We can question how reasonable it is to separate these into distinct theories considering the profound similarities. Nevertheless, the academic literature does so, with special books, journal issues, and international conferences geared towards each. The table below provides a very brief summary of the four theories to reinforce the unique and important contributions they make.

Table 2.4 Revising the Key Contribution Made by Each Theory

Theory	*Key Contribution to Field*
Systems of Innovation	Innovation as evolutionary and interactive; wide range of actors and institutions involved; two main geographical approaches are regional and national.
Clusters	Geographical agglomeration of firms in certain sectors; clusters as key drivers of national or regional competitiveness; influential policy blueprint.
Learning Region	Emphasises knowledge and learning processes and networks as the driver of innovation at regional scale; has proved especially popular in European contexts.
Triple Helix	Less geographically delimited; focuses overwhelmingly on the three spheres of university, industry, and government and their interactions to drive growth.

2.6 Conclusion: Towards a Theoretical Framework

This study examines regional innovation policy, and so the different approaches to the study and practice of innovation policy that each theory advocates are of particular interest. Table 2.5 summarises the theoretical approaches to the study of innovation policy, highlighting the key elements of this literature review that form the basis of the theoretical framework developed.

The previous section has discussed theoretical approaches taken by other researchers to the analysis of innovation policy, and the present study builds upon this body of work by proposing a conceptual framework that combines the four key interactive innovation theories. The rationale behind this is that each of the theories has important lessons for regional policymakers and can help us understand regional innovation, and that the approaches require further empirical testing in a weaker region context in order to establish how appropriate they are in this setting. A combination of theoretical approaches to innovation is proposed, which could provide more sophisticated insights than selecting one theoretical approach and applying it normatively; this proposition requires empirical testing through applying it to “real world” innovation

Table 2.5 The Theoretical Approaches to the Study of Innovation Policy

Theory	*Policy Approach Advocated*	*Examples of Policy/ Programmes*
Systems of Innovation	National or regional approaches advocated (also sectoral and technological). Role of government is to facilitate and co-ordinate collaboration between other actors. Moved policy from a market failure to systems failure logic.	Sweden- Vinnova Supranational Organisations- OECD, UN, World Bank, EC National Policies- UK, Spain, Germany, Finland, Sweden, Austria
Clusters	Policies aim to build competitiveness through the "diamond" of four forces. The geographical agglomeration of firms in certain sectors. Government should support existing clusters, not build them from scratch.	Silicon Valley, Italian Industrial Districts, Cambridge English regions Turku, Finland
Learning Region	Main role for innovation policy is stimulating interactive learning between firms and the region. Developing human capital elements- attracting workers with knowledge and skills. Education and training programmes.	Netherlands- KIM, RIT EC- RTP/RIS European and American approaches differ
Triple Helix	Universities as innovation and economic drivers. Encourage collaboration between government-university-business. Government as a facilitator/enabler rather than controller.	Pittsburgh's High Tech Council, Recife Brazil Science Park Board, the Knowledge Circle of Amsterdam, and New England Council , Japan, South Korea.

policy in a weaker region. Through the process of the literature review no one theoretical approach has emerged as the best or the most appropriate for a weaker region case study, and each approach has a variety of pros and cons.

As well as this theoretical argument, there is a practical argument for using a blended theoretical approach rather than selecting one theory as a normative lens through which to examine innovation policy. Innovation policy, as it is implemented "on the ground" in

regional contexts does not follow one theoretical approach as set out in the academic literature; in reality we can see "policy mixes" (Flanagan et al., 2011). Laranja et al. (2011, p.711) call for "substantial empirical innovation policy histories", or histories of policy mixes, which understand policy making as it actually is rather than in the normative manner that we would like it to be. An evolutionary theory of the policy process cannot be predictive or firmly prescriptive about specific policies (Kerr, 2002, p.334, cited in Laranja et al. 2011). Policy actions have been found to reflect much of the current analytical thinking surrounding innovation but there is need for a more systematic evaluation and comparison of the impacts of the various programmes to enhance our knowledge and understanding of innovation processes and the realistic policy options in each case (McCann and Ortega-Argilés, 2013, p.211).

Theories rarely transfer in their original form from academic literature to policy practice; Laranja et al. (2008, p.825) find that scholarly ideas are seldom adopted "wholesale in a one-to-one transfer of ideas to policy" but that attractive elements are "cherry picked" by policymakers, so examining one theory in isolation would miss the real nature of the process of implementing academic ideas in a policy setting. Majone (1989) adds another dynamic to this process; policymakers use theory selectively, to justify policy actions and choices, rather than based on which is the most appropriate or correct action. As well as being practically more appropriate it is argued that a policy mix, drawing on a range of approaches, could be more effective or useful:

> *"At the level of sub-national regions the challenge is much more how to prioritise among many policy actions that are in general prosperity enhancing on their own to create a policy mix that has the strongest positive effect given local circumstances" (Ketels, 2013, p.278).*

A policy-mix approach to developing a conceptual framework to assist us in the study of innovation policy in a weaker region is proposed, which draws on the four theories identified through this literature review as the most prominent both in the academic and policy spheres: systems of innovation, clusters, triple helix, and the learning region.

Finally, this chapter has provided the academic context for this study; it has situated the study within the core academic disciplines and debates to which it contributes, namely regional economic geography and innovation policy studies, and has highlighted the state of the literature so far. First, it has been situated within wider debates about the knowledge-based economy and the important position of regions within this. The key themes of innovation, knowledge, networks, and proximity are discussed as the key factors driving economic growth in the knowledge economy, and the main topics investigated by this study. Innovation policy was introduced as the means through which governments attempt to drive innovation and economic growth; discussions of other researchers' attempts to study and theorise innovation policy are provided, which this thesis builds directly upon. The final section of the literature review considered the key theories proposed as conceptual frameworks for understanding innovation at the regional level and also as policy best-practice models. It identified four as the most relevant for studying the role of government at the regional level. These are combined into a multi-theoretical framework that will be employed in the case study of innovation policy in Wales. The conceptual framework is proposed as an interesting approach to studying innovation policy at the regional level, and also as a means through which the findings of the case study can be fed back to enhance the theory itself.

2.7 Research Questions

Before progressing to the presentation of the Wales case study, methodology, and empirical chapters it is necessary to present the research questions which have arisen out

of the literature review conducted, and which guide the remainder of the study. The research questions guide the study towards the fulfilment of the two underlying aims, which are to undertake an in-depth case study of the evolution of innovation policy and programmes in Wales since devolution, and to interrogate leading theories of regional innovation in a weaker region setting. Here, the questions are stated, with a brief explanation of how they are addressed in the chapters which follow. The first two questions relate to the Wales case study specifically, and the latter two are more widely concerned with the application of theory to the study of innovation policy in the weaker region context.

These research questions have been developed to directly address the important gaps identified through the literature. The first is the relative lack of studies examining innovation and government policy in weaker regions. The literature is dominated by the exceptional regional case studies, and there is a clear need for more studies of a wider range of different types of regions, with characteristics and contexts that differ from the leading regions. Related to this is the fact that there is need for more application of regional innovation theory to the weaker region context, having been overwhelmingly developed in exceptional regions. Another research area identified as a promising one for this study to fill is that of bringing together theory and the study of "real world" innovation policy. This thesis will build on work already conducted in this area, enhancing our understanding of how theory influences policy, and how policy can be fed back into advancing the theory.

How has regional innovation policy in Wales evolved since the period following political devolution from the UK?

Wales presents an ideal opportunity to examine the complete picture of the evolution of innovation policy in a weaker region by studying the period from devolution (1999) to the present day (2014). The case study methodology employed (Chapter 4) requires that the historical, geographical, political and cultural context of the case is considered. As such, Chapter 3 presents an overview of these aspects, with a particular focus on the economic and political elements that are deemed to be central to the study of innovation policy. The evolution of innovation policy and programmes in Wales is presented through chapters 5, 6, and 7, which detail the findings of a comprehensive policy review and interviews with key stakeholders from the government, university, business, and intermediary spheres in Wales.

Three time periods are identified in the evolution of Welsh innovation policy: from 1999 to 2003 (Chapter 5) innovation was an important priority in the Welsh Government's wider agenda. During the period from 2003 to 2009 (Chapter 6) the Welsh Government is less focussed on innovation, although the role of universities as the main drivers of economic growth is enhanced. Chapter 7 examines the most recent five years (2009-2014), whereby new economic, science and innovation policies have restored innovation as a key priority, and a sector-based approach to economic development is introduced. The programmes and actions implemented to drive innovation are examined alongside the policy developments. In Chapter 8, the theoretical framework is employed to further explore the evolution of the Welsh Government's innovation approach. Chapter 8 also reviews the efforts undertaken, to build up a picture of which interventions are considered more or less successful, in order to answer the following research question:

What is the nature and the outcomes of innovation interventions implemented in Wales since devolution?

A qualitative approach is taken to analyse innovation interventions from the perspectives of those involved in the design, implementation, and use of the programmes. This allows a rich picture of the different programmes and actions to be built up, from a variety of perspectives, to produce a more rich and nuanced analysis. Certain theoretical approaches are found to be more successful and well-regarded by stakeholders than others, and suggestions for future policy and programmes can be made according to this. In Chapter 9, the policy recommendations that arise from the study are presented, and the types of actions that emerge as more successful from the analysis are suggested as promising avenues for future approaches to follow.

The theoretical framework is employed throughout the study, to enhance and provide further insights into the case study. Also, an important dimension is to interrogate theories of regional innovation in the weaker region context. As such, research questions have been formulated to address the more theoretical elements:

How can regional innovation theory be employed in the empirical study of regional innovation policy, and what insights can it provide us?

Chapter 8 presents a comparative theoretical analysis of the whole study period, mapping out innovation interventions visually, according to the approach to innovation that they take. The policy map illustrates which approaches were popular across the study period, and shows where the majority of supports and actions have been concentrated. This is an example of how theory can be applied to the study of "real world" policies and programmes, and is proposed as a model for analysing regional innovation interventions that could be replicated elsewhere. The four theories act as different lenses through which to study the policies and programmes, leading to a set of different insights and lessons about the Wales case. The empirical application of the

theoretical framework allows fundamental questions to be asked about the innovation theory itself:

Which theoretical regional innovation models are most relevant and applicable to explaining and understanding policy and programmes in weaker regions?

A multi-theoretical framework is proposed, which combines four prominent interactive innovation theories in order to test their applicability in the context of a weaker region. Specifically, this study explores how the various theoretical approaches have influenced the Welsh Government's approach to innovation, and how successful the interventions following the various approaches have proved to be. Interestingly, the approaches that have proved the most popular at the policy level in terms of the scale and number of actions implemented have received the least positive reviews from stakeholders. Chapter 9 provides an overview of the benefits and weaknesses of the different theories when considered in the context of Wales, and provides suggestions for future development to increase the relevance and applicability of innovation theories in the weaker region context.

Having set out the research questions which inform the study, this thesis now presents an introduction to the Wales case study in order to contextualise and situate the analysis which follows.

3 Case Study Context

In this chapter the background context to the Wales case study is provided, with the elements of recent economic and political history considered important to this study of innovation policy following devolution highlighted. There are two reasons why an understanding of the wider context of the study is important: the case study methodology requires it; and the theoretical framework takes an evolutionary approach to economic development, examining the current situation with an appreciation of the historical, geographical, political, and cultural context. Furthermore, in order to understand the analysis presented in the empirical chapters, some basic knowledge of the Welsh economic and political situation is helpful. A brief economic history of post-war Wales is presented, followed by a discussion of the current state of the Welsh economy. Then, political aspects of the case study are discussed, specifically the story of devolution and the governance of the innovation system in Wales.

3.1 The Welsh Economy

3.1.1 Economic history of Wales

To understand the challenges facing the Welsh economy today, it is important to consider the historical background to the current situation. The Welsh economy has witnessed a series of structural changes in its recent history; path-dependence and lock-in emerge as important concepts to explain the present situation. The history of the Welsh economy is, largely, one of natural resources and heavy industry giving way to the manufacturing and service sectors in recent years. Coal and steel are two industries that have dominated the Welsh landscape over the past century (Davies, 1994; Morgan, 2002). Whereas mining has more or less vanished now, the steel industry still has a presence, with a recent £800 million investment by Tata steel in its Port Talbot site

(BBC news, 16th April 2012). In the 1960s oil became increasingly important with the first oil refinery built in Milford Haven (Morgan, 2002, p.316), and this industry retains its strong presence in west Wales.

From the 1960s onwards employment in the service sector grew with the establishment of important public sector institutions in Wales such as the Royal Mint in Llantrisant, the vehicle licensing centre in Swansea, and the passport office in Newport, so that by 1948, 345,000 people were employed in service occupations (Morgan, 2002, p.317). Manufacturing also became increasingly important during the post-war era, with a high degree of government support to attract industry to Wales (Johnes, 2012, p.250). A good example of this is the motor industry; Ford opened a factory in Swansea in 1965 employing 2000 people, and a factory in Bridgend to follow in 1977 (Morgan, 2002, p.312). In Wales' recent history, foreign direct investment (FDI) has been an important source of jobs. In the 1980s Wales gained 3-4 times the share of inward investment and associated jobs coming to the UK than would be expected based on its population; these firms were attracted by government regional aid and infrastructure spending, and also relatively low wages (Pickernell, 2011). Cooke (2003, p.4) agrees; from 1983 to 1993 Wales consistently attracted between 15- 20% of inward investment in the UK despite having only 5% of the UK's population. However, from 1998-2008 around 31,000 jobs were lost as companies moved to China, South East Asia and Central and Eastern Europe to take advantage of lower labour costs, increasing education and skills levels, and growing markets (Evans et al. 2008), or 44,000 jobs between November 1998 and November 2002 (UK ONS, 2003, cited in Cooke, 2003).

The unemployment impacts of these changes were not represented in the figures because of the increase of public sector employment, but there were profound effects on the innovation system (Cooke, 2003). The multinational firms present in Wales "injected a

propulsive innovation element into the economy" and "made suppliers innovate in ways they had never been used to before" (Cooke, 2003, p.2). When they left, Welsh SMEs lost the leadership they provided in supply chain practices and investments in technology and innovation (Thomas and Henderson, 2011). Until 1998 there was a Welsh innovation system evolving around engineering sectors and clusters, animated by the Welsh Development Agency (WDA) and facilitated by FDI, which then unravelled when the multinationals departed (Cooke, 2003, p.8). Manufacturing remains an important sector of the economy today; around one in five jobs are still in manufacturing, it accounts for 20% of Wales' GDP, and is interlinked with other sectors in Wales (Ball, 2008, p.39).

Although Wales has been discussed to this point as if it where one homogenous region, there are differences in economic structure and performance, and also wider socio-cultural differences, between the sub-regions of Wales. The urban conurbation around Cardiff has GDP and employment levels that compare well with the rest of the UK, whereas west Wales and the valleys qualifies for Convergence funding.[2] In the post-war era, the south east and north east of Wales gained in population and prosperity, whilst depopulation and economic stagnation has been the trend for the rural north and west, and the south Wales valleys (Morgan, 2002). Balsom has proposed the "three Wales model" based on earlier observations by Zimmem in 1920, who differentiated between "Welsh Wales", "industrial Wales" and "English Wales" (Smith, 1994). These sub-regional differences have long been appreciated by Welsh academics and authors, and more recently by the Welsh Government in the *Wales Spatial Plan* (WAG, 2004). The heterogeneous nature of the economic geography of Wales can have important policy

[2] The highest level of structural funding from Europe. Previously known as "Objective 1".

implications, for example the different levels of support available through EU Structural Funds in west and east Wales (see Figure 1.1).

3.1.2 Economic Performance

The Welsh economy persistently underperforms in relation to the UK as whole. From 2000-2006 GDP growth in Wales was 3.9% compared to 4.3% for the UK, leaving Wales at the bottom of GDP growth tables, with a level of economic inactivity 4% above the UK average (Thomas and Henderson, 2011). Some see this as a result of "serious and persistent structural deficiencies" in the Welsh economy, caused in large part by structural adjustments in the 1980s whereby industry declined to be replaced by employment in services, in particular relatively poorly paid public services and back office functions (Thomas and Henderson, 2011, p.i). Cooke (2003, p.15) ascribes the low economic activity rates and GDP per capita figures to past generations of deindustrialisation, and we can see related problems with skills and qualification levels (13.7% of the Welsh population have no qualifications compared to 11.4% of the UK) (Economic Research Programme, 2011). Welsh GVA figures are 74.3% of the UK average, but once the cost of living is taken into account the picture is less problematic; Gross Household Disposable Income in Wales is 87% of the UK average (Economic Research Programme, 2011). Wales sits at the bottom of the regional competitiveness table for the UK (Huggins and Thompson, 2010). It is important to emphasise that the Welsh economy is interlinked with that of the UK, and developments in the Welsh economy are likely to be consistent with those at the UK level (Welsh Government, 2012d).

There are a number of different reasons for the underperformance of the Welsh economy proposed. Entrenched problems with the structure of the regional economy are identified, in particular a lack of private sector dynamism and an overreliance on the

public sector for employment (Ball, 2008; Cooke and Clifton, 2006). There are too few innovative and R&D performing firms in Wales, and Welsh SMEs are usually involved in the low-value aspects; however strengths in aerospace, opto-electronics, and bio-sciences are recognised (Thomas and Henderson, 2011). The general business culture is seen to be weak, with a culture of entrepreneurship and innovation lacking across Welsh SMEs; this can be attributed to the over-reliance on branch plants and FDI rather than building indigenous capacity and capabilities (Ball, 2008, p.6). Cooke and Clifton (2006) note how dependent Wales has become on public sector job generation, with such jobs tending to be low skilled and low paid. Indeed, 25.7% of Welsh people are employed in the public sector compared to 16.6% in the South East (ONS, 2012). It has been proposed that Wales misses out on the spin-offs and knowledge base developments that can result from government R&D activity because of the absence of government research institutions (Thomas and Henderson, 2011), but considering the high levels of publically sponsored R&D being carried out in Welsh universities this assertion is challenged (Cooke, 2003; Thomas and Henderson, 2011).

In terms of the productivity gap between Wales and the UK, Pickernell (2011) highlights three factors that explain this: physical capital, human capital and social infrastructure. Pickernell (2011) suggests that enterprise, networks and innovation should have 20% of the government's economic spending dedicated to it, but receives only 4.5% of the Welsh Government's spending on the economy. However, skills and qualifications, despite being attributed to 15% of the productivity gap receive 66% of Welsh Government spending (Pickernell, 2011). This mismatch between the relative importance of issues for business productivity and the proportion of resources directed to them raises questions about the coherence and effectiveness of Welsh policy.

3.2 Welsh Politics

Having provided an overview of the Welsh economy, this chapter now turns to the political aspects that are important to consider in a study of policy and the role of government. Wales is a self-governing constituent country of the United Kingdom, with a directly elected legislature, the National Assembly for Wales (NAfW), and an executive arm, the Welsh Government (WG, formerly the Welsh Assembly Government or WAG). The Welsh Assembly was created by the Government of Wales Act in 1998, and the process by which power was transferred from the UK government out to its constituent nations is referred to as devolution. Since 1999 the Welsh Government has had the power to develop its own policies in devolved areas and implement them. Since the referendum in March 2011 the National Assembly can propose and make its own legislation within its areas of responsibility. The National Assembly for Wales (NAfW) meets in the Senedd building in Cardiff Bay, which opened in 2006; it consists of 60 elected Assembly Ministers. The Welsh Government is headed by the First Minister for Wales, currently Carwyn Jones. Alongside the Assembly Ministers, Wales has 40 elected MPs of the UK Parliament and also four elected members of the EU Parliament.

In order to understand the policy making process, it is important to establish the background to the political environment and culture in Wales; policy making is political and cannot be separated as a distinct process. Heineman et al. (1990, p.567) assert that to understand policy making, one must understand policymakers' values and also political considerations that can elevate voter's values above "rational" choices. Although the other political parties have pockets of support in Wales, Labour dominates:

> *"For much of the 20th Century it has been possible to confuse Welsh politics with the politics of the Labour Party in Wales" (Morgan and Mungham, 2000, p.69).*

Since devolution, the Welsh Government has been led by the Labour party, sometimes in coalition with other parties; firstly with the Liberal Democrats (2000-2003) and then with Plaid Cymru (2007-2011). Whilst this has led to a certain degree of stability, there are downsides to the Labour dominance of Welsh politics that are relevant to the innovation agenda. In particular, Welsh political leaders are overwhelmingly from a public sector or trade union background, and whilst the Welsh Assembly candidates score well on age and gender, there is a lack of political leaders from business (Morgan and Mungham, 2000, p.76; Morgan and Rees, 2001, p.142). There are efforts currently being made to involve people with a business background in the policymaking process through the establishment of the sector panels to advise on economic policymaking. In order to better understand innovation policy, it is important to appreciate the wider political background within which policy is made and implemented. Exactly what impact Welsh political history and culture has on innovation policy today it is hard to know, but it is important to recognise that:

> *"As a small nation of just 2.8m people Wales is something of a political village", with rival politicians being on close terms, key power brokers in business and politics are well known, information travels fast through "old boys networks", and secrets are difficult to keep." (Morgan and Mungham, 2000, p.57).*

3.2.1 "Devolution" and Welsh Innovation Policy

This study takes 1999 as its starting point, from which we can see a distinctly "Welsh" approach to innovation emerging as a result of devolution in the UK. Prior to this, innovation and economic development were determined at the UK level. There were numerous cases for devolution: administrative, economic, and cultural, but the main driving force was political (McAllister, 1999, p.637; Morgan and Mungham, 2000, p.13). The key rationale behind the devolution movement was the perception of a

"democratic deficit" based on the power of the Welsh Office and un-accountable Quangos governing Wales; a "crisis of representation" was seen to exist, whereby the majority were voting Labour but were being governed by a Conservative government (Aughey et al. 2011, p.26; McAllister, 1999, p.635; Morgan and Mungham, 2000, p.55). Garnett and Lynch (2012, pp.300-339) provide a detailed explanation of the devolution settlements across the UK, including the process and history of devolution. The important point is that since 1999 a Welsh approach to innovation has emerged, providing a case study over the last fifteen years of how an innovation agenda has evolved in a regional setting.

There were some problems faced by the Assembly in its early years, which meant that it got off to a somewhat shaky start, including: the removal of the First Secretary, Alun Michael following a scandal; problems with the UK treasury over the allocation of Objective One funding; the foot and mouth crisis; and the problems faced by Labour ruling as a minority government (Aughey et. al, 2011, p.27; Morgan and Rees, 2001). In the following years, a number of changes were made to the Assembly's character to improve its functioning and create a body more parliamentary than corporate in character such as "Cabinet Secretaries" becoming "Ministers", the "First Secretary" becoming the "First Minister", strengthening the various Subject and Regional Committees, and securing independence of the Office of the Presiding Officer (Jones and Osmond, 2001). In 2006 the Government of Wales Act (HMSO, 2006) led to the formal separation of powers between the legislative and executive, and also allowed for the Assembly to gain more autonomous law making powers following a referendum, which was passed in 2011. Over time the Welsh Assembly and Government have been gaining more powers and capabilities with recent developments looking to increase this

trend, for instance the announcement that limited tax raising powers will be devolved to Wales and the upcoming Scottish independence referendum.

Whilst the Welsh Assembly has undergone changes and difficulties in its early years, the policymaking process and governance of the innovation agenda has been in something of a state of flux. As Cooke and Clifton (2006) observe, Wales' economic governance has been dominated by reorganisation of the administrative apparatus. An important insight here, especially relevant to regions or nations that have recently gained autonomy or self-government is that the policymaking agenda may be affected by structural change and instability for a period of time whilst transition is taking place. Nevertheless, there has been a reasonable degree of political stability over the lifetime of the Assembly because Labour has been the main party in power. In terms of innovation policy, we might expect this to be quite stable and consistent compared to a situation where the party in government switches to different sides of the political divide, like at the UK level where both Labour and the Conservatives have been in power over the course of the study period.

There are a number of differing opinions about whether devolution has been "good" or "bad" for Wales as a whole, and the economy in particular, but this wider debate is beyond the scope of the current work. Instead it confines itself to matters directly related to the policymaking process. Morgan and Rees (2001, p.126) believe that the Assembly has the capacity to produce "effective policies more closely attuned to the particular needs of Wales" and that the Assembly's policy making process is "more open, more transparent and more inclusive than the semi-secret world of administrative devolution that proceeded it". On the other hand Morgan and Mungham (2000, p.214) criticise the Assembly for being "weak, parochial and short of self-confidence", reflecting wider societal trends. General attitudes towards Welsh devolution have become more positive

over time; although there is widespread criticism of the Assembly's work, the people of Wales increasingly support devolution and an extent of self-governance (Jones and Scully, 2012).

3.2.2 Powers and Funding

The National Assembly and its executive (the Welsh Government) are responsible for devolved matters, including: education, health, local government, transport, planning, economic development, social care, culture, environment, agriculture and rural affairs. Although innovation falls within the Welsh Government's capabilities, the UK Government is responsible for many important areas including taxation, defence, the justice system, foreign affairs, and other issues that impact on the innovation agenda. A pertinent issue to the study of the Welsh economy and innovation is that the Assembly does not have its own tax raising powers and is dependent on Westminster for funding. There are two important dimensions to this: the first is the potential that tax raising or varying powers could hold for Wales in terms of economic development (Ball, 2008; Thomas and Henderson, 2011); and the second is the nature of the mechanism through which funds are transferred from the centre to Wales, the Barnett formula, and how is it seen by many not to be fit for purpose or damaging to the Welsh economy (Holtham Commission, 2010; McGregor and Swales, 2005; Roy, 2011; Shipton, 2012). There exist fierce political debates surrounding these issues (finance, tax, devolution of powers) and several interviewees felt that the task facing the Welsh Government, of transforming the Welsh economy from lagging to leading, is not feasible without further capabilities and powers; a view shared by the (independent) Holtham Commission (2010, p.33):

"Some transformational change is required to improve Wales's relative economic performance within the UK and no other single change would be likely to be as effective as giving Welsh ministers the scope to reduce corporation tax".

Change is unlikely to happen soon because as long as the threat of Scottish independence is strong, the UK government is unlikely to reform the arrangements (Withers, 2012). The Holtham Commission (2010, p.53) does not see any political change in the matter until the next Welsh Assembly elections in 2015, but changes to borrowing powers or tax could have profound effects on the Welsh Government's approach to innovation and economic development by expanding the tools at its disposal.

3.2.3 Multi-Level Governance

The Welsh case study is interesting because of the multiple levels of government that are active in the field of innovation policy and programme design, funding and delivery: the local, Welsh, UK and EU levels. Although innovation falls under the Welsh Government's economic development remit (HMSO, 2006), there are a number of programmes and funding sources (such as those offered by the TSB and NESTA) that are UK wide.[3] The UK Government has its own innovation policies; the same is true of EU level policy. Kerton and Bright (2012) carried out an analysis of the innovation support offered in Wales compared to the other parts of the UK, and found that the breadth and types of innovation support offered to businesses in Wales are comparable to those of other regions in the UK; they also found some unique supports, in particular those funded by WEFO.

[3] The Technology Strategy Board (TSB) describes itself as "the UK's innovation agency", which provides support and funding to help businesses develop new products and services (see: https://www.innovateuk.org/). The National Endowment for Science Technology and the Arts (NESTA) describes itself as "an innovation charity with a mission to help people and organisations bring great ideas to life", providing funding, programmes and awards relating to various innovation activities (see: http://www.nesta.org.uk/).

At the UK level the Department for Business, Innovation and Skills (BIS) is responsible for supporting economic growth in the UK, and provides a number of supports for business innovation. However there was little evidence of their influence on the Welsh agenda expressed during interviews. The UK level is more important in terms of the areas outside of the Welsh Government's responsibilities; in particular tax and regulation.

The present approach to innovation at the European level is set out in *Innovation Union*, and a key tenet is "smart specialisation", which is a concept premised on regions and nations building on their strengths rather than trying to compete with one another in the same few sectors (EC, 2010; Foray et al. 2009, 2011). The European level is important in Wales not only in driving the direction of policy but also in supporting innovation programmes and actions through the match-funded structural funds, in particular ERDF (European Regional Development Fund). The aim of the ERDF is to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions (EU, 2012a), and west Wales and the valleys is eligible for the highest level of funding.

Jones-Evans and Bristow (2010, pp.13-15) analysed the first round of structural funds (referred to as Objective 1, running from 2000-2006) and found that 50% of funding went to universities, closely followed by the Welsh Government; only 5% of innovation funds went to the private sector and 1.5% to charities and not-for-profits. The study concludes that "there is no real evidence of a step change in innovation capacity and performance within Wales", which is ascribed to a failure to address the disconnect between public sector funding and private sector interests (Jones-Evans and Bristow, 2010, pp.13-15). These authors question whether concentrating on the knowledge base in universities will lead to improved innovation performance. So, although structural

funds undoubtedly make up an important part of the Welsh innovation support infrastructure it is not clear how effective they have been in achieving economic growth.

3.2.4 The WDA and Welsh Government Economy Department

The department in the Welsh Government responsible for innovation and economic development is the department of `Business and Economy' (formerly known as `Business, Enterprise, Technology and Science', and `Economy and Transport') under the Minister for Economy, Science and Transport (Edwina Hart AM at the time of writing). Prior to this, the innovation agenda was within the remit of the WDA, which was amalgamated into the Welsh Government in 2006. The WDA was established in 1976, which meant that "for the first time, Wales had a body capable of promoting strategic economic development", and despite never producing an actual economic plan, a tacit sector strategy developed to intensify inward investment (Cooke, 2003, p.4). Whilst the WDA was very successful in attracting FDI into Wales in the form of branch plant factories, which created jobs in needy areas, this was not a sustainable strategy in the longer term (Morgan and Rees, 2001). Whereas the WDA's role began as one largely focussed on supplying hard infrastructure and inward investment, this later shifted to one of a "regional animateur" seeking to develop a soft infrastructure of business services, skills, and social capital (Morgan, 1997, p.70).

The WDA has an interesting and contested legacy in Wales, with recent calls for it to be resurrected in light of perceived failure by the Welsh Government to improve the fate of the Welsh economy. Indeed, Morgan (1997, p.90) argues that "the economic situation in Wales would have been that much worse were it not for the endeavours of the WDA over the past 20 years". According to Osmond (2012), the WDA was "a brand to die for...and the failure to remedy that act of vandalism (the abolition) has been a black mark against every Economic Development Minister over the last 8 years". Morgan

(2012) questions the decision to amalgamate the WDA into the Welsh Government, arguing that the current system is actually less accountable than the independent body was. His outlook on Welsh innovation policy capacity is fairly bleak, asserting that we no longer have the institutional capacity to engage with the cutting edge of new regional innovation policy ideas in the EU (Morgan, 2012).

Returning to the present day governance of innovation, since the latest *Economic Renewal Programme* (WAG, 2010), the Business and Economy Department has restructured into sector teams based around nine key sectors (discussed at length in Chapter 7) with respective sector panels made up of external stakeholders to advise the Welsh Government. Business support is also delivered through Finance Wales, which is an independent company owned by the Welsh Government and provides commercial funding to Welsh SMEs; it essentially plays a venture capital role. Finance Wales invests both private and public funds, including EU funds, but its future is uncertain following a review into its activities (Jones-Evans, 2013a, 2013b). As well as the economy department, elements of the innovation agenda fall under other departments' responsibilities, for example the education department (DCELLS), the health department and in particular NISCHR[4], and the environment department. Interviews with policymakers found fairly strong links between the economy and health departments, but not so much with the others despite the strong policy and agenda overlaps.

The three main stages in the evolution of the governance of the innovation agenda in Wales are: devolution and growing policy independence from London; integration of the WDA and ELWa into the Welsh Government; the shift from centrally developed and managed programmes to a regional and sectoral focus in recent years (Thomas and

[4] National Institute for Social Care and Health Research.

Henderson, 2011, p.8). As later chapters will show, the evolution of innovation policy and programmes in Wales can also be seen in terms of three distinct periods.

3.2.5 Previous Studies of Welsh Innovation Policy

Some previous studies of Welsh innovation policy and the Welsh economy have been conducted. It is important illustrate the existing body of work that this thesis is building on, in order to garner insights, and ensure that duplication of research is not taking place. Reviewing Welsh innovation policy since devolution, Pickernell (2011, p.27) considers it "an ever changing series of top down "Big Ideas" with a lack of collective long term strategy running through them". The current policy approach, of concentrating on a small number of sectors, is considered a continuation of Wales' economic history in terms of relying on a small number of industries (coal and steel, and more recently manufacturing and the public sector) (Pickernell, 2011). Thomas and Henderson (2011) agree that the current focus of innovation policy is relatively narrow, concentrating on technology commercialisation from HEIs and IP embedded within products; with little attention given to innovation processes, management, and service or social innovation.

A distinctive Welsh approach to innovation has emerged following devolution, and the role of the EU in driving the Welsh agenda is important. Following the arrival of ERDF allocations, Wales has been able to develop distinctive regional innovation policies (Thomas and Henderson, 2011). The Objective One programme (2000-2006) introduced a new style of bottom-up policies focussing on entrepreneurship and skills; a departure from the top-down inward investment focus of the pre-Assembly period (Brooksbank et al. 2001). For Cooke and Clifton (2006), Welsh innovation policy follows the EU's standard approach of "innovation push" and promoting knowledge transfer, entrepreneurship, venture capital, and incubation, designed to absorb EU funding. Because of European requirements, Welsh innovation policy and programmes have

undergone frequent evaluations and reviews, but Thomas and Henderson (2011, p.10) found that the results of these are not always fed back into the policy process, so the lessons and recommendations do not get taken into account.

Universities have been allocated an important role in driving innovation, and many of the innovation programmes implemented by the Welsh Government address innovation through the higher education sector, with a strong focus on the promotion of knowledge and technology transfer (Jones-Evans and Bristow, 2010; Thomas and Henderson, 2011, p.16). In fact, Jones-Evans and Bristow (2010) found that under 18% of WAG's resources to support innovation went to the private sector, and less than 5% of Objective One funds for innovation went to private sector organisations; they suggest better partnership between government and business is needed. For Cooke (2003, p.20), the Welsh Government's approach is "failing dismally to foster entrepreneurship and innovation" due to risk adversity and an over centralised grip on budgets and the design of support instruments more for the benefit of the public than the private sector. Currently, the major innovation programmes in Wales have a combined budget of over £100m over 6 years, but links between major programmes are lacking "resulting in fragmented support and providing limited opportunities for synergies across programmes" (Thomas and Henderson, 2011, p.20).

There are some strong criticisms of the Welsh Government's efforts in the field of economic development; for example, Dixon (2012) compares the Welsh Government's approach to economic policy with the "South Pacific cargo cults" because it is mostly a matter of "observing and copying the rituals of others". Cooke and Clifton (2006) criticise the Welsh government's approach for being "precautionary and confined to reorganisation of the administrative apparatus", but explain that the Assembly is constrained by its lack of powers and inability to attract top calibre politicians and civil

servants. They find that critique of the Welsh Government's work is effectively silenced because so many organisations are dependent on it (Cooke and Clifton, 2006), and there is a general lack of effective stakeholder engagement (Bristow et al. 2008). Greater participation needs to be encouraged from a wide range of stakeholders such as businesses, universities, local authorities, and others with a stake in the innovation performance of Wales (Thomas and Henderson, 2011, p.ii).

3.3 Conclusion

This chapter has introduced the contextual background to the present study of innovation policy and programmes in Wales. It has provided background information on Welsh history, both economic and political, allowing readers to understand and contextualise the analysis and findings presented in following chapters. It has highlighted the weakness of the Welsh economy, and the historical lock-in that renders the current situation entrenched and difficult to change. It has also explained the unique and complex political situation in Wales, which is of vital importance to this study because of the implications for the governance of innovation and economic development. The wider issues that emerge in the interviews have been highlighted here, in order that the reader is aware why they are important and are discussed at this stage; when these topics are returned to in later chapters the foundation will have been laid so that the discussion and findings make sense. This thesis builds on a tradition of academics conducting research into the Welsh economy and innovation (Bristow et al., 2008; Cooke 1998, 2003, 2005; Cooke and Morgan, 1998; Morgan, 1997; Pickernell, 2011; Thomas & Henderson, 2011, etc.). The insights from these prior studies provide a firm foundation to build upon, and highlight some interesting issues and topics for further investigation.

4 Methodology and Methods

4.1 Introduction

This chapter provides an overview of the methodological design of the study, introducing the reader to the case study methodology and the specific methods chosen to collect data: policy review and stakeholder interviews. It explains why the project has been designed as such, and draws on the methods and research design literature to support the choices made. First, the choice of a qualitative research project is explained as well as the ethical considerations that underpin the study; then, the overarching methodological framework of the case study is introduced, followed by an explanation of the two methods. The final section explains how the conceptual framework is applied to the case study in order to create a theoretical map of innovation supports from devolution to the present day.

The methodological design of the study is informed by the research questions being asked, and the information and knowledge sought in order to answer these (Halperin and Heath, 2012). In order to examine the evolution of innovation policy and programmes in Wales a two stage research process has been designed, which hinges around an in-depth review of innovation policy, and interviews with key stakeholders in the innovation system. The rationale behind these two methods is that this is the best way to study the role and actions of the Welsh Government and to gather data and information that can be analysed using the theoretical framework developed. There is precedence in the policy studies literature of combining these two methods as the best way of understanding the policymaking process (Burnham and Gilland, 2004; Garnett and Lynch, 2012; Harrison, 2001). Denzin and Lincoln (2005, p.21) explain how a research design fits together:

> *"The gendered multiculturally situated researcher approaches the world with a set of ideas, a framework (theory, ontology) that specifies a set of questions (epistemology) that he or she then examines in specific ways (methodology, analysis)."*

As the following sections will explain, this thesis takes an overwhelmingly qualitative approach to collecting, analysing, and interpreting data in order to answer the research questions posed. There is much debate over which sort of data, and which sort of research (qualitative or quantitative) is the most valid or scientifically rigorous; numerous authors have made the case for qualitative research (e.g. Bryman, 1988; Corbin and Strauss, 2008; Gbrich, 2007; May, 2002; Silverman, 2006). This thesis does not intend to replicate or review the qualitative versus quantitative debates here. Silverman (2006, p.58) suggests that whichever methods and data most relevant and useful in answering the research questions of a study should be used. As Richards (2005, p.34) underlines:

> *"Qualitative and quantitative data do not belong in different worlds. They are different ways of recording observations about the same world"*.

For the purposes of this particular study, qualitative methods are deemed appropriate; qualitative data should be used when the situation is likely to be complex and needs to be understood in its context, otherwise understanding may be lost (Richards, 2005, p.34). The rationale behind using qualitative methods here is that they can provide a "deeper understanding of social phenomena than would be obtained from a purely quantitative methodology" (Silverman, 2006, p.56). The issues investigated here – policy evolution and the role of government – are inherently social phenomena, centred on people as actors.

The qualitative research guides (such as Denzin and Lincoln, 2005; Richards, 2005; Silverman, 2006; Yin, 2009 etc.) highlight the importance of triangulation when conducting qualitative social research in order to ensure that validity and rigour is maintained and problems of anecdotalism are mitigated (Bryman, 1988, p.77). Yin (2009) believes that mixed methods research enables you to address broader, more complicated research questions. The triangulation of data sources, as well as data types, is important to bring together different sources and forms of evidence around the same event (Cochrane, 1998, p.2130). According to Flick (2002) qualitative research is inherently multi-method in focus, and the "combination of multiple methodological practices, empirical materials, perspectives... adds rigor, breadth, complexity, richness and depth to any inquiry" (Denzin and Lincoln, 2005, p.5). For this reason, as well as combining different methods, data is gathered from a range of stakeholders to access a variety of different knowledge, expertise and perspectives.

Whatever the methodological approach being taken, the key underpinning principles are that of validity and ethics. When reporting findings, it is important to be thorough by backing up explanations offered with evidence, whether it is from interviews or observations rather than hard numerical data (Rubin and Rubin, 2005, p.70). Data triangulation is an important part of the verification process, as a means of cross-checking the relevance and significance of issues, testing out arguments and perspectives, and strengthening evidence in support of key claims (Simons, 2009, p.129). In this study, three levels of triangulation take place: firstly, the policy review and interviews represent methodological triangulation; secondly, the data triangulation takes place through interviewing stakeholders from different groups and comparing their responses; and finally, theoretical triangulation is the result of applying a multi-theory framework to the data analysis and discussion.

4.2 Research Ethics

Underpinning the design of this study is consideration of research ethics; this study was approved by the university's ethical committee, but there is a wider responsibility on the researcher to ensure that participants are not negatively affected by contributing to the project. There are certain ethical considerations that we should take into account when carrying out qualitative research involving participants at every stage of the research design. The underlying principle is that participants should not be harmed through their participation in the research, but this is far from simple because "harm" can be interpreted differently by different people (Simons, 2009, p.96).

In this project the main consideration was that, because interviewees were speaking in a professional capacity (excepting, perhaps, retired officials), there would be no negative implications for their career or credibility. Some responses could be contentious, especially when interviewees were critical of the Welsh Government and its work; some expressed concern that their comments could cause problems if traced back to them. Some asked to answer questions "off the record", and others explained that they could not answer fully and frankly due to the need to protect their interests and position. An issue that emerged as important, and is relevant to the wider innovation system, is that many organisations are dependent on the Welsh Government and so feel that they cannot be too critical of it for fear of losing their funding or access to the policy making process (see Cooke & Clifton, 2006). In response to these concerns the decision was taken to anonymise the respondents and not to publish a list of individuals and organisations at any point. Also, any information in the text that could identify the respondent (e.g. names, places, organisations) was removed.

When interview quotes are presented in the thesis they are labelled according to a general description of the person's role, and numbers are used to ensure each label is

unique, so that it is clear when quotes originate from the same respondents. It is important for the analysis that follows to know which stakeholder group (business, university or government) the respondent belongs to, whilst at the same time retaining the anonymity of the individual concerned. Information about respondents is kept to a bare minimum; Wales is a small country where people within a given community are likely to know one another and so care was taken to select labels that are suitably generic, whilst still conveying the group to which the respondent belongs. The problem with complete anonymity is that this could counteract another key consideration-validity. If the reader does not know who the respondent is, or what their position is, it could be problematic to accept their authority or opinion.

Even within anonymity there are some ethical issues to take into account, because participants may wish to be named, and in not doing so you may be denying them an identity or voice (Denzin and Lincoln, 2005). On balance it was decided that the potential harm (professionally) that could arise by identifying respondents outweighs the negative implications of anonymity. Each interviewee was asked if they were comfortable with being anonymised or if they would rather be named. The vast majority did not mind either way, and a small minority requested anonymisation, thus rendering it the most convenient and appropriate action.

Consideration needs to be taken that participants' opinions are not misrepresented and that their voice is preserved; the logic of the analysis should be clear to the reader, and they should be able to hear the different voices of the interviewees and the researcher (Yin, 2009, p.78).

> *"Accuracy and honesty of presentation mean that the interviewer does not put words in the mouth of the interviewee, or selectively choosing (thus biasing) what the interviewee said." (Rubin and Rubin, 2005, p.71).*

Participants should not feel "let down, at risk, or disempowered" when they see experiences shared in the field in written text (Simons, 2009, p.97).

4.3 Methodology: Case Study

This section will explain why the case study approach has been selected as the best methodology to meet the aims and objectives of the project. A methodology is:

> *"A strategy, plan of action, process, or design lying behind the choice and use of particular methods... Linking this choice and use of methods to the desired outcomes" (Crotty, 2003, p.3).*

As Yin (2009, p.4) explains: "the case study is used in many situations to contribute to our knowledge of individual, group, organisational, social, political and related phenomena". The case study approach can help us understand the process and context of policy making, rather than viewing it as an isolated phenomenon divorced from the people who created it and its historical and geographical context. It has been found to be a useful methodology for researchers and policymakers alike, helping us to understand "complex social settings and programmes in order to inform the policy judgements they need to make" (Simons, 2009, p.107).

This study fits comfortably within the case study approach; in fact, Yin (2009, p.10) uses the example of a study investigating how and why a government programme has worked or not as an ideal case study. The aim of this study is to enhance and increase our understanding of the particular Wales case, but also to provide some insights into

innovation and economic development that could be of broader relevance to weaker regions elsewhere. According to Stake's (2005) typology of case studies, this project fits into the "intrinsic case study" approach because it is aims to gain a better understanding of the specific case, but also within the "multiple/collective case study" approach because it is believed that gaining an understanding of this case will lead to better understanding and theorising about a larger collection of cases. Regarding the research aims of this study, Schramm's (1971) assessment that the "essence of a case study is that it tries to illuminate a decision or set of decisions; why they were taken, how they were implemented, and with what result" is pertinent (cited in Yin 2009). There are a number of aspects of the case study that need to be taken into account, such as its historical background, the physical setting and wider contexts of the case such as the political, economic, legal, and aesthetic (Stake, 2005, p.447). As the previous chapter has explained, these wider factors have been taken into account and form important background context to the case study.

Yin (2009, p.11/63) asserts that "the case study's unique strength is its ability to deal with a full variety of evidence - documents, artefacts, interviews, and observations" as part of a mixed method approach, which allows us to "collect a richer and stronger array of evidence", by collecting "contemporary data" and conducting "counterpart analysis". The case study methodology was selected, in large part, due to its ability to provide an overarching structure within which to conduct a mixed-methods approach. In terms of the epistemological background of the study, highlighted as an important aspect of the research design (Crotty, 2003; Denzin and Lincoln, 2005), Stake (2005) provides some useful insights: within the case study approach we access experiential knowledge, which is how the experiences of actors and stakeholders in the study are conveyed. Through

presenting these experiential and contextual accounts, case study researchers partake in the construction of knowledge.

> *"Case studies need accurate description and subjective, yet disciplined interpretation... Empathetic representation of local settings - all blending (perhaps clumped) within a constructivist epistemology" (Stake, 2005, p.459).*

The research design is based on the view labelled by Rubin and Rubin (2005, p.21) as "interpretive constructionist", i.e. truth differs from person to person according to what individuals see and experience and how they interpret events, stories, and conversations. This study appreciates that people see things differently and come to different conclusions but it is interested in the "synthesis of understandings" that come about by combining different individuals' reports of an event or issue, and weighing different versions of events to put together an explanation (Rubin and Rubin, 2005, p.29/30). Whilst there are specific themes and topics being investigated, as per the research questions, a partly inductive approach is taken, "using observations gleamed through documentary analysis or interviews to generate interpretations of the political world" (Garnett and Lynch, 2012, p. 39).

A conceptual theoretical framework is developed for the purpose of analysing the Welsh case study, and also to feed back the case study findings into developing the theory itself. Theory development is a crucial aspect of the case study methodology, and should be addressed prior to data collection; the theoretical framework is an "immense aid in defining the appropriate research design and data collection" and helps focus attention on certain data whilst ignoring other data (Yin, 2009, p. 40). However, the researcher should be "unbiased by preconceived notions, including those derived from theory" (Yin, 2009, p.69), and a central motivation behind designing a framework based on a

combination of different theories is to move away from the more normative and prescriptive nature of a single theory approach. The theoretical framework has evolved iteratively by moving between empirical data and theory at the various stages of the study, with each informing and shaping the other. This is to avoid the scenario that Simons (2009, p.33) warns against:

> *"Having a theoretical framework at the beginning provides security, focus, and makes analysis comparatively straightforward; the danger is that it can lead to a false consensus - making the data fit the framework - or failing to see the unexpected."*

Concerning data collection, Yin (2009, p.98) highlights possible sources of case study evidence as: documents, archival records, interviews, direct observation, participant observation and physical artefacts. According to Simons (2009, p.33), the three qualitative methods most often used in case study research to facilitate in-depth analysis and understanding are interview, observation, and document analysis. This study uses two of these three core methods: document analysis (through policy review) and interviews. Observation was considered and built into the original design but proved difficult due to the problems in accessing "elites" (especially politicians) and the closed and private nature of large parts of the policy process. Policy review and interviews were the most realistic and pragmatic methods to fit within the constraints of the project, and as the study progressed it became clear that a vast amount of data was being generated through these two approaches and that more would have led to the project becoming unmanageable.

An important question is how much data should be collected to constitute a good case study? There is no simple answer provided in the literature. For Yin (2009, p.100),

enough data should be collected so that you have confirmatory evidence, from two or more different sources, for main topics, and the evidence includes attempts to investigate major rival hypotheses or explanations. Garnett and Lynch (2012, p.38), writing specifically about policy studies, suggest around 20 elite interviews to achieve a rounded picture, bearing in mind how difficult it can be to access political elites. In this study it was necessary to decide when enough data had been collected under each of the two different sources. With the policy review this was relatively straightforward once the limits of the analysis had been set in terms of time period and types of document. For the interviews, it was less obvious when enough data had been collected. Equal representation was desired between the different stakeholder groups to ensure a range of opinions were sought and bias minimised, the target was set at fifteen interviews from each of the three main groups, with supplementary interviews from other stakeholders (e.g. politicians, third sector).

The government respondents proved the most responsive to interview requests, and more inclined to pass on requests to other colleagues in a snowballing process; as a result the numbers for this group are higher. The "other group" (mostly politicians and third sector organisations) proved the most difficult to speak to, with a high incidence of ignored requests. By collecting a substantial amount of data from a range of different sources the triangulation process could be observed as an essential part of the case study methodology (Stake, 2005, p.454; Yin, 2009, p.18).

4.4 Methods

Research methods are "techniques or procedures used to gather and analyse data related to some research questions/hypotheses" (Crotty, 2003, p.3). The two qualitative methods usually employed in political research are documentary analysis, both primary and secondary, and elite interviews (Garnett and Lynch, 2012). Both of these are discussed

at length in the following sections, with policy review addressed first, and then interviews, according to the order in which they were conducted. The reason behind the choice of these two methods is to best answer the research questions that were developed following the literature review in Chapter 2. The first question relates to the evolution of innovation policy in Wales, and as such a policy review was considered the best method for answering this question:

4.4.1 How has regional innovation policy in Wales evolved since the period following political devolution from the UK?Systematic Review of Welsh Innovation Policy

4.4.1.1 Defining "Policy" and "Public Policy"

Before explaining the methodology behind the review of innovation policy conducted, it is important to discuss what is meant by "policy" in this study. Defining what is meant by policy is no easy task, and there are numerous definitions provided all of which are attempting to define something that is inherently problematic. As Cunningham expresses:

> *"Policy is rather like the elephant- you recognise it when you see it but cannot easily define it." (1963, p.229 cited in Hill, 1997)*

Definitions of policy range from a stance within which future decisions will be made (Friend et al. 1974, cited in Hill, 1997, p.7) to broad statements such as "economic", "social", or "foreign" policy describing "fields of governmental activity and involvement", or policy as an expression of general purpose or desired state of affairs (Hogwood and Gunn, 1984, p.13). However, these authors also underline the problem with viewing policy in terms of "spheres" and "areas" because drawing boundary lines

between different policy areas does not hold up in practice (Hogwood and Gunn, 1984, p.14).

This study examines documents published by the Welsh Government that can broadly be categorised as "public policy". For a policy to be regarded as a "public policy" it must to some degree have been "generated or at least processed within the framework of government procedures, influences and organizations." (Hogwood and Gunn, 1984, p.24). In practical terms, policy is understood for the purposes of this study as being a physical document that details the Welsh Government's intentions with regards to actions it plans to take, whether that be in a particular areas such as education or the economy, or more generally setting out its wider strategy. In this analysis any official document published by the Welsh Government is considered, under the "public policy" bracket as defined above, including strategies, plans and reports; Table 4.2 lists the documents identified as "public policy" relevant to innovation and thus analysed in this study.

An important consideration was to what extent to incorporate "grey literature" into the analysis. Examples of grey literature considered as potentially relevant to this study include reports, evaluations, and opinion pieces that are not published in academic forums or official Welsh Government publications. In some cases it proved helpful to draw on some "grey literature" to enhance the analysis, especially for the older interventions (such as EAP and RTP). As one might expect, there was less discussion by interviewees of the programmes that are fifteen years old compared to the current interventions, and as a result the "grey literature" proved an important source of further information. However, the use of this form of literature was kept to a minimum in order to uphold the academic nature of this study and ensure that the novel empirical data remains at the forefront; it was decided to draw on these sources only lightly.

Hill (2009) emphasises aspects of policy that we should bear in mind when studying it. The first is that it is inherently political:

> *"The policy process is a complex political process in which there are many actors: politicians, pressure groups, civil servants, publically employed professionals, and even sometimes those who see themselves as the passive recipients of policy" (Hill, 2009, p.4).*

The second is that it is changing over time: "the policy process is dynamic rather than static...we need to be aware of shifting definitions of issues" (Hill, 2009, p.8). This study proposes a review of the evolution of innovation policy over the last fifteen years, in order that we can see how the approach to innovation has changed over time. There are different ways of carrying out policy studies: studies of policy content; studies of policy output; studies of the policy process (Hill, 2009, p.5), and this thesis incorporates elements of each to build up a rich picture of the evolution of innovation policy and the role of government in driving innovation in Wales.

4.4.1.2 Conducting the Review

Writing a methodology for the policy review is challenging because of the lack of attention given to this method in the main methodological texts. According to Scott (1990, p. ix; cited in Burnham et al., 2004, p. 168):

> *"It is somewhat surprising that most social science research methods texts fail to give documentary materials more than a passing reference."*

Within the broad category of documentary materials, public policy is a specific sub-category, and so is receiving even less attention in the standard methodological textbooks. In response to this problem, a number of political science texts were

consulted, which devote more attention to methods for analysing and studying public policy (Burnham et al., 2004; Garnett and Lynch, 2012; Halperin and Heath, 2012; Harrison, 2001) and these have been drawn upon in the design of this stage of the study.

The first stage was to identify which policies are relevant to the study and to source them. Garnett and Lynch (2012, p. 37/38) summarise the types of documentary sources that can be drawn on in a qualitative policy study: they define secondary sources as those which are interpretations of evidence produced by others, such as academic texts, journal articles, and newspaper reports; whilst primary sources are those documents produced by authoritative sources such as government, political parties, and well-informed journalists. The formal analysis was restricted to official government publications, but other sources such as news articles, political speeches, and blogs by political commentators were also read to provide a wider perspective and background to the policy review.

The search process was challenging due to the broad definition of innovation policy taken (see 2.4.2); it is hard to draw the line between policy that has an impact on innovation and economic growth, and policy that does not. One of the contributions of this study is to identify which Welsh policies are most important to the innovation agenda. The policy search was guided by the definition of innovation policy (2.4.2), which views innovation policy in a broad sense, encompassing efforts to contribute to wide objectives of growth, jobs, and sustainability (European Commission, 2012). After a search for Welsh innovation policy returned only one document, it became clear that broadening the search to encompass other policy areas that overlap with the innovation agenda was necessary. Past studies, as presented in Chapters 2 and 3, were consulted to identify other policy areas that could be relevant and as a result the policy search was broadened to include: economic policy, including different sector strategies; science;

environmental; education; spatial; and general strategic policies. These were the policy spheres deemed to have the strongest relevance and overlap with the innovation agenda.

For the most part the documents could be obtained via the Welsh Government's website[5], but for some of the older documents it was necessary to source hard copies from the Welsh Government's publications office. For the oldest documents published before the Welsh Government's creation it was necessary to directly contact individuals known to be active in the area of innovation and economic development in the pre-devolution period (e.g. ex-WDA employees) to obtain printed copies. Whilst the study begins in 1999 it proved necessary to also examine some policies from the years preceding devolution because these were still active and influencing the agenda in the early years. Once the documents had been identified and sourced, the next stage was to read them all and make an assessment of whether they are relevant to the study of innovation.

The policy review was later triangulated with stakeholder interviews to ensure that all relevant documents had been included; interviewees were asked their perspective on the evolution of Welsh innovation policy, and which policies and programmes since devolution they consider important. This was to ensure that policies had not been missed. The work of other academics studying Welsh innovation policy (as highlighted in Chapter 3) was also useful in ensuring that all the important documents were included in the review. The policies selected for inclusion in the empirical analysis were those that addressed innovation and economic development as themes, or introduced programmes and actions that impact on the innovation agenda. Some policies initially identified were omitted from the analysis because innovation was not as strong a theme as expected; an example being energy and environment policies. Another example of

[5] http://wales.gov.uk

policies that were initially selected for analysis but proved not to have a strong relevance to innovation and economic growth were education policies below the level of higher education. It is an interesting finding in itself that these policy agendas are not well linked up in Wales.

Once the policies had been narrowed down to a "shortlist" (Table 4.2), the review of the individual documents was conducted, to identify the key themes. Harrison (2001, p.113) explains that the two main methods to analyse policy documents are content and semiotic analysis and elements of both are drawn on to explore the themes set out below. The process was partly guided by the research questions of the study (see 1.2), and partly inductive with themes emerging as the analysis progressed. The overall aim of the policy review is to present an evolution of innovation policy in Wales understood using the conceptual framework developed. The key themes that were searched for as part of the analysis include:

- How prominent innovation is as a theme in the document.
- How innovation is understood and what approach is being taken.
- What theories emerge from the document either explicitly or implicitly.
- What programmes are introduced or discussed in the policy.
- What other policy documents are referred to and how they link together.

The process of analysing each document addressed these key themes, based on three stages. The first stage was to read the document through to understand how innovation fits relative to other priorities, and to gain a sense of the overall aim and approach of the document. The second step was to conduct a search of the term "innovation" within the document, and to explore in more detail how innovation is understood and dealt with. Then, analysis could progress to a deeper level, looking at the language used to discuss

innovation and draw links between the policy and theory. As this thesis is examining the evolution of innovation policy in Wales, the policy review is structured chronologically, as opposed to thematically according to the research questions or policy spheres. Within the chronological structure it is possible to examine different policy areas and groups of policies, but it is important to maintain the timeline approach to explore how the shape of innovation policy in Wales has changed and evolved. There is a need to prioritise policies within the chronology, because some are more central to the innovation and economic development agenda than others. For example, the innovation and economic policies have a more central role in the review than some of the more general strategic documents.

Table 4.1 outlines the policy documents identified as important to the innovation agenda, comprising the analysis presented in the following empirical chapters. As well as the date of publication and title of the policy, it provides a very brief description to provide an overview of the policy and why it has been deemed appropriate to a study of innovation and economic development.

In the fourth column a grading system has been devised to highlight those policies that are most directly related to the innovation agenda, and those that are more towards boundary of what can be termed "innovation policy". Because a broad understanding of innovation policy has been taken, a wide range of different policy documents are included in the review, it is important to appreciate that some are more central to the study of innovation policy than others, and as such a "low", "medium" or "high" level of relatedness to innovation is included. This is as a result of analysing each document for mentions of innovation and relevance to the wider innovation agenda. Some policies had a strong theme of innovation running throughout, identified as such due to frequent mentions of innovation, a high proportion of the document dedicated to innovation

themes, and inclusion of the concepts related to innovation, as per the literature review, such as science, knowledge, learning, and economic growth. Others had only a scant mention of innovation and much less discussion of the key associated themes.

Three time periods were identified as a result of distinct breakpoints in the development of policy: the first in 2003 following the publication of the first innovation policy, *Wales for Innovation*, and the second in 2009, before the new economic, science, and innovation policies were published in 2010, 2012, and 2013 respectively. This chronological structure is explained in greater detail in the following three chapters.

Table 4.1 Welsh Policies Identified as Addressing the Innovation Agenda

Year	*Title*	*Description/Details*	*Innovation Relatedness*
1998	Pathway to Prosperity	The first economic plan for Wales.	Medium
1999	Education and Training Action Plan for Wales	Emphasises the need for skilled workforce to make transition into knowledge economy.	Low
1999/ 2000	Entrepreneurship Action Plan, Strategy, and Implementation	Aims to build a culture of entrepreneurship, give more people the skills and motivation to start a business, develop entrepreneurship education.	Medium
2000	A Better Wales	10-year plan with targets for improving life for everyone in Wales.	Low
2001	The Learning Country	Importance of learning and training to ensure long term sustainable economic growth and social development.	Low
2002	Reaching Higher	Highlights key role of HEIs in both the economy and society.	High
2002	A Winning Wales	Welsh Government's first economic strategy, innovation and entrepreneurship are key themes.	High
2002	Wales for Innovation	Encourage business innovation through equipping people to innovate, improving support, and maximising potential of HEIs.	High
2002	Skills and Employment Action Plan for Wales	Bring issues of skills and employment together, addresses need to raise skills.	Low
2004	Creative Success; a strategy for the creative industries in Wales	Support and encourage creative industries that could make a significant contribution to the Welsh economy.	Medium

Year	*Title*	*Description/Details*	*Innovation Relatedness*
2004	Knowledge Economy Nexus; role of HE	Report to encourage greater links between university and industry, views them as key strands of the Welsh innovation system.	High
2004	The Wales Spatial Plan	20 year policy, promoting a sustainable economy is one of its key themes, different approaches across Wales.	Low
2005	Skills and Employment Action Plan for Wales	Need for employers, employees and public sector agencies to work together to support high quality jobs in a growing economy.	Low
2005	Wales: A Vibrant Economy	Strategic framework for economic development, builds on A Winning Wales, key objectives are to raise quality of jobs and increase employment rate.	Medium
2005	Social Enterprise Strategy for Wales	Underlines importance of social and community enterprise to the Welsh economy, especially in poorer areas, and their potential to be innovative.	Medium
2006	Science Policy for Wales	Advances in science, engineering and technology drive the knowledge economy, and have a positive impact on society, culture and economy.	High
2007	One Wales Agreement	Coalition government promises to create jobs, stimulate enterprise and business growth, promote tourism, and enhance skills to the end of creating a 'prosperous society'.	Low
2007	Commercialisation in Wales	Independent report critically reviews commercialisation initiatives, suggests clearer strategy from government needed, and fewer but more effective programmes.	High
2008	Spatial Plan Update	Goals include: increasing employment rate, improving skills levels, regeneration programmes across Wales, all Wales approach to economic development.	Low
2009	For Our Future - Higher Education Strategy	Dual role of Welsh HEIs in economy: raising the skill levels of Welsh workforce, exploiting the knowledge base to support businesses.	High
2009	Social Enterprise Action Plan for Wales	Explains role of social enterprises in the economy, highlights their innovation potential, business support.	Medium

Year	*Title*	*Description/Details*	*Innovation Relatedness*
2009	One Wales; One Planet	Welsh Government's sustainable development scheme with innovation as a key action area.	Medium
2010	The Heart of Digital Wales	Review of creative industries, suggests creation of new creative industries fund, government should be supporting a wide range of businesses, not directing them.	Medium
2010	Economic Renewal: A New Direction	5 main priorities: investing in high quality and sustainable infrastructure; making Wales a more attractive place to do business; broadening and deepening the skills base; encouraging innovation; targeting business support.	High
2010	Delivering a Digital Wales	Driving economic growth, social inclusion, better public services.	Medium
2011	Programme For Government	Sets out the Labour Government's approach for the current Assembly period. The economy is top of the list of issues.	Medium
2012	Science for Wales	A strategic agenda for science and innovation in Wales.	High
2012	City Regions Final Report	Recommends a city region approach to economic development based on two city regions in South Wales.	Low
2012	Wales Infrastructure Investment Plan	Strategy for major infrastructural investments to contribute to sustainable growth.	Medium
2013	Innovation Wales	New innovation policy for Wales, prepared in time for the next round of structural funds in 2014.	High

As for the specific programmes and interventions analysed, this was based on their discussion by interviewees. Numerous programmes and interventions were identified from the policy review, but the decision of whether or not they are included in the analysis in the following chapters was on account of their discussion at interview. This triangulation of both methods ensures that omissions are not made: that important strategies or actions were not overlooked during the policy review, and that the interventions discussed were actually considered important to the innovation agenda by

stakeholders interviewed. If programmes or interventions appear not to be innovation related (such as city regions or apprenticeships) their inclusion in the analysis is due to their discussion by interviewees. Similarly if other programmes or actions that could be considered innovation related are omitted, this is because they were not discussed during interviews. The analysis conducted is empirically grounded and led.

4.4.1.3 Creating the Policy Map

The final stage of the policy analysis was to practically apply the conceptual theoretical framework, as presented in Chapter 8. The reason for applying theory to policy is to answer the theoretically focussed research question:

How can regional innovation theory be employed in the empirical study of regional innovation policy, and what insights can it provide us?

This process entailed examining the policies and programmes through the lenses of the different theories and categorising them according to the theory to which they best corresponded. The programmes did in fact fit quite comfortably into the different theoretical approaches, and this in itself is an interesting finding. In some cases it became clear that the interventions were theoretically informed because they explicitly followed approaches as set out in the literature. In others this was not the case; the programmes did not explicitly follow a theoretical rationale, or at least it was not stated in a way that matches the academic literature. In these cases it was necessary to examine the elements and components of the programme in more depth and apply the theories comparatively to ascertain which, if any, fits best. The potential flaw with this theoretical categorisation process is that it depends on the researcher's understanding of both the theory and the policy; different results could occur if different researchers with their own understandings conducted the analysis. To minimise this effect and ensure the

process is as reliable and methodological as possible the literature has been heavily consulted in the development and application of the framework; there is precedent for using innovation theory in a similar manner (Flanagan et al., 2011; Garofoli and Musyk, 2003; Nauwelears and Wintjes, 2003). Through bringing together innovation theory and policy analysis in this manner, the overarching research question can be addressed in the concluding chapters:

4.4.2 Which theoretical regional innovation models are most relevant and applicable to explaining and understanding policy and programmes in weaker regions? Interviews

Following the policy review, the second stage of data collection was qualitative interviews with key stakeholders in the Welsh innovation system. This is in order to supplement the analysis of the evolution of innovation policy in Wales, and also to answer the following question relating to the programmes and actions implemented over the study period:

What is the nature and the outcomes of innovation interventions implemented in Wales since devolution?

A method was required which enables the perspectives and knowledge of different stakeholders to be accessed above and beyond the policy documents, thus broadening the perspectives and viewpoints considered and enabling data triangulation. Interviews were chosen as the best method to follow the policy review because "qualitative interviews are especially good at describing social and political processes, that is how and why things change" (Rubin and Rubin, 2005). Interviews "enable [the researcher] to get to core issues in the case more quickly and in greater depth", to probe motivations and ask follow up questions, and to facilitate individuals telling their stories (Simons,

2009, p.43). A much richer picture will be painted of the evolution of innovation policy using insights from the key stakeholders from different groups, and interviewees can be questioned about the success and failure of innovation policies and programmes to create an evaluative picture. According to Simons (2009, p.69/70) we need to understand policies and programmes through the perspectives of those who enact them and "[the researcher] may need to know why key people in the case were prominent, why they acted the way they did in the particular circumstances and what lay behind their judgements and perspectives". There were other methods considered, such as observation of the policymaking process, focus groups, and surveys, but interviews were considered the most practical and feasible means of collecting the rich data required in the timeframe available.

4.4.2.1 Selection of Interview Format

It was necessary to choose the interview format most appropriate for this study based on the information and knowledge sought, and also the individuals being interviewed. The aim of the interview process is to further enhance our understanding of how innovation policy evolved as it did in Wales, how successful it has been, and to further explore the role of government within the Welsh innovation system. Because these are quite complex issues that are likely to provoke rich and complex answers, a style of interviewing is required that is open and flexible, and allows respondents to give lengthy answers and opinions.

Another important consideration is the nature of the individuals being interviewed; people were sought who had knowledge and expertise in the sphere of innovation and economic development, and who could provide and interesting perspective on these issues. As such, the interviews conducted for this study are classed as "elite" interviews because they are with senior policymakers, academics, business people, often directors

of organisations or departments. Whilst the concept of "elites" is problematic and contested (Smith 2006), there is precedence for taking into account the status and power of respondents in the design and conducting of studies into government and policymaking (e.g. Cochrane, 1998; Smith, 2006; Woods, 1998). Cochrane (1998, p.2131) summarises the researcher's role when interviewing elites: that she needs to allow members of elites to speak for themselves, whilst maintaining a critical distance, so a style of interviewing allowing for this is required.

This study follows the process of topical interviewing because it aims to "explore what, when, how, why, or with what consequence something happened" (Rubin and Rubin, 2005, p.11), in relation to Welsh innovation policy. The style of interviewing is often more "directive" due to the researcher's need to obtain particular information, and it is important that the conversation stays on target (Rubin and Rubin, 2005, p.12). Because there are specific questions that this study tries to answer, interviews are centred on a series of topical questions. A balance must be achieved in the design of the interview between being open enough to adapt to the respondent but structured enough to address the research questions (Flick, 2002). Furthermore, because of the elite nature of interviewees there may be less time available for the interview due to their busy schedules; it is necessary to have structured interviews that elicit as much relevant information as possible in the time available (Harvey, 2006, p.434). As Garnett and Lynch (2012, p.38) explain, political researchers often favour elite interviews with a semi-structured format in which the interviewer works from a prepared list of questions covering the major topics they wish to discuss, but which allows for supplementary questions and for the interviewee to introduce other relevant material. Appendix 1 provides examples of the pre-prepared questions for different stakeholder groups.

To summarise, the form of interview deemed to be most appropriate is the qualitative, in-depth, topical, elite interview (Flick, 2002; Harvey, 2006; Rubin and Rubin, 2005; Simons, 2009). Interviews were conducted with a range of stakeholders from different groups within the innovation system in order that an unbiased and varied picture of innovation policy in Wales is built up, which takes into account the perspectives of those involved in designing, implementing, and using innovation policies and programmes. By interviewing different individuals and organisations across the stakeholder groups in this manner it is possible to "piece together" experiences and perspectives, "while recognising that each person might have his or her own construction of events" (Rubin and Rubin, 2005, p.11).

4.4.2.2 Designing the Interviews

Having decided upon the style of interviews being used, the next stage was to carefully design the interviews to ensure that they would meet the objectives and requirements of the study. There are a number of studies addressing the specific elite interview context or "studying up", as it is sometimes referred to (McDowell, 1992; Sayer, 1985; Schoenberger, 1991, 1992), and the insights provided by this body of work is drawn upon (Cochrane, 1998; Harvey, 2006; Hughes and Lormode, 1998; Mikecz, 2012; Rice, 2010; Sabot, 1999; Smith, 2006; Woods, 1998). Many of the practical decisions made in the design and carrying out of the interviews were determined by this elite context, and it was sometimes necessary to compromise on the best-practice as set out in the methods literature to ensure that access was secured and data collected. As Harvey (2006, p.435) asserts: "some data from elite respondents [is] better than no data".

It is important to recognise that "each conversational partner has a distinct set of experiences and different areas of expertise", and bespoke questions should be created to "tap this distinctive knowledge" (Rubin and Rubin, 2005. P.34). As well as those

involved in the policy making and delivery process (i.e. predominantly within the Welsh Government) interviews were conducted with those using or receiving innovation supports because "using multiple sources may offset bias arising from anyone" (Simons, 2009, p.132). The interview schedules can be seen in Appendix 1, and were tailored to the different stakeholder groups based on the knowledge the respondent was likely to possess. It might not be useful to ask the same questions of business and government stakeholders; instead it would be more interesting to question the former about the barriers to innovation they perceive and their opinions on supports available, and the latter about the policy making and implementation processes. Common themes are addressed under each interview plan; they were designed to be similar enough that comparisons can be made across the stakeholder groups and triangulation of responses carried out.

The interviews begun with relatively simple, descriptive questions to build rapport and make the respondent feel comfortable, and moved on to more evaluative and controversial questions to probe the interviewees' opinions (Fontana and Frey, 2005, p.107). Yin (2009, p.107) explains that a balance needs to be achieved between "satisfying the needs of your inquiry, whilst putting forth friendly and non-threatening questions". Harvey (2006, p.434) agrees: "effective interviewers are those that are able to easily adjust their style and make the interviewer feel as comfortable as possible", and this generates high quality responses as well as increasing the likelihood of respondents providing other opportunities and contacts. Indeed, referrals from interviewees to colleagues and friends were an important source of access to elites otherwise difficult to secure interviews with. Building rapport with interviewees was not always easy, especially if time was short and the interview needed compressing to fit a participant's requirements - introductory questions were minimised in such cases.

A balance is required between flexibility and rigidity of the interview design because alternative questions may be needed for respondents who can or will not answer certain questions (Flick, 2002, p.82), without surrendering to the agendas of elites in the process of gaining their cooperation (Hughes and Lormode, 1998, p.2099). It can be difficult for a researcher in the less powerful position to ask critical questions for fear that access and cooperation be withdrawn (Cochrane, 1998; McDowell, 1992). To account for these tensions a mixture of simpler descriptive questions are combined with more probing questions; open and closed questions are asked to elicit as much response and data as possible from the interviewees (Harvey, 2006, p. 435).

There are different reasons why a respondent may not answer a question posed ranging from deliberate evasion to poor recall and inaccurate articulation, and elites may have received media training about how to avoid answering difficult questions (Fontana and Frey, 2005, p.702; Harvey, 2006, p.438; Yin, 2009). By building redundancy into the research design, distortions, fabrications, and omissions can be recognised by asking the same questions in different ways and asking the same questions to different people in separate roles (Rubin and Rubin, 2005, p.73). In the case of this study, there could be political factors that come into play whereby certain agendas get pushed by respondents; a variety of different viewpoints are sought to counteract these effects.

The interviews were designed to take around one hour to conduct; this was the length seen as most appropriate to request when approaching elites because any longer may not be tenable, and much shorter would not allow enough data on the range of topics to be collected (Harvey, 2006). The interviews ranged between 30 and 90 minutes, with 45 minutes to 60 minutes being the norm. Planning the interview schedule was challenging because “for interviewing key persons you must cater to the interviewee’s schedule and availability and not your own” (Yin, 2009, p.85). A six month time block was allocated

for the interviewing period to arrange interviews according to the participants' availability, and to allow a snowballing process to occur. The reason for conducting interviews over a longer period is that the research design must be flexible enough to accommodate new information learned and adjust to any unexpected situations, and also have in built time for reflection to compare what was asked with what should have been asked and decide what requires more depth (Rubin and Rubin, 2005, p.35/37).

4.4.2.3 Conducting the Interviews

It was necessary to draw up a list of the individuals and organisations to be contacted to request an interview. This was based around the three main groups of government, industry, and academia, with some third sector, politicians, and intermediaries also included. By interviewing stakeholders from these three groups, those involved in the different stages of the policy process (design, implementation, and end-users) are represented, to enable triangulation. As Cochrane (1998) highlights, a major barrier when attempting to interview elites is identifying who local elites are and who has the power. This was especially true of government actors because the names and positions of staff are not publically available, and it is a large and multifaceted organisation that is difficult for an outsider to understand and navigate. Due to the longitudinal nature of the study it was also necessary to find interviewees with knowledge of the earlier period; interviewing retired officials could also potentially elicit richer data if they are more able and willing to answer questions honestly.

It was possible on most occasions to identify potential interviewees in advance and to conduct some basic research on the individual and their organisation in order to prepare the most appropriate interview schedule. This was important because elites often consciously or sub-consciously challenge researchers on their subject and its relevance (Zuckerman, 1972); it is vital to be well prepared.

Having created a list of possible interviewees from the stakeholder groups, it was then necessary to arrange interviews. Gaining access is difficult, especially with elite interviewees who may feel that they are too busy to talk to researchers or have little to gain through participating, and hold a more powerful position than the researcher (Burnham et al., 2004, p.209; Cochrane, 1998; Rubin and Rubin, 2005, p.93). Table 4.1 details the number of interviewees from the various groups contacted and eventually interviewed. Letters were sent in the first instance, explaining what the research is about and why individuals were being contacted (Appendix 2), and these were followed up by emails and phone calls if no response was received. As Table 4.1 illustrates, there were a number of interviewees contacted who did not respond. There were some difficulties encountered in reaching potential interviewees who may have changed organisations and roles and thus contact details; another issue encountered was that the individual was off sick or on maternity leave (in five known instances). Others responded positively but were simply busy to the extent that it was impossible to organise a specific date or time. Only on one occasion a stakeholder stated a personal/political reason for not wanting to partake in the study. In several instances multiple individuals had been contact within the same organisations and some declined to be interviewed because another colleague was seen to be representing the organisations' view; this account for the majority of the "other reasons for not partaking" category. Due to the snowballing process, some interviews were conducted with individuals that were not initially identified or contacted but were referred by other interviewees; this was especially the case for the government respondents.

Table 4.2 Numbers of Respondents Contacted and Interviewed

Group	*Number Contacted*	*Number Interviewed*	*Did Not Reply*	*Other Reasons for Not Partaking*
Government	25	23	4	3
University	24	14	11	2

Business	28	15	6	8
Other	18	6	9	3

Five written responses were received from individuals contacted who it was not possible to interview (2 politicians, 2 civil servants, 1 business person), but were willing to contribute to the study; this follows the precedent of Harvey (2006), who found that sometimes written responses were the only means of getting data from interviewees who did not agree to be interviewed. Three interviews were conducted via telephone with respondents who were geographically distant (for example north Wales and London), and again Harvey (2006) found in his elite study that sometimes telephone interviews were the only way of speaking to busy elite respondents. Table 4.3 provides further information about the various stakeholders groups and the number of interviewees from each of the main categories to provide a clear picture of the types of people interviewed.

Table 4.3 Further details about each interviewee group

Group	*Sub-Category*	*Number*
Government	Policymakers	11
Government	Sector Groups	8
Government	Other (retired)	4
University	Technology Transfer Officers	4
University	Academics	5
University	Other (representatives and sector panels)	5
Business	Panel Members[6]	8
Business	Representatives	7[7]
Other	Politicians	2
Other	Intermediaries	4

The interviews followed a fairly fixed structure but each interview is a "mutually created story" between interviewer and interviewee (Fontana and Frey, 2005, p.695), with the

[6] The panel members interviewed were all involved in the management, running, or ownership of businesses ranging from SMEs to large multinationals with a presence in Wales.
[7] One of the business representatives was also an SME owner-manager.

direction of each interview being shaped by each persons' concerns (Rubin and Rubin, 2005, p.14). There is debate over how much the interviewer should contribute to the interview conversation, but the balanced view is that showing empathy encourages respondents to talk and providing occasional responses and comments can give interviewees a break from speaking, but researchers should avoid biasing or leading responses (Harvey, 2006, p.438; Rubin and Rubin, 2005, p.31). To minimise the negative effects of the researcher's presence, the interview questions were designed to be as neutral and non-leading as possible. Where interviews requested questions in advance, these were provided.

4.4.2.4 Transcription, Coding and Analysis

Interviews and focus groups can be recorded, providing data to be later transcribed and analysed. Some benefits of using a tape recorder are that the researcher is free to interact with the interviewee rather than taking notes, it provides a detailed record of the interaction, and ensures that no details are missed (Rapley, 2004, p.18). There are certain considerations when using digital recording devices. Although recording interviews allows us to capture the whole range of verbal data, there are also nonverbal cues that will be omitted from the recording (Fontana and Frey, 2005, p.713). It is also prudent to take some notes in case of equipment failure, especially highlighting issues to follow up, key points to transcribe, observations of body language, and anything unexpected that arose (Simons, 2009, p.53).

There is debate over whether or not elite interviews should be recorded, with some researchers viewing the recording device as problematic or a barrier to data collection (Byron, 1993; Peabody et al. 1990) with others seeing the benefits of having an accurate record of the interview outweighing these (Aberbach and Rockman, 2002; Richards, 1996). There is a trade-off between recording, which provides a more detailed record of

the interview but potentially less rich data due to interviewees discretion, and taking written notes, which provide a weaker description of the interview but potentially provide more detailed off-the-record information (Byron, 1993; Harvey, 2006).

It was decided in the case of this study that the benefits of using a recorder would outweigh the downsides because of the much higher volume of data that could be captured. The risk is that further "off-the-record" data could have been collected without the presence of a recorder, but this could not be presented in the thesis in any case and it was deemed more important to have an accurate record of the interviews. Interviewees were given the choice of not having the recorder switched on, but only three took this option. It was made clear to each respondent that the recordings were solely for the purpose of keeping a record, would not be disseminated any further, and would be securely stored. Notes were also taken during the interviews in case of equipment failure, and to take down any non-verbal or supplementary information that was not picked up by the recording device. The notes were then typed up, alongside the interview transcripts.

The transcripts were made "verbatim", to include pauses, emphasis, laughing, and other verbal elements. This was combined with any written observations made during the interviews in the accompanying notes. The decision was taken to personally transcribe the interviews (rather than subcontracting out this process) in order to become more familiar and involved in the data (Harrison, 2001, p. 102). The transcripts were sent back to the respondents to be checked and amended if so desired but the vast majority did not choose to make any changes. Those changes that were made replaced the original copies. Once the transcripts had been written up and checked, data coding and analysis could begin.

Analysis consists of "procedures which enable you to organise and make sense of the data in order to produce findings and an overall understanding or theory of the case", and can include coding, categorising, concept mapping, or theme generation (Simons, 2009, p.117). This study follows a more formal inductive style of analysis using descriptive, topical and analytical coding (Richards, 2005, p.88), as opposed to a more hermeneutic analysis involving methods such as poetic reconstruction and narrative. Because of the necessarily fairly rigid and structured nature of interviews conducted, as discussed above, the information collected is best suited to an inductive analysis, pulling out key themes. The codes developed were of central importance because the "development of a good coding scheme is central to trustworthiness in research" (Hsieh and Shannon, 2000, p.1285). The purpose of coding is to break data down into segments, enable the researcher to sort through large amounts of data, categorise the data into a more theoretical level, and gradually build understanding and explanations (Rubin and Rubin, 2005, p.208; Simons, 2009, p.121).

The two main approaches to coding, "a-priori" and "in-vivo" (Barbour, 2007, p.115) were used in conjunction by combining a thematic coding process, where the coding groups are defined a-priori from the research questions (Flick, 2002, p.185), with a "conventional content analysis" allowing further categories to flow from the data (Hsieh and Shannon, 2005, p.1279). This mixed approach is proposed as a way to combine insights from literature or theory with empirical material (Flick, 2002, p.186/190):

> *"Theory or prior research will guide the discussion of findings. New categories either offer a contradictory view of the phenomenon or might further refine, extend, and enrich the theory".*

The NVivo programme is used to make the coding and analysis process more manageable (Richards, 2005, p.89). Codes are determined according to the questions asked, and sub-categories created under different topical headings to create a tree and branch structure of data. This is a useful process because theory is built up by working out which of the themes discovered are related, and showing how and why (Rubin and Rubin, 2005, p.231). Other coding categories were also added as they emerged as important from the data, in line with the combined inductive and deductive approach. Key themes emerged from this, which were triangulated with the pre-existing data analysis from the policy review in order to develop a rich picture of innovation policy and programmes, and also wider issues affecting the Welsh innovation system. Each interview raised ideas, issues, and insights that have contributed to building up a detailed analysis of the Welsh approach to innovation.

4.5 Conclusion

This chapter has explained the methodological design of the study, and the particular methods chosen to undertake the empirical research. The underlying principles of validity and ethics were considered at the outset, and inform every stage of the research design. The rationale behind choosing a case study methodology is explained, as well as the two methods of data collection (policy review and stakeholder interviews) that have been selected. Also, the processes of transcribing, coding and analysing the data are provided so that the reader is fully aware of how the insights and findings presented in the following chapters are arrived at. Of course, it is not possible to design a "perfect" research project due to practical restrictions such as access, time and cost, and the weaknesses of the study are reflected upon in the final chapter and suggestions made as to how future research could build upon this.

The introduction, literature review, context chapter, and methodology have explained the background to this study and the contribution it makes. The following chapters present a chronological study of the evolution of innovation policy and programmes in Wales, employing the theoretical framework developed. The analysis is broken into three stages: the early years (1999-2003); the middle period (2003-2009); and the recent period (2009-2014). Each chapter analyses the evolution of innovation policy and also identifies the important programmes and actions implemented; the theoretical framework is employed to enhance the case study. Alongside this, data from interviews with key stakeholders further enriches the analysis and allows triangulation to take place. The reason for dividing the analysis into three chronological sections is to trace the evolution of the Welsh approach and draw out the key trends which characterise each period.

5 The Early Years (1999-2003): From "Hand-outs to the Periphery" to the Emergence of Innovation Policy

Wales was one of the first regions in Europe to develop its own innovation strategy, the *Regional Technology Plan* in 1994 (WDA, 1998) and there have been two other innovation strategies in Wales to date (WAG, 2002d; WG, 2013b).[8] Innovation has featured in economic policies throughout the period (WO, 1998; WAG, 2002a, 2005c, 2010b), and also in specific sector, education, science, spatial policies and the general strategy documents (see table 4.1). Higher education policy is an especially important sphere because universities are central to the Welsh Government's innovation agenda, and are relied upon as drivers of innovation and economic growth.

The analysis is broken down into three sections, which emerged as distinct break points in the evolution of innovation policy in Wales: the first is a gap in innovation policy following the publication of *Wales for Innovation* in 2002; the second is in 2009 before the recent economic, science, and innovation policies are published, restoring innovation to a prominent position in the Welsh Government's work. The key findings of the three following chapters are that innovation policy in Wales has varied in importance relative to other policy agendas, and that the approach to innovation has changed significantly over time.

In the early period, innovation is a priority, and there are three important strategies (*Regional Technology Plan, Innovation Action Plan*, and *Entrepreneurship Action Plan*) taking an explicitly systems-based approach to innovation. In the second period, we see

[8] Policies are referenced using acronyms. WDA refers to the Welsh Development Agency; WAG refers to Welsh Assembly Government; WG refers to Welsh Government (the name changes from WAG to WG in 2011); WO refers to the Welsh Office; NAFW to the National Assembly for Wales. The reason for the use of acronyms is to avoid lengthy references breaking up the text in this chapter and adding unnecessarily to the word count.

the innovation agenda weakening and policy focusing more on sustainability and social spheres, with the innovation agenda driven by higher education policy in the absence of formal innovation policy. The practical result of this policy direction is a strengthening of the triple helix approach. In the third period, we see the resurgence of innovation as an important element on the Welsh Government's agenda; it features centrally in the most recent economic strategy and a new innovation policy has been published, the first in over ten years (WAG, 2010b; WG, 2013b). The sector-based approach and the move towards smart specialisation, at the current time, have resulted in a cluster approach to innovation and economic development dominating.

This chapter addresses the first five years of the study period, presenting the evolution of innovation policy and programmes during this time. It combines policy review and stakeholder interviews to build up a rich picture of the Welsh approach to innovation, and draws on the conceptual framework to gain further insights from the case study. The three following chapters follow the same structure: first, the policy is critiqued with those most central to the innovation agenda addressed at greater length; second, the programmes and actions implemented are analysed, drawing on stakeholders' reviews.

5.1 Pre-Devolution

The story of innovation and economic policy in Wales is tightly interwoven with the political story of self-governance (see Chapter 3). Around the same time that Wales gained the ability to make its own economic policies and deliver its own programmes, the nature of economic policy was fundamentally changing to embrace innovation, entrepreneurship, and smaller indigenous firms. This is not to say that more traditional measures such as inward investment, large industry, and large scale employment growth projects became unimportant but the focus of economic policy shifted around the time of devolution. Prior to the analysis of Welsh innovation policy following devolution it is

important to briefly set the historical background of economic policy in the UK in order to understand the contemporary policy environment, and how it evolved from past approaches.

The dominant theme in the UK's approach to regional economic policy across the post-war era has been of "handouts to the periphery" (Cooke and Clifton, 2006), through attempts to treat the symptoms of regional decline, mainly through employment creation, rather than addressing the complex causes (Ball, 2008, p.3). For example, in the sphere of unemployment rates, policy actions began in 1934 with the *Special Areas Act*; Wales was one of the first places to receive these resources made available (Pickernell, 2011). In the industrial sphere, the Macmillan government (1957-63) made use of *Industry Development Certificates* to steer industry towards Wales; the 1960 *Local Employment Act* was used to encourage industry to venture into South Wales and other old industrial regions through providing tax and rate concessions (Morgan, 2002, p.315). Wales has long been a recipient of regional aid from central government, but we are caused to pose the key question:

> *"Why despite the use of regional policy resources in Wales has relative GVA continued to fall?" (Pickernell, 2011, p.5).*

5.1.1 Emergence of Innovation Policy

During the mid-1990s, innovation policy became a feature in Wales; in the years leading up to devolution we see important innovation policies and programmes implemented. Wales serves as an interesting case study of how innovation policy has emerged and evolved in a weaker, self-governing region of Europe. Observers of the Welsh case have noted a shift in economic policy in the 1990s away from inward investment and FDI attraction towards more indigenously focussed innovation and entrepreneurship policy:

> *"Wales became one of the first regions in Europe to develop a regional innovation strategy, a trend since followed by other regions" (Jones-Evans and Brooksbank, 2000, p.2).*

From the mid-1990s onwards Welsh policy began to focus more on business support, technology transfer, skills development, indigenous entrepreneurship, and cluster-focused policy (Pickernell, 2011) rather than more straightforward policies of employment creation and inward investment. Cooke (2003) saw an end to the WDA's "love affair" with inward investment around the turn of the millennium with the focus of economic development shifting towards entrepreneurship. Also, the establishment of Finance Wales meant EU funds could be channelled into loans and equity investments for SMEs and start-ups (Cooke, 2003, p.9). The most significant markers of this qualitative shift in policy were the *Innovation Action Plan* and the *Entrepreneurship Action Plan* (WAG 2002d; WDA, 1998).

Having introduced the backdrop to the study of innovation policy and programmes from devolution onwards, this chapter now turns to the analysis of the policies implemented from 1999-2003. Table 5.1 provides an overview of the following sections: the key policies are highlighted, and their main objectives as well as specific actions and targets they contain identified. Analysis according to the theoretical approach to innovation they take is provided, drawing on the framework developed in Chapter 2.

5.2 Policy

Table 5.1 Early Period, Policies: Objectives, Targets, Approaches & Actions

Policy Name	*Objective*	*Targets*	*Approach to Innovation*	*Actions*
Regional Technology Plan	Raise innovation capacity in weaker regions by creating/enhancing a system of innovation and addressing the culture to make it more innovation-friendly.	Mobilise regional actors; strengthen region's networking capacity; build social capital. Aims to build innovation systems in poorest parts of Europe.	Explicitly systemic: aims to build/enhance the regional innovation system. Systems and networks needed to promote innovation.	Over 60 projects contained within the plan under 6 priority areas; led by WDA and steering group of actors from different spheres. Monitoring and evaluation built into plan, and it was updated and extended.
Entrepreneurship Action Plan	Create a culture and environment conducive to entrepreneurship. For Wales, within a generation, to become one of the most entrepreneurial nations in Europe.	The plan aims to create a culture of entrepreneurship in Wales, raise the number of business start ups, and increase the number of businesses that grow.	Close links between the innovation and entrepreneurship policies; systems based approach. The first and to date only entrepreneurship policy for Wales.	Actions: embed entrepreneurship in education; stimulate entrepreneurial behaviour; co–ordinate the national programme of start up support, and provide funding and tailored advice to start-ups.
Innovation Action Plan	Establish a strong culture of innovation in Wales to make Wales more competitive within global economy. Five main action areas including: better equipping people to innovate; making business support simpler and more accessible; maximising the economic development impact of colleges and universities.	Five areas of action: communicating the importance of innovation, developing high growth potential businesses, better equipping people to innovate, simpler and more effective business support for innovation, and maximising the innovation potential of universities and colleges.	Broad and systemic understanding; aims to build regional innovation system. The first innovation policy published by Welsh Government.	Investment of £260m in innovation from 2002-2005 but a large proportion of this (£150m) is allocated to the Technium network, and £40m to the Knowledge Exploitation Fund to encourage the commercialisation of university held knowledge.

Policy Name	*Objective*	*Targets*	*Approach to Innovation*	*Actions*
Pathway to Prosperity	Close the gap between the Welsh economy and rest of the UK. The first economic policy for Wales.	GDP per capita to match UK average; employment rates to meet UK average; spread prosperity across Wales.	Largely absent: separation between innovation and economic policy.	Priorities include skills, telecommunications, inward investment and indigenous growth, new technology sectors.
A Winning Wales	Aims to transform the Welsh economy; ten year strategy.	Aims to raise: GDP per capita, private sector R&D spending, employment and skills levels, innovativeness of indigenous firms.	Innovation is central theme; linear approach to innovation - emphasis on R&D.	The first economic policy published by Welsh Government, superseded by WAVE (2005) and ERP (2010).
A Better Wales	Sets out the Welsh Governments overarching strategy across all policy spheres to 2010.	Raise GDP in West Wales and Valleys from 73% to 80% of UK average, and the level of innovation throughout the Welsh economy to be amongst the best in the UK. Fostering an entrepreneurial culture, encouraging the start up and growth of indigenous businesses.	Learning region approach: aims to create a "learning country", innovation framed very much in terms of education and skills.	Introduces the three core aims that run throughout all of the Welsh Government's work: creating a sustainable economy, tackling social disadvantage, and equal opportunities. Each policy and programme must address these different elements.
Education and Training Action Plan for Wales	Links education and economic policy spheres, addresses the perceived inadequate skills base and high levels of worklessness.	Better partnership between the business community and education and training providers so needs of Welsh economy are better met. Enhance economic role of universities.	Learning region approach: sees a crucial link between education, training and innovation; emphasises role of universities as innovation drivers.	Introduces programmes to support 3rd mission activities; £15m fund provided to help FEIs and HEIs support businesses, commercialise innovation, and generate stronger R&D.
The Learning Country	Sets out the education and learning programme over 10 years.	Enhance economic contribution of higher education, alongside social	Assets that: "Innovation in the arts, sciences and technology stimulates, and	Introduces the Knowledge Exploitation Fund to encourage third mission activities.

Policy Name	*Objective*	*Targets*	*Approach to Innovation*	*Actions*
		and cultural dimensions of education.	is promoted by, a vigorous learning country".	
Reaching Higher	First strategy dedicated to higher education; places universities at heart of vision for Wales to become a "learning country".	Enhance the role of universities in third mission activities, better careers advice for graduates, closer working with industry to ensure best match between graduates and available jobs.	"Learning Country" concept further established, focus on human capital elements providing a skilled and educated workforce.	Innovation and engagement fund for universities introduced (via HEFCW); Wales Spin Out programme introduced.
Skills and Employment Action Plan	Strategic framework for policies and programmes at intersection of economic and education agendas.	Bring together supply and demand side so education and training systems can meet needs of Welsh businesses.	Learning region approach: focuses on human capital as key element of knowledge economy.	

5.2.1 Regional Technology Plan (RTP)

The *RTP* is the starting point for the analysis as the first Welsh innovation strategy, and was introduced as one of a new generation of regional innovation policies created by the EU (WDA, undated a, undated b, 1998). The *RTP* set the innovation agenda in Wales; it took an explicitly systems-based approach. The EU plays an important role in driving forward the Welsh innovation agenda at this time; the Wales *RTP* was a response to the requirement for regions to prepare a strategy setting out their approach to innovation prior to receiving the first round of structural funds. The *RTP* is both a policy document and a collection of different programmes contained within one strategy. It was developed and implemented in Wales by the WDA and led by a steering group of innovation actors from different spheres:

> *The original exercise was huge; there were about 100 different organisations that took part in it: the TUC, the universities, business representatives, and a whole host of people. (Ex-WDA Senior Official B)*

The policymaking process and the involvement of different stakeholders emerged as an important and positive aspect of the *RTP*, according to stakeholders involved at the time. The bottom-up involvement of different organisations in creating the strategy is seen as a break from past approaches and marks the *RTP* as a novel approach to policymaking in Wales, which has continued. The process was as important, if not more so, than the policy outcomes:

> *It was influenced a great deal through essentially a bottom-up approach to policymaking. It was never around policy, the policy benefits spun out of just getting politicians and policymakers to engage and accept the rationale. (Ex-WDA Senior Official A)*

The *RTP* established the importance of the innovation agenda from the outset of the Welsh Government's existence and marks an important point in the shift in Wales towards innovation and indigenous economic development that accompanied increasing self-governance. The broad and systemic approach it introduced was carried forward by the *EAP* and *IAP* in the post-devolution period (WAG, 1999b, 2002d). There is a high degree of overlap between these three policies, which flow on from one another and have at their core efforts to enhance the system and culture of innovation and entrepreneurship in Wales to achieve long-term economic development.

5.2.2 Entrepreneurship Action Plan (EAP)

The *EAP* was another element of the shift around the turn of the millennium in Wales towards more indigenous and innovation oriented approaches to economic development.

> *[The EAP] was around how we actually break out of a policy strait jacket being about grants, large investment, factory building, foreign investment etc. How do we break out of that? (Ex-WDA Senior Official A)*

The *EAP* stems from the Welsh Office's *Pathway to Prosperity* economic strategy and the *RTP* (Cooke, 2003), created in 1999/2000 after it was noted that an entrepreneurship strategy for Wales was needed (Jones-Evans and Brooksbank, 2000). It was a key policy in the Assembly's early years, and is, to date, the only strategy devoted specifically to entrepreneurship. Those policymakers interviewed suggested that a new entrepreneurship policy may be forthcoming following the publication of the new innovation policy (WG, 2013b).

The *EAP* was one of the first of its kind in Europe and represented an overall vision for Wales, within a generation, to establish itself as one of the most entrepreneurial nations in Europe. It has strong systems elements, in particular the focus on developing a wider

environment and culture in Wales conducive to entrepreneurship and economic growth (WAG, 1999, 199b). The interlinked approach of the *RTP*, *EAP* and *IAP* is a good example of policies working in conjunction to address the wider system of innovation during the Welsh Government's early years. The manner in which the innovation and entrepreneurship agendas are addressed in a complementary fashion is novel and interesting on the one hand, but was challenged for assuming a similarity between the two agendas that does not necessarily exist.

> *[The Welsh Government] think that innovation and entrepreneurship/enterprise are the same thing, but they're not. (University Professor B)*

Following the bottom-up approach introduced by the *RTP*, the *EAP* brought together entrepreneurs, educationalists, business support professionals and government; the strategy was guided by a private sector led steering group and was implemented by the WDA, with government taking a facilitating role. The decision to abandon the *EAP* in 2005 before it had run its course is an unpopular one with stakeholders interviewed. This was attributed to the fact that the programme was not owned and controlled by the Welsh Government, and a change in economic minister led to other policy areas - economic and science - being prioritised over entrepreneurship. The *EAP* is generally well regarded, and there will be further discussion of stakeholders' reviews of it in Section 5.3.2.

5.2.3 Innovation Action Plan (IAP)

The first innovation policy published by the WAG is the *IAP* (2002d). According to government sources, the *IAP* replaced and furthered the agenda set by the *RTP* (WDA, 1998). There are no explicit linkages between the two strategies, but there is certainly overlap in their approach to innovation being wide and systemic. The *IAP* was designed

to run until 2005, after which there was no innovation policy to replace it. Until the publication of the latest innovation policy in 2013 there has been something of a vacuum with the innovation agenda instead being driven through general economic, education, and science policy. A government respondent explained that the innovation agenda was still being driven by the *IAP* ten years after it was launched:

> *We used to have an Innovation Action Plan... We haven't had an innovation plan since then. And that's been the main driver. (Civil Servant D, Business & Economy Department)*

This is the point at which we can see the innovation agenda shifting towards a triple helix influenced approach through programmes introduced to push innovation out from universities to the business sphere. The *IAP* introduces the *Technium* programme, later rolled out across Wales and becoming the dominant programme addressing innovation (see section 6.2.1). The *IAP* is praised for the systemic and cultural approach to innovation it takes. However, it is not seen as having delivered in tangible or practical terms. A driving rationale behind the *IAP*'s publication was as a response to the European Commission's requirement that regions have innovation strategies in place to set out which programmes would be funded by forthcoming structural funds.

> *The original purpose of [the IAP], as far as Europe was concerned, was to inform how regions, which got structural funds, actually spent some of their money on innovation. (Ex-WDA Senior Official B)*

The European level plays an important role in the development of Welsh innovation policy, and it has guided the programmes and actions implemented because so many of these receive structural funds. The *IAP* is another example, alongside the *RTP*, of where the Welsh agenda is strongly influenced by what the European Commission wants to see

from its member regions, and this emerges as a pertinent issue in the recent period with the pursuit of the smart specialisation agenda (see 7.2.1). The *IAP* is of central importance to this analysis because it was the first and, until recently, only Welsh innovation policy strategy. It also marks the end of the early period defined here, where innovation was high on the Welsh agenda and there were a number of policies explicitly aiming to create a system and culture of innovation in Wales.

5.2.4 Economic and Strategic Policies

In the absence of dedicated policy, innovation is often addressed through economic policy in Wales. In the early period this was not so much the case because there were distinct innovation policies (*RTP, IAP*). However, innovation is increasingly subsumed within wider economic policy during the middle period. The early years saw two economic policies published; the first was actually published one year before devolution (WO, 1998) but was guiding the approach prior to the Welsh Government's first economic policy (WAG, 2002c). An important strategy document was published in 2000, which set out the overall approach for the next decade (WAG, 2000a). This section will consider how the innovation agenda has evolved through these policies.

The first economic strategy, *Pathway to Prosperity* (WO, 1998), does not focus on innovation explicitly, but addresses wider and underlying economic issues, which are still high on the economic agenda today, suggesting that they are persistent and have yet to be successfully addressed. Innovation is largely absent from this document, and it is interesting to see that the innovation and economic spheres were quite separate at the start of the study period, with innovation addressed through the WDA's work (*RTP, EAP*), and economic policy by the Welsh Office. The two agendas become increasingly interwoven in the post-devolution period with the publication of *A Winning Wales*

(WAG, 2002c), and *Better Wales* (WAG, 2000a), which aimed to transform Wales into a "learning country" and amongst the most innovative regions of the UK.

In *A Winning Wales*, innovation is key to the overarching aim of turning Wales into a knowledge-based economy (WAG, 2002c). In these early policies, innovation and entrepreneurship are given equal weighting as important drivers of growth, but as the period progresses the focus on innovation is retained and entrepreneurship falls off the radar. Innovation is addressed in a fairly linear and traditional fashion, through improving infrastructure, supporting the private sector to raise R&D, and increasing the commercialisation of academic R&D (WAG, 2002c). This is somewhat in contrast to the innovation policies, which view innovation in a more systemic and broad manner (WDA, 1998; WAG, 2002d); it is interesting to see this difference in approach between the economic and innovation policies.

Whereas the previous economic policy (WO, 1998) did not prioritise innovation, we can see the innovation and economic agendas merging in *A Winning Wales* (WAG, 2002c). This is the beginning of a trend whereby innovation increasingly becomes subsumed into economic, science and education policy. The difference between *Pathway to Prosperity* and *A Winning Wales* illustrates the increased importance placed on innovation by the Welsh Government compared to the Welsh Office. Innovation is also a key priority in *A Better Wales* (WAG, 2000a), which sets out the Welsh Government's strategic agenda to 2010 of creating a "learning country"; innovation occupies an important position within this rationale. This prioritising of the innovation agenda is not a trend that continues, as the following chapter will explain.

5.2.5 Education, Skills and Training Policies

Alongside innovation and entrepreneurship, education and skills were key priorities for the Welsh Government in the early years. There were several policies concerned with uniting the two agendas (economic and education) in order to transform Wales into a "learning country". The trend of utilising universities as key innovation drivers emerges in this early period, and continues throughout. The *Education and Training Action Plan for Wales* (WAG, 1999) marks the beginning of this trend in education policy; many of the important programmes implemented across the rest of the period follow this rationale. *The Learning Country* (WAG, 2001) and *Better Wales* (WAG, 2001) develop the Welsh Government's aspirations for the Welsh economy. It is interesting to see a concept usually associated with economic development emerging in education policy. Whilst the learning region discourse has a strong presence in the early period, actions and programmes turning this rhetoric into reality are largely absent.

Alongside the direct contribution to innovation through third mission activities, *Reaching Higher* (WAG, 2002d) highlights the important role Welsh universities play in providing a skilled workforce; the importance of skills is further enhanced by the *Skills and Employment Action Plan for Wales* (WAG, 2002b). Again, the learning region approach is visible, with the focus on human capital as a key element of the knowledge economy. The policy concentration on skills and education in the early years establishes it as an important priority area, which continues during the mid-section but appears to have fallen off the agenda recently.

5.3 Programmes

This chapter now addresses the programmes and actions that were implemented during the early period, the majority of which were introduced by the policies already discussed. There were four programmes implemented during this early period that

emerged as particularly important from the policy review and stakeholder interviews. Table 5.2 provides an overview of the programmes and the approach to innovation that they take; to avoid repetition readers are referred to the above sections discussing the *RTP, IAP*, and *EAP*. Also summarised are the stakeholders' reviews of the programmes, expanded upon here using interview data. The first three programmes discussed (*RTP, EAP* and *IAP*) are both policies and programmes, consisting of strategy and implementation documents, the latter detailing the specific actions that are implemented under the plans; these have been grouped together under their respective documents for ease of analysis.

Table 5.2 Early Period, Key Programmes: Objectives, Targets, Approaches & Actions

Programme/ Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
RTP	See Table 5.1 above.	See Table 5.1 above.	Actions situated under 6 priority areas: developing an innovation culture; profiting from global innovation and technology; developing supply chains and networks; high quality innovation and business support; finance for innovation; and addressing education and training. Over 60 different projects implemented under the plan.	Generally positive due to the wide range of stakeholders involved and the bottom-up mode of policymaking it introduced. However, was not discussed by as many interviewees as later programmes and those who did discuss it were often involved in the process and so may be somewhat biased.
EAP	See Table 5.1 above.	See Table 5.1 above.	Actions under three challenges: better awareness of the opportunities and benefits of entrepreneurship; focusing on potential high growth start ups, especially under-represented groups (women, young people, and ethnic minorities); increase the number of high growth business in Wales that are wealth and opportunity creators.[9]	Generally received positive reviews based on the impact on entrepreneurship levels (rising) and the involvement of so many stakeholders in the policy process. A widespread criticism of the Welsh Government is that it did not follow up on the programme and allowed entrepreneurship to fall off the policy radar.

[9] (Jones- Evans and Brooksbank, 2000).

Programme/ Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
IAP	See Table 5.1 above.	See Table 5.1 above.	Specific actions include: £25 million grant scheme to support innovation, investing in innovation support services, promoting application and exploitation of new and existing technologies, rolling out the Technium programme across Wales, forming strategic alliances with global companies, and investing in universities' and colleges' third mission activities.	The systemic and cultural approach to innovation taken by IAP (and other early programmes) is commended and suggested as a good direction for current innovation policy to move towards. However, the programme is not seen as making an impact on the innovation system, and implementation stage is seen as being weak.
KTPs	Launched in 1975 as the "Teaching Company Scheme" delivered by the TSB as a UK wide programme. KTP's purpose is to form relationships between academia and industry to encourage transfer of knowledge, technology and skills through placing an "associate" (usually a graduate or postgraduate) into a company with academic supervision, and also providing training for the business. Also includes further education institutions, research and technology organisations.	Triple Helix style intervention to increase collaboration between university and business, with financial and administrative support from a government sponsored agency. Also the structure of the projects involving three partners of an academic or research institution, a company or public sector organisation, and an individual "associate". Fits the triple helix model.	On the whole, Welsh companies do not have huge success in applying to TSB funds and supports, as interviewees highlighted, but the KTP is an exception. The projects are between 12 and 36 months in length. It created £311.88 million of additional turnover, £2.05 million net additional value in GVA to the knowledge base of Wales, £78.19 million net additional GVA to companies and created 705 new jobs (CMI, 2011, p.3).	The KTP programme received the most positive reviews of all the programmes. However, these came from the government and especially the academic spheres; the business stakeholders did not mention the programme at all suggesting it is not having much impact on this sphere. Those who did mention it were strongly positive, seeing it as a good and useful programme. It is long running (over 30 years).

5.3.1 Regional Technology Plan (RTP)

Evaluations have previously been carried out of the RTP, so it is possible to draw upon these in addition to stakeholder interviews to build up a comprehensive review of the programme (Cooke, 2003; Henderson, 2000; Morgan, 1997). Morgan (1997) provides a positive review, as does Asheim (2012, p.995), who interestingly characterises it as a learning region approach. This thesis views it as RIS influenced, in line with Morgan (1997) and Cooke (2003). An aspect of the *RTP* that was praised, in the prior evaluations and also by interviewees, is the way it brought together stakeholders from across the innovation system to build consensus about the direction of travel, developing interactive learning processes between the state, firms, and intermediaries (Cooke, 2003; Henderson, 2000, p.347).

> *And the original exercise was a huge exercise... We set up a steering group... We had somebody from CBI chair it, and we had representative organisations on it. (Ex-WDA Senior Official A)*

The process involved in the development of the *RTP* was commended by Henderson (2000, p.531), in particular the way in which external perspectives were sought from international experts and opinions of business, education, government, development and other organisations were sought through a series of panel events. The bottom-up and participatory approach was also recognised by interviewees:

> *[The RTP] was influenced a great deal through, essentially, a bottom-up approach to policy making. (University Professor D)*

Although the design of the *RTP* is commended by evaluators and interviewees, the outputs and outcomes were not so positive; evaluators saw little by way of new initiatives and much re-packaging of existing instruments (Technopolis, 1998, cited in

Cooke, 2003). Henderson (2000) questions the effectiveness and success of the *RTP* in diffusing the new ideas beyond the individuals and organisations represented in the steering groups to the rest of Wales.

Despite these shortcomings, interviewees generally viewed the *RTP* quite positively, especially the level of stakeholder involvement and focus on the needs of the programme recipients:

> *The original RTP, and later iterations, were all focused around what business needs, what innovation means to business. (Ex-WDA Senior Official A)*

Evaluators also see its success in bringing business and state closer together by building new insights and awareness of firms' needs in the Welsh administration (Henderson, 2000, p.353). The *RTP* was certainly an ambitious strategy, and systems-based policies by definition tend to be broader and longer term; this makes them somewhat difficult to evaluate. On the whole, respondents and evaluators were fairly positive about the *RTP*'s legacy in Wales, and it is praised for introducing a new approach to policy making which was more participatory, collaborative and geared towards the beneficiaries of the programmes.

Despite this bottom-up nature, the programme was still very much driven by the state; the EU had a key role in encouraging the development of systems-based approaches at the regional level. Interviewees involved in the programme's development explained how the purpose of the *RTP* was to set out the region's approach to innovation in preparation for receiving structural funds.

> *You had to prove before you got money from Europe what the region was going to spend its money on. (Ex-WDA Senior Official B)*

The EC supported other programmes taking a systemic and network based approach to innovation, including *STRIDE* (*Science and Technology for Regional Innovation in Europe*) and *RITTS* (*Regional Innovation and Technology Transfer Strategies*) (Morgan and Nauwelaers, 1999). This "push down" from the European level, and the requirement for Wales to produce an innovation strategy in order to secure the structural funds, drove the innovation agenda in Wales towards a systems-based approach. The actions implemented broadly match the trends observed at the policy level.

5.3.2 Entrepreneurship Action Plan (EAP)

A number of actions were introduced under the *EAP*, detailed in table 5.3, and they have been grouped together because there are far too many individual actions and projects to discuss separately; this format is a trend of the early policies. As with the *RTP*, the *EAP* is commended for the way it involved a variety of different stakeholders, bringing together entrepreneurs, educationalists, business support professionals and government. The strategy was guided by a private sector led steering group and was implemented by the WDA; the funding was provided by government but the priorities were set by stakeholders. It is seen by respondents involved in the process as delivering against the private sector's priorities. Some felt that the earlier programmes delivered by the WDA were more attuned to the private sector's needs than the later ones delivered by the Welsh Government.

There was discussion of the *EAP* by academics and policymakers (some of whom are retired) who have been active in the innovation system in Wales for many years. Again, past evaluations by researchers are available to enrich the analysis and supplement the interview data. The *EAP* is generally viewed it in a positive light:

> *The EAP was successful in trying to raise that start-up rate and therefore improve the innovation process in that way, and I think to some extent it was successful. (University Professor A)*

The *EAP* is credited with changing attitudes of people in Wales towards entrepreneurship and also led to the public sector explicitly supporting entrepreneurship across its activities (Jones-Evans, undated). It led to an increase in successful business start ups in Wales due to the simple set of outcomes by which success can be measured, and the coherent and structured approach to developing entrepreneurship as part of a national strategy (Jones-Evans, undated). However, stakeholders highlighted the fact that, whilst positive steps had been made in raising start up rates, this has not translated into business growth.

The novelty of the *EAP*'s approach was praised as one the first of its kind in Europe (Jones-Evans, undated). As well as being novel compared to other European approaches, respondents saw the *EAP* as a break from the past, as part of a wider move towards indigenous approaches to economic development. A criticism of the programme is that it was overly top-down, and some counties with already low levels of entrepreneurship received little additional support, meaning that the areas needing support the most missed out (Jones- Evans, undated). The *EAP* aimed to increase the rate of business start-ups in Wales so that it reached the UK average by the end of Objective 1 funding in 2006; it saw some success against this measure, but Pickernell (2011) explains that this was more because the UK rate fell rather than the Welsh rate increasing significantly.

A criticism of the Welsh Government is that the positive gains made by the *EAP* were not followed through. It seems surprising that a programme that was delivering results was not continued, and some respondents had insights as to why this might be the case.

Reaching parity with the UK level of entrepreneurship was seen as an end in itself, and once this goal had been achieved the programme was ended.

> *There were improvements in the GEM entrepreneurship rate, but people in government didn't see there as being an entrepreneurship problem in Wales. The policy focus was getting close to the UK average. They didn't look at the issue of high growth. (University Professor B)*

Other respondents see the decision to end the *EAP* as being a political move tied up in the abolition of the WDA and transfer of its responsibilities into the Welsh Government's economy department, or because a new minister decided to move in a different direction.

> *Because [the EAP] wasn't invented by the Welsh Assembly Government it was abolished in 2005; that was a disastrous decision. (University Professor B)*

> *With the EAP- it ended because the minister changed and the new minister moved onto innovation and then economic and science policy... Most of what was said was ignored. (University Professor A)*

After the ending of the *EAP*, entrepreneurship fell off the radar. Entrepreneurship programmes do not feature much in the latter half of the study period, with potential implications for the wider system of innovation as entrepreneurship is considered a vital element. The one area within entrepreneurship that has been addressed is youth entrepreneurship, through the *Youth Entrepreneurship Strategy*, discussed below in 6.2.5.

5.3.3 Innovation Action Plan (IAP)

The *IAP* (2002d) took a similar systemic approach to the *EAP*, in that it aimed to change the overall culture and environment in Wales to make it more innovation receptive.

> *One of the more interesting and softer programmes, which was successful, and which needs to be re-examined, is around the culture of innovation. (University Professor E)*

As is the case with the *RTP* and *EAP* before it, the *IAP* is seen as breaking the mould of traditional linear innovation programmes by focusing on the more cultural elements. The range of actions introduced under these three plans took a broad and comprehensive approach to innovation that has not been seen in policies and programmes since. In the post-*IAP* period the innovation programmes become less co-ordinated, lacking an innovation policy to tie them together. Addressing innovation at the cultural level is seen as a key priority; culture was often cited as an important barrier to innovation and economic growth. There is a perceived problem with the culture of Wales in that it is not conducive to innovation and entrepreneurship. The following quote illustrates how important culture is as the underlying factor upon which innovation, entrepreneurship, and economic development issues can be addressed:

> *I think all of these fantastic initiatives you see are never going to work; they're always going to be a waste unless the culture against which they applied is strong and fertile. I think for me culture is everything. (Local Government A)*

The *IAP* attempts to address this complex but fundamental issue of the culture of innovation; however as an action it is not particularly well regarded. Interviewees did not see it as having a particularly strong impact on the innovation agenda, and it was not discussed at great length. The lack of clear direction and action were cited as problems

and the fact that other issues became more important at the policy level (namely sustainability and education) meant it was effectively side-lined soon after its publication. In summary, the ideas underpinning the programme were good but the actual actions taken were lacking in direction and impact. Some stakeholders have called for a return to the systemic and cultural approach, and an important wider criticism made of the Welsh approach to innovation is that these elements were not addressed in the following period of ten years until the publication of the latest innovation policy (WG, 2013b).

5.3.4 Knowledge Transfer Partnerships (KTPs)

Whilst not being a Wales-specific innovation support, because it is delivered across the UK by the TSB, the *KTP* programme emerged during interviews as a popular and successful programme in Wales. A pilot of shorter *KTP*s is underway leading to further expansion of the scheme to encompass smaller businesses.

The Welsh Government respondents were generally positive about the programme because it is perceived to be good value-for-money and to deliver results, especially in terms of the human capital dimension of increasing the number of people qualified to PhD level in Wales. This contributes to the wider aim of building a knowledge-based economy through attracting and cultivating a highly skilled workforce. As well as the government respondents, university stakeholders were overwhelmingly positive about the *KTP* programme as this selection of quotes illustrates:

Table 5.3 Summary of views of the KTP programme

We've had a huge amount of positive response and we've actually increased our funding for KTPs. Actually getting practical help into small business in a cost effective way... So that's good.	Senior Policymaker C
Very big fan of KTPs, that's been great.	University Technology Transfer Officer A
The KTP programme is obviously well established, generally regarded as being good value for money, provides benefits for universities and for companies.	University Professor E
KTP project or programme is successful because there's a lot more flexibility there; we can be a bit more creative in the way we deliver and who we deliver to.	University Technology Transfer Officer D
I think particularly successful have been KTPs.	University Technology Transfer Officer B
[KTP] is a good successful programme.	Ex-WDA Senior Official A

In fact, there were no negative comments made about the *KTP* programme at all. However, the business respondents did not refer to the programme either in a positive or negative light; it may not have much impact on the business sphere in Wales. Whilst the *KTP* programme is highly valued by university stakeholders, this thesis suggests that providing additional funding for universities' activities, although arguably an important function, does not match the rationale behind these types of interventions, which is to encourage economic growth through greater university-business interaction. If the business sphere is largely untouched by the schemes and does not consider them to be important, one half of this equation is missing.

This finding counters the claims made in the two official evaluations of the *KTP* programme, which both assert that the scheme is popular amongst the business sphere. The TSB commissioned a review that found that it "is a well-liked product which generates good levels of client satisfaction and impact among the businesses, academics

and associates it supports" (Regeneris, 2010, p.i). Another evaluation portrays the *KTP* programme in a strongly positive light, finding it to be good value for money generating £5.85 additional GVA per £1 of public sector investment, and when Welsh Government investment alone is considered this produces £13.12 of additional GVA per £1 invested (CMI, 2011, p.4). There are certainly positive elements of the programme; it was reviewed positively by evaluators and interviewees alike. However, other programmes and actions are higher on business stakeholders' agendas. It is unsurprising that university respondents were strongly positive about the programme because, in a tight financial context, any programme that provides further avenues for funding is likely to be welcomed.

5.3.5 Other Innovation-Related Programmes

There were some programmes or actions that were highlighted by respondents interviewed but were less frequently discussed. This was usually because the programmes were smaller or more narrowly focussed and so only relevant to certain respondents, or less central to the innovation agenda as a whole.

Table 5.4 Early Period, Other Programmes: Approaches, Actions & Stakeholder Reviews

Programme/ Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Accelerate	Concentrates on automotive manufacturing sector, seen as needing extra support to survive in Wales. Overall aim was to improve the competitiveness of Welsh companies in light of increasing competition in the global automotive industry. The programme was devised in 2000 as a response to the collapse of MG Rover, amidst concerns about how this would affect the Welsh supply chain.	Cluster-based approach focussing on a specific sector. Structured around a supply chain clustering approach, with "programme champions" leading programmes within their separate supply chains. 25 supply chain groups created across Wales, involving around 200 firms of different sizes.	Resources devoted to this programme were relatively small compared to some of the larger programmes discussed in this section; it received £1.7m in 2001 from Objective One money and was continued for a second round of funding in 2002, providing extra £1.3 million in grants to the automotive sector.	Receives strongly positive reviews from a small number of respondents due to its narrow focus on the automotive sector. Praised for the way it involved the business sector as the ultimate beneficiaries. Respondents were highly critical about the fact it was ended without replacement after three years.
Sector Fora	Different fora set up in Wales relating to specific sectors, e.g. Welsh Automotive Forum and Welsh Opto-Electronics Forum highlighted as important elements of the innovation system by respondents. The fora receive financial support from the WG and also the private sector.	The fora have been categorised as cluster-based because they are focussed on specific sectors, and bring together actors from across the different spheres for the benefit of Welsh companies. Combination of sectoral and geographical agglomeration is typical of cluster approaches.	Each forum has a different role. E.g. Welsh Automotive Forum has 4 main aims: act as the voice of the automotive industry in Wales, influence the automotive sector strategy, forge links and partnerships with other forums, and provide a service to members.	Again, the narrow focus on particular sectors means only certain respondents highlighted the fora, but those that did were on the whole positive about their work and their existence as a point of contact between businesses and the Welsh Government.

Programme/ Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Apprentice-ships	WG delivers different programmes to encourage Welsh employers to recruit more apprentices (e.g. Young Recruits Programme) provides funding to employers offering apprenticeship programmes to train and recruit young apprentices. WG pays external training costs and business pays employees' wage. Apprenticeship Week has run for 6 years aiming to raise awareness and profile of apprenticeships.	Learning region approach to enhancing skills and training, better equipping the Welsh workforce to work in the knowledge economy. Human capital elements: retaining and attracting skilled workforce.	In October 2012 the Welsh Government announced an extra £5 million funding for additional apprenticeship places for young people. Apprenticeship schemes part funded by WG and the European Social Fund.	Widely discussed by respondents, especially those from the business sphere, but not strictly an innovation support. Seen as a crucial area for the Welsh Government to provide support. "Pathways" and "Young Recruits" programmes in particular reviewed positively. Stakeholders are pleased the WG is addressing this area.
Spin Out Wales	Launched in 2000, to support academic staff and students in setting up businesses, and accessing technical support and market research.	Triple helix based approach to driving economic growth through commercialisation of university based knowledge and research.	Later amalgamated into A4B alongside other triple helix style activities.	Highlighted as an example of a programme that has not worked particularly well. Implementation stage is seen as lagging, but original idea was a good one.
CETICs (Centres of Excellence)	18 centres for knowledge transfer and commercialisation across universities in Wales. The idea behind the CETICs programme was that world class scientific, technological, and research resources can be used to benefit firms both in Wales and internationally.	Triple helix based approach to driving economic growth through commercialisation of university based knowledge and research.	CETICs was the main predecessor of the A4B programme.	Similar to Spin Out, highlighted as an example of a programme that did not deliver results. Seen as over-ambitious because too many centres were created than demand for service existed. Good elements retained in A4B.

Programme/ Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Cardiff Innovation Network	Based around the premise that networking leads to innovation through the exchange of ideas, problem solving, and sharing of expertise. Aims to bring together business, industry, academics and financers.	Triple helix and network based approaches. Brings together stakeholders from different spheres to communicate and collaborate and provides an environment conducive to networking.	Established in 1996, the Innovation Network is free for businesses to use, and is funded by Cardiff University (not through direct government funding).	Not a government sponsored or run service, but received positive reviews from stakeholders, especially business respondents. Example of a triple helix programme that businesses respondents like.

5.3.6 Cluster Programmes

There are two of these smaller programmes in the early period that follow a cluster rationale: the *Accelerate* programme, and the creation of sector fora. Both of these actions were concerned with developing particular sectors and sub-sectors in Wales, encouraging clustering processes at the local level. *Accelerate* focuses on the automotive manufacturing sector and was highlighted and reviewed positively by respondents from this sphere as a good example of a programme promoting particular clusters with focussed support.

> *[Accelerate] worked great, for three years it was a fantastic programme. (Business Person D, Sector Panel 3)*

In a formal review, *Accelerate* was commended for the manner in which it was designed by the automotive manufacturing industry for itself, going beyond the traditional approach of government handing out support for businesses by encouraging Welsh businesses to help themselves (Welsh Affairs Committee, 2009). Programmes taking a cluster-based approach are seen to build on Wales' strengths as a small and well networked community of actors, and there is a perceived role for government as a facilitator of clustering processes. However, *Accelerate* ended after three years and, as with other programmes examined in this study, this was criticised by respondents who saw an important role for the programme and thought it should have continued.

During the early period a handful of different sector fora were set up, supported by the Welsh Government and the private sector; these are still in existence today. These fora were highlighted by stakeholders from the respective sectors as an important element of the innovation support system. It is rare to find a programme or action implemented in the early period that is still in existence today; the sector fora are one such example.

Originally they were linked up to the *CETIC* and *Technium* programmes, but these have since been wound up whilst the fora still exist independently. There two highlighted by interviewees are the automotive and opto-electronic fora. Respondents were generally positive about their existence and the fact that there is a known point of contact and hub for collaboration and networking activities. However, as they are narrowly focussed on particular sectors, the fora do not have such a wide impact.

5.3.7 Apprenticeships

The Welsh Government has implemented different programmes and schemes that fall under the banner of apprenticeships over the study period. Apprenticeships are not strictly innovation related but are seen by the Welsh Government as a key element in developing the skills base, creating a knowledge-based economy, and increasing Wales' attractiveness as a place to do business (Welsh Government, 2012). Also, apprenticeship programmes were highlighted by numerous stakeholders, in particular those from the business sphere. Skills are considered a key factor underpinning the wider success and performance of the Welsh economy, and apprenticeship programmes are seen to bring wider benefits to economy and society.

> *A person who's been through an apprenticeship would have a potent suite of skills to take to a business... It's a win-win situation. (Senior Policymaker D)*

There are two programmes highlighted by interviewees, as part of the Welsh Government's efforts to address innovation and economic growth, which aim to increase the number of people taking up apprenticeships in Wales: the *Pathways to Apprenticeships* and *Young Recruits* programmes. Business stakeholders in particular were positive about efforts to create more apprenticeships in Wales to improve the level of training and skills in the workforce.

> *Evidence I've had recently... Apprenticeships are working quite successfully, and generally businesses are quite pleased that the lack of apprentices seems to have been turned around. (Policy Advisor, Business Representative Organisation C)*

Pathways and *Young Recruits* are praised for the positive impact they have had on the human capital dimensions:

> *They probably brought another 1500 young people into the manufacturing sector in Wales... Plus it has aligned the academic institutes with industry in a much better way, a much better linkage between the business community and academia, and a much stronger pipeline. (Business Person D, Sector Panel 3)*

It is an interesting finding that many of the programmes cited by business respondents as important are not strictly innovation focussed; they are wider programmes or actions that have a bearing on innovation and economic development but primarily tackle other issues. Apprenticeship programmes are a good example of this; they are seen as important to the government and business stakeholders as part of the wider approach to the Welsh economy.

5.3.8 Triple Helix Programmes

There were three programmes implemented during the early period highlighted by respondents which following a triple helix approach of increasing collaboration between universities and businesses: *Spin-Out Wales* and *CETIC*s. These programmes have now been amalgamated into the much larger *A4B* programme, which was discussed at length as one of the primary programmes currently addressing innovation (see Section 6.2.2). *Spin-Out Wales* aimed to encourage university staff and students in knowledge commercialisation activities and spinning out academic research. It was identified as an effort made by the Welsh Government to drive innovation but respondents were not

convinced that *Spin-Out* had delivered on its aims, and whether it was proactive enough to achieve real results:

> *The question is whether the support primes people enough and is proactive enough to support those outcomes. (University Technology Transfer Officer D)*

> *I think that certainly the original mission, the ethos for the programme, was more ambitious and proactive than the implementation that we've had over the last few years. (University Professor E)*

Similarly, the *CETIC*s were not seen to have delivered on their aims; the programme was quite ambitious, there were 18 centres across Wales, and the intention was that they would become self-sustaining. However, this did not come to fruition:

> *The CETICs never became self-sustaining. They became dependent and they never broke that dependency. We never managed to change the culture in the universities that these were things that they wanted to do for themselves, they would do it as long as there was Welsh Government or WDA funding. As soon as the funding stopped they didn't want to do it; and that's a big failure to me, on both sides. (Senior Policymaker C)*

The positive elements of the programme were also recognised, such as the importance of the networking aspects; however these were not maintained in the current *A4B* programme. The *CETIC*s and *Spin-Out* programmes were not abject failures, and elements of both programmes have been maintained through *A4B*, which has rationalised and simplified the Welsh Government's various triple helix programmes. These programmes had a good underlying idea but did not deliver results when

implemented. This is something of a recurring theme: often programmes are seen to have a sound underpinning, but do not deliver upon implementation.

There are also important elements of the innovation support structure that are not government programmes, and so are strictly outside the boundaries of this thesis. However, one such programme emerged as an important element of the innovation support infrastructure in Wales: the *Cardiff Innovation Network*, funded and run by Cardiff University, which received positive reviews.

> *I do think the Cardiff Innovation Network is a good one. It reaches out. Whether business responds is another issue but I think as an example of open handedness... (Wales Director of Business Representative Organisation A)*

> *Cardiff, they've got like a hot house thing, and I met some of the people who have set up companies off the back of work they have done at Cardiff. That was really good stuff. That's where innovation comes from, not Welsh Government. (Business Person J & Director of Business Representative Organisation F)*

When examining the role of government as a driver of innovation, it is also useful to consider the roles of other actors in the innovation system and the supports that they are providing. It is interesting to see these positive reviews of Cardiff University's service considering the overall lack of discussion of third mission style programmes by business stakeholders. The University is providing a service that is both known to business stakeholders and is seen as useful. It would be interesting to expand the analysis to other university run supports and investigate whether these generally receive more positive reviews than government originated interventions.

5.4 Conclusion

This chapter has explained the evolution of innovation policy and programmes in the early part of the study period and has provided analysis and evaluation of these. Through combining policy and programme review with stakeholder analysis, a rich and nuanced picture of the evolution of Welsh innovation support has emerged. The theoretical development of innovation interventions during the early period has been presented, and also the importance of innovation relative to other policy priorities considered. At the policy level, innovation is dealt with by dedicated innovation strategies but also through the related policy areas of entrepreneurship, economic, and education. Four main interventions are identified – the *RTP, EAP, IAP* and *KTPs* – with a number of smaller or less central programmes grouped under the cluster, apprenticeships, and triple helix categories.

The early period represents a distinct phase because innovation and entrepreneurship were given a privileged position beyond general economic strategy, and we can see "joined up" policy making taking place between the different overlapping spheres. The systems approach dominates policy during this period with three main interventions (the *RTP, IAP,* and *EAP*) taking a wide and cultural approach to develop the RIS in Wales. It is suggested that the European level has an important role in directing Welsh innovation policy, steering it in a broad and systemic direction, in line with dominant thinking about innovation across Europe at this time (Asheim, 2012; Cooke, 2003; Morgan, 1997).

The interventions during the early period receive overwhelmingly positive reviews, but often the initiatives were not carried forward when the programmes ended. Analysis presented here, based on interviews with key stakeholders involved at the time, suggests political change and accompanying shifts in policy priorities as a possible explanation

for this. The issue of continuity emerges as a recurring theme throughout the study, and raises a key question for further research: why were apparently successful programmes in Wales ended without replacement?[10]

After this early period the innovation policy landscape changes; the systemic approach becomes less important, entrepreneurship falls off the radar and the innovation agenda is increasingly steered by the economic, science and education policies. The next chapter will examine the middle period from 2003-2009, conducting the same pattern of analysis. It will show a distinct difference to this early period and explore the fundamental shifts in the Welsh approach to innovation.

[10] See sections 9.2 and 9.3 in the final chapter for further discussion of this issue.

6 The Middle Period (2003-2009): Fragmented Policy Making & De-prioritisation of Innovation

This chapter follows the same structure as the last: it considers the evolution of innovation policy in terms of the published documents, and discusses the various programmes and actions implemented from 2003 to 2009. The analysis is presented in a summarised form at the start of each section, with data from policy review and stakeholder interviews employed alongside the conceptual framework to continue the rich analysis of the evolution of the Welsh innovation approach.

The middle period is characterised by a fairly sporadic and uncoordinated approach to innovation scattered across different policy areas but without a central guiding rationale. Education, economic, science, sector, and spatial planning all feed into the innovation agenda, but there is no innovation policy per se. The Welsh Government's focus shifts towards employment and jobs within the economic sphere, and education policy takes a much stronger role in driving the innovation agenda. In terms of actions, this period sees the massive expansion of the *Technium* network to ten centres across Wales, and it becomes the largest-scale innovation programme implemented across the study period. The economic role of universities is further enhanced, and spatial planning is introduced as the overarching framework within which other policy sits. The most important policies to the innovation agenda during this period are the economic, science, and higher education policies.

6.1 Policy

Table 6.1 Middle Period, Policy: Objectives, Targets, Actions & Approaches

Policy Name	*Objective*	*Targets/Actions*	*Approach to Innovation*	*Other Details*
Wales; A Vibrant Economy	Strategic framework for economic development. Main aim is to increase employment and quality of jobs across Wales.	Earnings to increase in line with UK average. Emergence of sector based approach, proposes industry led sector strategies. Focus on infrastructure, supporting indigenous businesses and increasing skill levels.	Innovation not a central theme, seen as one means of achieving better employment and earnings. Innovation is conceptualised as linear, with R&D and role of universities as innovation drivers emphasised.	Builds on and replaces *A Winning Wales.* States that more detailed sub strategies will follow for innovation and enterprise but these never materialised.
Science Policy for Wales	Maximise the economic impact of scientific activity; improve the performance of Welsh HEIs and increase research activity.	Stronger engagement between actors called for and funds provided for this: Knowledge Exploitation Fund, SMARTCymru, CETICs, Wales Innovation Relay Centre, Technium network and more.	Strong innovation focus, very linear approach built on the premise that advances in science, engineering and technology drive the knowledge economy, and have a positive impact on society and culture as well as the economy.	Strong education and skills focus- role of HEIs in economy, teaching of STEM subjects in schools, equipping people with skills and knowledge to enter into STEM careers.
Knowledge Economy Nexus (Report by Higher Education and Economic Development Task and Finish Group)	Emphasises the interconnection between universities and industry and the need to bring these two "spheres" together to drive the knowledge economy in Wales.	Explores the different role of universities: 3rd mission activities, direct wealth contribution, providing skilled graduates, attracting graduate migrants to the area, stimulating higher skilled jobs, and developing skills of the local population.	Explicitly follows national systems of innovation approach (as opposed to regional innovation systems approach seen in early innovation policies). Also triple helix, university based approach visible.	Triple Helix programmes: HEFCW's Knowledge Exploitation Fund, CETICS, Techniums, Wales Spinout Programme, Technology Commercialisation Centres, IP Wales, Design Wales, and Know-How Wales

Policy Name	*Objective*	*Targets/Actions*	*Approach to Innovation*	*Other Details*
Commercialisation in Wales (Final Report by Independent Task and Finish Group)	Highlights some problems with commercialisation of academic knowledge in Wales and makes recommendations.	Finds problems with commercialisation of academic knowledge: too many fragmented programmes, and a lack of clear strategy driving activity, expertise within universities to carry out third mission activities, and of information held within HEIs regarding their activities.	Triple helix approach: potential of universities to contribute to economic growth, need to enhance commercialisation and third mission activities.	Recommendations including the creation of an overarching commercialisation strategy, setting up cross sector advisory panels, and the preparation of an innovation toolkit. Did not have high impact due to suppression by Welsh civil service.
For Our Future	Replaces *Reaching Higher* as the Welsh Government's higher education strategy.	Economic contribution of universities in two areas: exploiting the knowledge base of universities and encouraging businesses to become more innovative, and adding to human capital development through raising the skill level of the workforce.	Triple helix approach: enhancing the economic contribution of universities and their role as drivers of innovation.	
Creative Success	The first dedicated strategy for the creative industries in Wales.	Creative industries is one of the sectors highly prioritised by the Welsh Government as a key growth driver.	Not directly innovation-related, part of sector-based approach to the economy and innovation that culminates in the sector teams and strategies.	Important position of creative industries in the WG's approach to economic development is established. Further enhanced in the most recent period.
Wales Spatial Plan and Update	Spatially differentiated approach, recognising that the different parts of Wales have different issues and need different	Core priority is addressing Wales' persistent economic inactivity issues through raising skill levels. Economic development at heart of the plan, but also provides framework for other policy spheres such as government services,	Not specifically innovation focussed, but a number of actions and objectives relating to the wider economic and innovation agenda proposed. Cluster-based approach to	Actions proposed: infrastructure, stronger collaboration between business and training providers, building clusters with different sector specialisms in the different

Policy Name	*Objective*	*Targets/Actions*	*Approach to Innovation*	*Other Details*
	solutions. Long-term planning (next 20 years).	health, education etc.	economic development.	parts of Wales.
Skills and Employment Action Plan Update	Skills and Employment as key issues for economic growth, wellbeing and equality.	Highlights the need for the different stakeholder groups of employers, employees and public sector to work together to support the creation of high quality jobs.	Innovation not prioritised- focus is on employment and jobs.	Updates the first *Skills and Employment Action Plan.*
Social Enterprise Strategy and Action Plan	Supporting social enterprises as a means of creating jobs and wealth.	Support growth and creation of social enterprises particularly in Convergence Wales.	Relevant to wider economic agenda, but not strongly concerned with innovation.	Further enhance the importance of employment as the driving rationale behind economic policy.
One Wales	Sets out the Labour-Plaid coalition government's agenda to 2011 across all policy spheres.	Main aims: improving quality of life of people across Wales; creating a healthy future with prosperity and jobs; ensuring learning for life; committing to the principles of social justice, sustainability, and inclusivity.	Economic agenda framed in terms of improving the quality of life of the people of Wales, and ensuring development is sustainable. Little reference to innovation.	Aspirations have remained consistent, little change in the overall approach to the economy since beginning. Economic growth situated within wider socio-economic rationales.
One Wales, One Planet: the Sustainable Development Scheme of the Welsh Assembly Government	Sets out sustainable development as the central organising of the WG and the public sector in Wales in order to develop Wales into a sustainable nation.	Sustainable development is seen as being about social justice, securing economic resilience and living within environmental limits.	Economic resilience highlighted; thus far has been largely absent from Welsh economic and innovation policy despite being a theme that has important overlapping elements.	Nation building agenda - sustainable development as the means for the Welsh Government to assert itself on a global scale.

The second of the Welsh Government's economic strategies was published in 2005, *Wales: A Vibrant Economy*, or *WAVE* (WAG, 2005c), which replaces *A Winning Wales* (WAG, 2002c). It coincides with the ending of the actions implemented in the *IAP* and replaces the innovation and economic policies from the early period. However, innovation is not a particularly strong theme in this document and is addressed only as one of several factors contributing to economic growth, such as job creation and attracting higher wage employment. When innovation is addressed it is conceptualised in a linear fashion as driven by universities.

The lack of an innovation dimension in *WAVE* left something of a vacuum in the innovation policy sphere post-*IAP*, which has only recently been filled by the publication of *Innovation Wales* (WG, 2013b). Interviewees highlighted the difficulties in commenting on Welsh innovation policy considering at the time of interviews only one had been published. This gap in innovation policy means that in practical terms the innovation agenda has been driven by the *IAP* across the whole study period despite the fact that it technically became outdated in 2005.

Returning to *WAVE* (WAG, 2005c), the focus is on employment and earnings as the main priorities for economic policy to address. This is a trend throughout the period; respondents highlighted a problem with the Welsh Government's approach generally that efforts are too focussed on job creation and retention rather than innovation. *WAVE* introduces policy priorities that become increasingly important in the later period, namely the sector-based approach to economic policy and the sustainability agenda. In this policy the focus is more on the social and sustainability elements of economic growth than on innovation and entrepreneurship. This is the key difference compared to the earlier period, perhaps reflecting the political change from a Labour-Lib Dem coalition to a Labour majority with different priorities.

The other key policy during this middle period is *Science Policy for Wales* (WAG, 2006). This is the first science policy published by the Welsh Government and was updated and replaced in 2012. It sees the economic potential of science and research if supported; specifically it asserts that IP created in Welsh businesses, universities, and public sector needs to be protected and commercialised, and addresses this through providing funding and advisory services for these activities.

Science for Wales (WAG, 2006) further enhances the trend of relying on universities as the main drivers of innovation through introducing programmes to push-out knowledge and innovation from universities to businesses. It links the education and economic agendas, focussing specifically on training and skills in the STEM area. There is a significant innovation section within the science policy and it is a much more central theme than in the economic policy (WAG, 2005c). Science and innovation policy in Wales are overlapping and interlinked, and during this period the innovation agenda is addressed primarily through science and education policy in absence of a dedicated innovation strategy. The importance of the link between the two spheres is highlighted by a government respondent:

> *Science and innovation are linked; science is throwing up the new stuff. But the link is probably grossly under exploited. (Senior Policy Advisor A)*

6.1.1 Higher Education

The science and economic policies are those in this period that are most obviously linked to the innovation agenda, but there are other policies published at this time that also have an important bearing. In this period the importance of education policy to the innovation agenda increases, especially higher education policy, as the role of universities as innovation drivers is enhanced. In a period characterised by little in the

way of innovation policy, the education sphere is central in driving the innovation agenda. *Knowledge Economy Nexus* (WAG, 2004b) and *Reaching Higher* (WAG, 2002d) emphasise the interconnection between universities and industry, and the need to bring these two "spheres" together to drive the knowledge economy in Wales. *Nexus* provides a comprehensive overview of the different supports available for third mission activities; it finds eight different programmes aiming to increase interaction between universities and businesses (WAG 2004b).

This is the period during which the triple helix approach becomes dominant both at the policy and programme level. *Commercialisation in Wales* further emphasised the importance of universities' third mission activities in building up the knowledge economy in Wales (NAFW 2007). The Welsh Government responded to this report's recommendations by combining its commercialisation activities under one programme- *Academia for Business* (*A4B*) in 2008, one of the main innovation programmes currently active in Wales. The report highlights a key problem with the Welsh Government's approach to innovation, that it is too focussed on property and infrastructure whereas the absence of expertise and support for innovation activities is the limiting factor in the Welsh innovation system (Gibson et al., 2007). Indeed, the Gibson report is notable because it highlighted fundamental problems in the Welsh Government's approach to innovation and economic development, and uncovered important shortcomings with the large scale Technium programme. However, the report did not receive the interest and coverage one might expect because it was suppressed by the Welsh civil service because it contained too many "inconvenient truths" for the civil servants and politicians alike (Morgan, 2012).

The focus on the innovation role and activities of universities is further enhanced during this middle period by *For Our Future* (WAG, 2009b); again, this policy fits into the

overarching goal driving policy throughout the study period of creating a knowledge economy in Wales. Alongside the sustained importance of the triple helix agenda, we can see further emergence of the sector-based approach in this document (WAG, 2009b). STEM subjects are paid particular attention, in particular those in which Wales is seen to have particular strengths, such as low carbon, health, and biosciences. These later evolve into the key sectors in economic policy and grand challenge areas in the future science and innovation policies (WG, 2012b, 2013b).

Education is central to the innovation agenda and a crucial area for further action in Wales due to the widely perceived underperformance of the education system at all levels.

> *Innovation does actually cover the whole of education because you want skilled people, to get the research happening... Drive the economy forwards. But you've got the complete other end of the scale and you've got primary children struggling to read... Of course it is linked the whole way. (Policy Advisor, Business Representative Organisation E)*

The perceived failure of the education system in Wales was a recurring issue, and is seen as a key reason why the Welsh economy is struggling. It is a theme that was discussed by respondents from all of the different spheres, as the comments below illustrate:

> *We were very vocal to the education department about what we saw as the current state of the system. And there is the evidence there to back our feelings up: something is not right. (Business Person A, Sector Panel 1)*

The relative decline, particularly of parts of Wales: that can't be written off. Much of it is I think due to basics - education and skills. (University Professor E)

Joint action in the education and economic spheres is seen as a solution to Wales' economic problems, in particular embedding innovation, enterprise, and entrepreneurship within the education system. Education proved to be one of the issues highest on stakeholders' agendas when discussing innovation and the Welsh economy, supporting the analysis presented here that sees the two policy spheres as fundamentally interlinked and co-dependent. It is suggested that innovation and education should not be examined as separate spheres, and to improve economic performance, addressing education is key to economic development

6.1.2 Innovation-Related Policies

There are other policies published during this period that have an impact on the innovation and economic growth agendas, but are not primarily innovation related. A trend emerging in this mid-section of the study period is the move towards a more sector-based approach to policy making. This is visible in dedicated sector strategies, such as *Creative Success* (WAG, 2004a), and as a theme in the main economic and science strategies (WAG, 2005c, 2006). It is interesting to note the prominent place creative industries have enjoyed in the Welsh Government's approach to the economy over the study period with dedicated strategies; *Creative Success* (WAG, 2004a) marks the beginning of this trend. However, the links with the innovation agenda are weak. The Welsh Government's approach to innovation centres around a more traditional and linear understanding, which is inappropriate when trying to address innovation in the creative and digital industries:

> *I think government's idea of innovation is quite traditional. Pure innovation... Whereas if you're talking about creativity and digital you have to recognise that the way in which we apply and use services and products is as important as the pure. And they do not recognise that, and they never have, and I disagree with it wholeheartedly. (Civil Servant K, Sector Team 5)*

Another important policy development in this middle period is the *Wales Spatial Plan* (WAG, 2004c), and its update (WAG, 2008), which mark the beginning of the trend towards geographical and sectoral co-location emerging. This is currently being replaced by the city region approach, discussed in the next chapter, and so did not last for the intended 20 years.

Skills and employment remain key to the economic agenda with the refreshing of the *Skills and Employment Action Plan* (WAG, 2005b). Employment is a key rationale driving Welsh economic policy, and this has a bearing on how highly innovation is prioritised. Further enhancing the jobs and employment agenda, the Welsh Government published two strategies on social enterprises; the *Social Enterprise Strategy* (WAG, 2005a) and the *Social Enterprise Action Plan* (WAG, 2009d), which are primarily concerned with finding means of creating jobs and wealth in Wales' poorest areas. Wales is unique in having two strategies devoted especially to social enterprises, integrating them into its economic development agenda. However, there are some tensions arising from the promotion of social enterprises to an important position as economic actors, as expressed by business respondents.

> *I think the problem with social enterprise, sometimes, is that not quite everybody is on board with the idea, and that's sometimes coloured politically... Even in the business community there are members [organisation names*

removed] who are really not completely sure that social enterprise should be round the same table because they're not proper businesses. (Policy Advisor, Business Representative Organisation C)

[The Welsh Government's] answer to the Welsh economy was to have more social enterprises and more co-operatives. I mean crikey, wake up and smell the coffee; it's nonsense. I mean, that is not going to answer the economy in Wales. (Business Person J & Director of Business Representative Organisation F)

In general, Welsh Government has prioritised employment creation above innovation; this has had an impact at the policy level on how much focus is devoted to the innovation agenda, and at the programme level on what the programmes are actually trying to achieve. We can certainly see policy during this middle period moving away from innovation towards concerns over employment, worklessness, and sustainability. These are potentially incompatible goals, possibly to the detriment of the innovation agenda, according to business stakeholders:

Funding for innovation, where it comes from government, shouldn't just be about job creation. Innovation doesn't necessarily create jobs. (Wales Director of Business Representative Organisation A)

Government respondents contest this view; they recognise the fact that in the past this was the case, but cite recent efforts that are being made to move beyond job creation and to focus more on R&D projects.

Whereas in the past, typical government schemes would be around job creation... Economic development is moving on... Our R&D funding, which isn't

predicated on job creation, is starting to come into its own more. (Senior Policymaker D)

Certainly we can see policy in this middle period focussing on job creation and employment rather than research, development, and innovation. The Welsh Government's work is progressive and innovative with regards to the more social and sustainability agendas, but lacking somewhat in the sphere of innovation and economic policy.

Overall, innovation is not the main priority during this period, as illustrated by *One Wales* (WAG, 2007), which sets out the Labour-Plaid coalition government's approach to 2011 and prioritises the principles of social justice, sustainability, and inclusivity. Innovation does not feature centrally, and economic growth is situated within a wider socio-economic rationale of greater prosperity and jobs for the people of Wales through the creation of a knowledge-based economy. Education and skills occupy an important position in relation to wider economic goals (WAG, 2007). In particular we can see the importance of the "learning for life" objective; encouraging a culture of learning is seen as key in achieving economic productivity and increased growth (WAG, 2007). Within the idea of the "learning country", higher education is central to the knowledge-economy; *One Wales* places further emphasis on universities as drivers of economic growth.

Sustainability is a priority that comes to the fore in this period. Indeed, sustainable development is a core principle within the Welsh Government's founding statute, and the Government of Wales Act in 2006 made a commitment to pursuing a sustainable development scheme across the whole of its work. The sustainable development agenda allows Wales to act as a global citizen and assert itself on a global scale by linking with

international and European levels (WAG, 2009c). Sustainable development is a politically important area for the WG because Wales is one of the first nations to fully embrace it as an organising principle, and can enjoy the position as a world leader in this particular area. Sustainability was highlighted as an important area by several respondents, and the role of Wales as a leader in this area was widely recognised.

> *Wales is the only constitution, the Welsh Government constitution, where sustainability is stated as a key attribute. (Civil Servant K, Sector Team 5)*

In the early period Wales was a leader in innovation and entrepreneurship, developing the first strategies in these areas. In the middle period this is the case for sustainable development. The links between the sustainability and innovation agendas are weak, and the opportunity to link up the two themes and to ensure that sustainable innovation is being pursued in Wales is missed. Because sustainability is a core principle of the Welsh Government's work, innovation and economic policymakers are aware of the need to link up the two areas and address them jointly.

> *We've got our department for sustainable development, clearly sustainability is a huge agenda, and it's important to weave that in to the innovation agenda as well. The two often go hand-in-hand. (Civil Servant J, Sector Team 4)*

However, there is little evidence of this interconnection at the policy level; in fact sustainability has supplanted innovation as a central element in the Welsh Government's approach if we compare the middle period with the early years. Different understandings are held of sustainability, and indeed innovation, and often sustainability is conceptualised in purely economic terms by those in the business and economy department. Innovation policymakers explained that when they address sustainability it is to encourage regional resilience and long-term indigenous growth. This is in contrast

to the policy (WAG, 2007; 2009c), which understands sustainability as a wider environmental and social issue.

There are tensions caused by these divergent understandings of sustainability and innovation, and also the enshrinement of sustainability as a core principle. Some stakeholders felt that the Welsh Government is trying to address too many priorities at once, and that innovation and sustainability in particular may not be compatible. Sustainability could even pose a barrier to innovation due to the requirement to conform to the agenda.

> *It's enshrined in NAFW, Welsh Government: the sustainability issue. Which may or may not be a hamper to innovation of course... Everything is a priority, and you think, they all can't be. I don't necessarily think business takes a lot of notice. If you want funding for something then you need to jump these hurdles in order to do it. It may well be seen as a handicap as well. (Policy Advisor, Business Representative Organisation E)*

6.2 Programmes

This period sees the triple helix strengthened as pre-existing programmes are expanded and new programmes introduced to increase the economic contribution of Welsh universities and support collaboration between academia and industry. These programmes receive a large proportion of the resources devoted to innovation. The systems approach becomes less dominant as the influence of the *RTP*, *EAP*, and, eventually, the *IAP* wane. Aside from the triple helix approaches (*Technium, A4B* and *KTP*s), actions during this period are smaller in scale and more dispersed, leading to a greater mix. As with the previous chapter, the programmes are summarised in the table below, which also includes the approach to innovation they take and a summary of

stakeholders' reviews. Some programmes span across the different chapters defined here and are usually discussed within the time period during which they were first implemented. An exception to this rule is the *Technium* programme, which is considered here because the middle period is when the programme was rolled out nationally from the first centre in Swansea to ten across Wales, thus becoming the headline innovation programme of the Welsh Government across the study period until its roll-back in 2010.

Table 6.2 Middle Period, Key Programmes: Approaches, Actions & Stakeholder Reviews

Programme	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Technium	Provides high-tech office space and support for firms to commercialise research and turn this into economic growth; especially aimed at university spin offs and high tech firms and began its life as an alliance between universities and the WDA. The rationale behind the programme was that the universities have expertise in IP, and the WDA in physical property and business support; the programme was designed as a combination of these elements.	Triple helix: concept closely follows incubator approaches seen in other locations, based on the premise that ideas and research from universities can be spun out to create a stream of high-tech high-growth companies. Funded and supported by government, and aims to assist private firms in commercialising both private and university research. The intended links with Welsh universities underpin the rationale behind the programme.	The remaining Techniums are located in Swansea (1 and 2), Cwmbran (Springboard), St Asaph (OpTIC) and Swansea University (Digital); the centres that have been closed were located in Bangor, Aberystwyth, Baglan, Pembroke, Llanelli and Bridgend. Estimated costs around £100m.	Overall, the programme has received negative reviews in Wales, and was the example most frequently cited by stakeholders of an unsuccessful or failed innovation programme. High degree of negative media coverage, and the Welsh Government has come under criticism for the perceived waste of public monies. In short, the Technium experience has not been a particularly positive one, and the programme's perceived failure has received widespread criticism from a variety of sources.

Programme	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
A4B	Targets include: helping at least 200 businesses to benefit from collaborating with universities, and helping to launch at least 60 new products and processes onto the market. A4B aims to achieve these targets through: auditing the IP held by academic institutions to pinpoint projects with the best potential for commercialisation; evaluating potential projects of strategic value to Wales; and filling the funding gap between basic early research and market exploitation.	Triple helix: aims to increase the economic impact of Wales' Higher and Further Education Institutions through encouraging knowledge commercialisation activities and the exploitation of academic held IP. Combines the earlier programmes (SMART, Spin Out Wales etc.) under one single programme so can be seen as continuation of past approaches.	A4B is a fairly large innovation investment, at £70m over six years, and is financially supported by ERDF funding. A4B aims to: audit the IP held by academic institutions to pinpoint projects with the best potential for commercialisation; evaluate potential projects of strategic value to Wales; fill the funding gap between basic early research and market exploitation.	As with other triple helix programmes (such as KTP), university respondents were overwhelmingly positive about the scheme, and saw it as an important part of the Welsh Government's approach to innovation, but it was not mentioned by business stakeholders at all either in a positive or negative context, suggesting that it may not be high on their agenda or having much impact outside of the university sector. There were some other problems of financing and reporting requirements highlighted by university respondents.

6.2.1 Technium

One of the most high profile innovation interventions over the last decade in Wales is the *Technium* programme, which features in all of the economic strategies and represents a significant infrastructural investment of almost £100m[11]. The first *Technium* in Swansea opened in 2001, but it was during the middle period that the programme expanded to ten centres across Wales. In 2010, six were closed due to high costs and low occupancy rates; the future of the remaining centres is not clear but government stakeholders suggested that the programme is being wound up. The *Techniums* were widely discussed, which is unsurprising given how they dominate innovation policy throughout the period and received much publicity from both the Welsh Government and media. There have been some evaluations of the programme carried out, which will be discussed alongside stakeholder's perspectives. Generally, the programme receives fairly negative reviews from both quarters.

A fundamental criticism made both by the evaluators and the stakeholders interviewed was that the *Technium* programme as it was implemented became quite different to the original design. It was designed as more than a property-based incubator approach, providing advice and support for companies located within the buildings and links to Welsh universities so that business could access their knowledge and expertise. However, these did not materialise and there were not enough spin outs coming from the universities to fill the incubator spaces. Cooke (2003, p.19) found that the *Technium* concept fell into the trap of replicating old incubation processes that failed to prioritise

[11] A report conducted in 2010 shows that the total development cost of the 10 Techniums across Wales was £93.4m, of which 89% was funded by the public sector with the extensive use of EU Structural Funds (DTZ, p. iv).

management assistance through, for example, allocating part time space to venture capital, legal advice, and management accountancy; the programme was not innovative, and became simply properties leasing space. Stakeholders reflected this view, questioning the innovation credentials of the programme and seeing it more as a continuation of the WDA's property investment programmes of the past:

> *I think to some extent [Techniums] became a substitute for a property investment programme rather than an innovation programme. (Senior Policymaker, D)*

> *[Techniums] weren't all proper innovation centres. (Ex-WDA Senior Official B)*

An explanation for why the programme became so focussed on property investment, rather than innovation, is to do with the pre-existing approaches and experiences of economic development in Wales:

> *Techniums were always about the property investment people in the old WDA, it was simply a way of continuing to build advanced factories... If they could pick up on innovation and technology as the underpinning rationale they could go and build very nice high quality sheds in parts of Wales and call them Techniums. (University Professor D)*

According to this respondent, the underlying problem was that the people in charge of the implementation of the programme fundamentally misunderstood the nature of an innovation programme and focussed on the property elements because that was where their expertise and experience lay. Cooke and Clifton's (2006) evaluation agrees with this analysis; they found that the buildings were not in themselves innovative and just replicated old incubation approaches; the focus on management assistance and advice became lost.

Another criticism is the manner in which the programme was expanded across the whole of Wales based on the perceived success of the first centre in Swansea. An evaluation commissioned by the Welsh Government (DTZ, 2010) found there to be no clear rationale for the roll-out of the programme beyond the first centre. Simply expanding the programme to more centres across Wales did not produce the results hoped for:

> *Technium... Basis of a very good idea. But we've had a tendency in Wales if something works well once then it will work ten times better if we have ten times as many, and it appears unfortunately that that wasn't the case. (Senior Policymaker B)*

The roll-out of the programme was problematic because of a mismatch between supply and demand; there were too many centres in total and not enough businesses to fill them. The programme was overambitious because it assumed over 400 incubator spaces could be filled across Wales, but this was simply not the case because there are not enough academic spin outs and high growth firms to use the service (Cooke & Clifton, 2006). Indeed, occupancy rates in the Pembroke *Technium* were as low as 4% (DTZ, 2010). The locations of some of the *Techniums* were problematic because there was little demand for the service from businesses in the areas concerned.

> *I think that model was flawed in so much as it was necessarily tagged to European funding, which is necessarily tagged to particular areas of Wales... There was no critical network around it in some areas. I don't believe in some areas there has ever been a business case. There have never been businesses to populate that. (Wales Director of Business Representative Organisation A)*

The official evaluation (DTZ, 2010) was highly critical of the programme and provided five reasons why it was not a success: there was no clear rationale for the roll-out

beyond the first incubator in Swansea; there were no explicit objectives; monitoring and evaluation by *Technium* managers was practically non-existent; occupancy rates were very low; and the provision of business support and its take-up was minimal. The cost of the programme was problematic and each job in the *Techniums* cost an average of £190,000 of public money (DTZ, 2010); Morgan (2012, p.16) expresses his surprise that there has been no public inquest into the "failure of an experiment that cost around £111 million". Interviewees were similarly critical:

> *I think the Technium network, which has been well documented, is not one of the greatest examples of what we have to show to the world. (University Professor E)*

> *The "Emptiums"... There was nobody there. The place was empty. (University Professor D)*

> *We have seen largely that it has been... Discredited is a bit harsh. But largely it has not been a roaring success. (Wales Director of Business Representative Organisation A)*

Bristow et al. (2007, p.25) provide some counterbalance to the negative evaluations, whilst conceding the critical points made by other evaluators. They found some support for the programme on the basis that it could help facilitate university-business knowledge transfer thus "laying the basis for a new knowledge economy" and they also explain that although the cost per job seems very high, the jobs tend to be graduate, R&D based positions, and form the basis for more high value added growth in the future.

The original design became disjointed from the programme's delivery: the underlying idea behind the concept was not necessarily a bad one, but as the programme expanded

the innovation elements were lost and the later centres were arguably placed in the wrong locations. Simply duplicating an approach that has worked in one context will not necessarily produce results in another, as the *Technium* experience shows. The former Economic Development Minister asserted that "*the concept was sound...the management and roll-out was deficient*". A wider problem with supply side policies centred on a physical development that is relevant beyond this particular example is that if not enough firms utilise the service, they will become reduced to the status of "cathedrals in the desert" (Cooke and Morgan, 1992 cited in Morgan 1997).

> *Wales is not alone in this. If you go around Europe there are many of these examples of effectively white elephants. (University Professor E)*

6.2.2 Academia For Business (A4B)

A4B is one of the Welsh Government's key current innovation programmes, which combined and replaced earlier programmes (*Spin Out Wales, CETIC*s etc). It is part of a wider trend during this period whereby triple helix style interventions dominate the Welsh approach to innovation. Government has the role of encouraging and facilitating university-business interactions and, to a large extent, relies on universities to drive the innovation agenda. The *A4B* programme was created in order to present a clear commercialisation offer and resolve the problem of programme dilution caused by having too many small programmes. Huggins and Kitagawa (2011) found that *A4B* is capturing significant European finance for third mission activities and thus providing the possibility of developing a system of sustained and coherent support for these. It received positive reviews, especially from the university sphere:

> *A4B is a really useful scheme. (University Technology Transfer Officer D)*

A4B is seen by university actors as filling a gap in the support infrastructure by providing funding for smaller scale projects that are not so well supported by UK level schemes.

> *[A4B] has provided very good interventions, what they've been very good at actually is providing things that fill the gap. Because often the UK things tend to be bigger and longer term. But they've filled the gap in, where the opportunities really are. (University Technology Transfer Officer B)*

In this case the role of the Welsh Government seems to be one of providing programmes that offer a service that better meets the needs of Welsh stakeholders than the pre-existing UK programmes.

It is perhaps unsurprising that actors from the academic sphere are positive about *A4B* because it is a means through which they can gain funding for third mission activities at a time when universities are facing funding issues. However, business stakeholders did not mention *A4B* at all, suggesting that it may not have such an impact on the wider innovation system beyond the university sphere. This leads to the question of whether there is the necessary demand for these triple helix style programmes in Wales, and whether there is something of a mismatch between supply and demand occurring. Also questionable is the capacity and capability of the private sector in Wales to absorb the outputs of these university-driven third mission activities.

Although university respondents were generally supportive of the aims and rationale of the programme, some highlighted issues with the financing and design. This emerged as a wider problem with Welsh Government programmes, that they are not always supported over the long term:

> *Lots of projects and programmes have productive starting points but are not followed through. For example, A4B suffering from a lack of long term funding. (University Professor 1)*

Another problem in the programme's design is that it did not involve the key stakeholders who would actually be the end users and deliverers:

> *We weren't really involved in the development of the [A4B] project. Although we were going to be the main beneficiaries of the project, and we actually had to deliver, we weren't involved in the development, which was a bit frustrating. (University Technology Transfer Officer C)*

These problems were also raised by respondents in reference to other programmes; issues of funding availability and programme design are cross-cutting. There is a particular issue highlighted by respondents with regards to programmes with EU structural funding behind them (including *A4B*) because the reporting requirements are perceived to be too stringent; this is seen as a barrier to participation.

6.2.3 Other Innovation-Related Programmes

As with the previous chapter, there were a number of programmes highlighted by interviewees that are innovation related but are not as central to the innovation agenda as the main programmes discussed above, and were not raised by as many interviewees as important elements of innovation support. These have been grouped together thematically, according to the approach to innovation that they take, and stakeholder's evaluations of the programmes are presented.

Table 6.3 Middle Period, Other Programmes: Approaches, Actions & Stakeholder Reviews

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
KESS	Supported by funds from the European Social Fund to 2014, KESS is led by the Welsh university sector primarily by Bangor University. Example of university led innovation programmes, with government (European and Welsh) funding behind them. Supports collaborative research projects between research students (Master's and PhD) and business partners in the Convergence area of Wales.	Triple helix- aims to benefit both Welsh companies and the students taking part by increasing the research capacity of Welsh SMEs, training individuals as research professionals, and supporting the development of key technologies. Run by the university sector (Bangor and Aberystwyth).	Linked in to the Welsh Government's key economic sectors prioritising projects in the areas of the digital economy, low carbon, health and bioscience, and advanced materials and manufacturing. Although the project is being run by universities with support from EU funding we can see that the Welsh Government's policy priorities are shaping where the support is actually focussed.	KESS is quite a small scale programme, and was only discussed by a couple of participants from universities that are involved in the scheme; it is not relevant to university actors in non-Convergence areas. These respondents were generally positive about the scheme, seeing it as part of wider efforts to create a knowledge economy and innovation ecosystem in Wales.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Know How Wales	Innovation focussed business advisory service: relationship management, knowledge management and communications. KHW was designed as an impartial source of support and advice, free to all Welsh businesses, delivered through a network of 5 regionally based managers to provide innovation and knowledge transfer support.	Triple helix: Welsh Government provides business advice, but the distinctive element of KHW was that it was specifically geared towards supporting business- university collaboration.	KHW was linked up to the Technium programme as the service provided to resident companies (but was available to all businesses in Wales) to link them to the knowledge and expertise contained within academic institutions to support commercialisation, R&D, product development etc.	Not seen as particularly successful, but elements have been retained and re-packaged under A4B. Inextricably linked to the problems with the Technium programme (as the advisory function within it) and did not produce the expected results. Not discussed widely, and no mention by business stakeholders as with the other triple helix interventions.
Expertise Wales Portal	This is a portal through which businesses can find and access facilities, knowledge, and support from universities in Wales; the portal is accessible at www.expertisewales.com.	Triple helix- aims to drive collaboration and innovation by increasing the links between academia and business.	The project is funded by ERDF via A4B (discussed above), and the Welsh academic institutions supply and manage the information on the portal.	Another example of an intervention that is seen as being underpinned by a good idea, but it lacking in actual impact due to problems in the implementation. Currently being improved.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Pro-Act	Developed as a rapid response to the economic recession so that rather than making staff redundant, companies retain their personnel and use the spare capacity to train staff to improve the capability of the business ready for the economic upturn. Originally focussed on the automotive sector due to the damage to the Welsh manufacturing economy as a result of reduction in global production and market consolidation but later was expanded to all companies.	Learning region: focussing on skills and training to enhance the human capital. More employment focussed than innovation focussed; not strictly an "innovation programme" but was highlighted by numerous respondents as important element of the WG's approach.	Wound up in 2010, was always designed to be a short term response to the global economic crisis. In total, £27 million committed to support 254 companies. Based on Pro-Act's success Skills Growth Wales launched in April 2010 to help businesses in Wales take advantage of growth opportunities provided by the global economic upturn.	Received overwhelmingly positive reviews from the academic and business stakeholders. No negative comments about these programmes, which was unusual because usually there were some critical comments made of the programmes. In particular, the quick nature of the response by the WG was praised and they way it moved to offset some of the problems caused by the economic downturn.
Youth Entrepreneurship Strategy (YES)	Aims to boost young people's entrepreneurial confidence so they can play a full and effective part in the economy and community, and education is a key strand of the strategy, designed to draw together the different dimensions of the Welsh Assembly Government's economic development and education policies.	Elements of different approaches, theme of business-academia interaction in *YES*, corresponding with the triple helix approach. Stronger learning region elements, focusing on education, learning and knowledge.	The strategy has three key themes: raising the profile of youth entrepreneurship in Wales; focussing on education and training; and providing supports and integrating entrepreneurship into FEIs and HEIs. Youth entrepreneurship framed as response to the economic downturn and high levels of youth unemployment.	Seen as an important and useful support, and addressing entrepreneurship is an important and useful element of WG's work. In particular, the cultural elements are seen as crucial, and YES is praised for the way it addresses the underlying educational aspects embedding entrepreneurship.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Re-Act	Launched October 2008 to provide funding for training to people in Wales facing redundancy or employers who are downsizing or recruiting. From the employer perspective, grants of up to £3000 and further £1000 for training are available to Welsh companies that recruit individuals recently made redundant. From the individual's perspective, they can receive funding for training to acquire new skills.	As above.	Re-Act II was launched to continue the perceived successes of the original Re-Act programme. It is discussed in the following section because it was launched in 2011.	As above.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
GO Wales	Graduate Opportunities Wales aims to contribute to developing a knowledge-based economy in Wales by providing businesses with access to skills and ideas to grow and develop their business and by assisting students and graduates to develop their careers in Wales through providing work experience, training opportunities and a job portal. GO Wales is funded by the Welsh Government, and also the European Social Fund, managed by HEFCW, and delivered by the universities' own career services.	The premise behind the programme is that Welsh companies will become more competitive if they can access up to date knowledge, skills and techniques through their workforce, and create links with other actors in the knowledge network; this corresponds with the approach advocated by the learning region theory.	Aims to assist 6,741 students and graduates with training and development opportunities from 2009-2014. Provides funding to Welsh SMEs to train and develop graduate level staff, up to £8,500 per organisation at 50% of course costs to help staff gain further qualifications. Also provides a job portal and opportunities for Welsh graduates (or other EU graduates living or studying in Wales) to help them to find a graduate level job, or to receive further training through the Graduate and Freelancer academies.	The issue of "brain drain" and graduate retention was highlighted by several stakeholders from the different spheres as a major issue affecting the Welsh economy. GO Wales is regarded positively because it is attempting to address this issue. Stakeholders did not provide much evaluation of the programme, but those that did were quite positive about it. Mostly when it was discussed, it was as an example of the WG trying to find a solution to an important and deep-seated problem.

6.2.4 Triple Helix Programmes

As well as the *Technium* and *A4B* programmes, three smaller programmes implemented during this period take a triple helix approach to innovation. *KESS*, which is similar to the *KTP* programme but much smaller in scale and only available in Convergence Wales, received some positive reviews. In particular, it was praised for the way it is trying to address the Welsh "innovation ecosystem":

> *[KESS is] all about those different components to develop the knowledge economy in Wales. And skills, R&D skills are a part of that. You can't have innovation without a fully developed ecosystem... I think that is true. (University Technology Transfer Officer A)*

An interesting point of discussion is the use of the term "innovation ecosystem"; this was a phrase that recurs in many of the interview transcripts and is a popular term amongst policymakers. Respondents were questioned further about the concept, revealing ideas closely related to the systems of innovation theory, taking into account different actors and institutions and conceptualising innovation broadly and in its geographical context. This is a good example of a concept that is being used by policymakers, but is not particularly theorised in the academic literature; theory lags behind practice in this instance.

Know How Wales (*KHW*) is another programme that aimed to establish relationships between academia and business; it was designed as the business advisory arm of the *Technium* programme to elevate it from a traditional property development programme to an innovative incubator approach. However, the advisory and networking functions of the *Techniums* did not really work as envisaged and the service has faded out. The *KHW* programme did not really take off and was short-lived, but elements have been

subsumed into *A4B*. *KHW* received negative reviews; it was discussed as a programme that should have worked but did not.

> *Know How Wales didn't work particularly well as a programme. It should have logically speaking, there's no reason why it shouldn't have worked well (Senior Policymaker D)*

Academic respondents who used the programme provided some insights into why it may not have worked very well:

> *Know How Wales...Was all about promoting university ideas to business, but it was totally top down and what we should have done was invested in the universities to do that, not put another middle person in between. (University Technology Transfer Officer A)*

Another project that did not emerge during policy analysis, but was highlighted by respondents from the university sphere is the *Expertise Wales Portal*. Being situated within *A4B*, the portal aims to provide a single point with project details and contacts to simplify the collaboration process, making it easier for businesses to access university expertise. It was highlighted as an example of an action that is underpinned by a good idea but has fallen down in the implementation. This is emerging as a common theme across the study period, with several programmes receiving similar reviews.

> *The Expertise Wales Portal, which the Welsh Government has developed. I can't say that's bringing us any benefit at the moment... It needs ditching or improving to be honest. (University Technology Transfer Officer D)*

The portal is seen to be a good idea and there is demand for such a service in Wales, but the programme was not a success due to the weakness of the implementation.

The discussion of these programmes was limited to a few university and government actors who were involved in some way with the programmes, and generally they are viewed fairly negatively. They do not seem to have made much of an impact on the business sphere in Wales judging by the fact that business stakeholders interviewed did not mention them. There could be an issue of balance in these triple helix-style interventions, in that the university and government spheres are stronger and more dominant that the business helice, whereas in fact they should be in balance (Etzkowitz, 2008).

The smaller programmes became subsumed into the larger *A4B* programme, which has received more positive reviews from stakeholders, especially those in the university sphere; this analysis supports the Welsh Government's decision to amalgamate and rationalise its triple helix style supports under the *A4B* banner.

6.2.5 Learning Region/ Human Capital Programmes

During this middle period some programmes were introduced that focus on the human capital, and skills and education elements of innovation and economic development. Some of these developments do not immediately appear to be closely linked to the innovation agenda, but they were all highlighted by stakeholders. They have been grouped together under the heading of 'learning region' because they are all concerned with increasing the knowledge and learning capabilities of the region through enhancing the human capital elements. Whilst there is an underlying logic to these programmes that fits into the innovation and economic development agenda, they are more explicitly concerned with addressing the pertinent unemployment problems in Wales; increasing innovation capacity and capabilities is more a side issue than a central aim. If they were not highlighted by several interviewees they would not necessarily have been identified as innovation programmes through the policy review process.

Two such programmes are *Pro-Act* and *Re-Act*, both of which are training and skills based, created in response to the economic crisis and difficult employment situation this heralded. These are not strictly innovation programmes but they contribute to the human capital agenda, seen as an essential element of the economic landscape. The two programmes were delivered at the same time, and both had broadly the same goals and approach; they were discussed as a pair by stakeholders and are unusual because there were no negative comments about them. In particular, stakeholders were positive about the speed at which the programmes were delivered and the responsiveness of the Welsh Government to the economic crisis.

> *I think there's been some really good specific initiatives. Things like Re-Act and Pro-Act... Quick policy responses to recession and those sorts of crises, which I think have been quite good. (University Professor C)*

Generally the business stakeholders were quite critical of efforts to improve the Welsh economy, but *Pro-Act* and *Re-Act* received overwhelmingly positive reviews. The timeliness and responsiveness of the Welsh Government was praised:

> *So when the economic crisis did hit, all of a sudden some of the barriers were put aside and the First Minister certainly drove though very quickly [Pro-Act and Re-Act]... Incredibly successfully... Considered to be really successful. (Policy Advisor, Business Representative Organisation C)*

> *They've got some major successful initiatives and I think where it was able to react – Pro-Act and Re-Act have been excellent... They were good, productive, they were timely and they were right on the button. I think the WG should be congratulated for that sort of effort. (Business Person J & Director of Business Representative Organisation F)*

Another programme that emerged as an important support is the *GO Wales* scheme. This was identified through policy review as an economic-related programme, but was not considered to be particularly closely linked to the innovation agenda because its focus is on graduate employment. A business owner explains how a programme that is primarily concerned with employment and graduate retention can have an important innovation impact:

> *We've used Go Wales...[which is] a success and having that input of fresh thinking, fresh talent, sometimes just a fresh face into the company and giving them the opportunity perhaps is good, it energises the company and it energises the individual. From an innovation point of view I think that whole strand of activity is really important. (Business Person E, Sector Panel 3)*

This insight is in line with the understanding advocated by the learning region which brings together the human capital, learning and innovation strands of economic development (see Rutten & Boekema, 2007). But there is also a triple helix element to the programme, highlighted by respondents from the university sphere, who explain how the programme is important in building up links between Welsh businesses and universities, often introducing universities' work to new companies.

> *Go Wales... Encourages SMEs in Wales to employ graduates because once they've got the graduate in, very often that company sees for the first time what other services and projects a university might have to offer their particular business. (Policy Advisor, University Representation Organisation A)*

Although the programme did not initially appear to be innovation related, stakeholders have highlighted it as such and provided a broader understanding of the programme and its impacts. The opinions expressed about *GO Wales* were positive; it is seen as useful

and important especially considering the problems of graduate retention in Wales, which is considered a major issue for the Welsh economy.

> *If we can find a way of holding onto or keeping more of our graduates with the ideas, and the brains, and the capacities, in Wales... (University Professor 3)*

The other programme implemented during this middle period that was discussed by interviewees, which addresses human capital elements of economic development is the *Youth Entrepreneurship Strategy* (*YES*), the entrepreneurship programme implemented following the *EAP*. Whereas the *EAP* had strong links to the innovation agenda, *YES* is much more focussed on the education aspects of entrepreneurship. It is seen to provide an important and useful support which encourages entrepreneurship and also helps address issues of youth unemployment; in fact the programme has recently been extended by the Welsh Government until 2015. The Global Entrepreneurship Monitor (GEM) has shown that youth entrepreneurship in Wales has grown significantly over the last decade, and this has been attributed in part to the success of the Welsh Government's programmes (Brooksbank and Jones- Evans, 2006; Levie and Hart, 2011). However, stakeholders highlighted some issues with the positive headline figures on entrepreneurship, explaining that they can mask deeper underlying problems. Positive rates of entrepreneurship can be a result of necessity entrepreneurship, or in other words people taking the entrepreneurial route because there is no alternative available.

> *It's not all good because what we're seeing is that it's a necessity because there aren't any jobs. (Local Government B)*

Another problem with the positive entrepreneurship rates is that whilst start-up rates have increased over the last decade, this is not translating into business growth and jobs.

A number of stakeholders raised this issue from the different groups, and the quotes below illustrate some of the perceived problems:

> *Simply because we've got a lot of businesses that have started up, but they're not growth businesses they're happy just to stay in their own community and do a bit of this and a bit of that. (Local Government B)*

> *I think we can see a growing sense in which we've perhaps got more small businesses, but are we seeing a shift into them expanding and becoming a more important part of the economy? I don't know, those are areas where I'd say the jury's still out. (University Professor 3)*

In this light, the entrepreneurship programmes (*EAP* and *YES*) have been only partly successful. Innovation was recognised as a key priority by government actors attempting to address this disconnect between start-up rates and business growth; it is seen as a long-term and culturally situated phenomenon that is difficult to address.

> *Innovation and the ability to constantly innovate is a factor in that. So they start-up with a bright idea, they're quickly overtaken by the competition and so we're looking... Making sure they continually innovate. It's a never ending process. (Business & Economy Department Official- Sector Team 5)*

> *I think it's about creating the right conditions... That's when people are entrepreneurial, or want to run their own business, or have a product or skill that could become their own business that they are encouraged and know how to do that. (Civil Servant K, Sector Team 5)*

This link between innovation and entrepreneurship was recognised by multiple stakeholders, and the wider culture and environment is perceived to be an important barrier to innovation that needs addressing.

> *I think the culture of innovation and entrepreneurship is still a weakness, although improving. (University Professor D)*

6.3 Conclusion

This chapter has presented an analysis of the evolution of innovation policy and programmes during the middle section of the study period from 2003-2009, using insights gained from the policy review and stakeholder interviews. It finds a distinct shift in the Welsh Government's approach to innovation and economic development compared to the earlier period; innovation features less prominently in the policy mix, and other issues move up the agenda, in particular the education and sustainability policy spheres. The number of programmes and interventions addressing innovation expands during this period, in particular those that take a broadly triple helix style approach to innovation and economic development. These have received mixed reviews, and the perceived failure of the *Technium* programme is looming over the Welsh Government's efforts during this period.

In the early period the Welsh Government was quite innovative and progressive in its pioneering of innovation and entrepreneurship policy, but increasingly the focus has shifted towards social and sustainability goals. The argument advanced here is that this has been at the expense of innovation and economic growth, which have been side-lined at a policy level. The conceptualisation of innovation during this period is quite linear and the triple helix approach becomes central. This is due to the innovation agenda being driven through higher education policy in the absence of dedicated innovation

policy, and an increasing trend towards utilising universities as the key innovation drivers. To summarise the policy trends during this period: innovation was de-prioritised and superseded by other concerns, and innovation policymaking is dispersed and fragmented across a number of different policy spheres without a guiding innovation strategy.

In the next chapter, the most recent period from 2010 to the present day is discussed. Again, we can see a distinct shift in the approach to innovation and economic development as Welsh policy becomes increasingly aligned to the smart specialisation agenda gathering momentum at the European level. Innovation returns as a key priority within the Welsh Government's overall approach, and important policy documents are published with innovation as a central tenet. The types of programmes being implemented shift towards a more cluster-based approach, and the Welsh Government restructures into a series of sector teams.

7 The Recent Period (2009-2014): the Resurgence of Innovation Policy

This chapter presents the analysis of the most recent period of policies and programmes and follows the structure of the previous two chapters. The approach during this period is predominantly cluster-based, in line with the smart specialisation agenda being pushed from Europe, and as such marks another distinct break from the previous period. Three policies in particular have a strong innovation theme: the economic, science, and innovation policies (WAG, 2010b; WG 2012b, 2013b); innovation is restored as a central priority in the Welsh Government's work after the hiatus of the previous period. Other important policy developments in this period relate to infrastructure (WAG, 2010c; WG, 2012c), which emerged as an important barrier to innovation and economic growth according to stakeholders from the different groups. The first section discusses the evolution of policy since 2009, and this is followed by analysis of the programmes and actions implemented during this period. As with the previous chapters, the policies and programmes are first summarised in tables, followed by fuller discussions incorporating interview data and policy analysis.

7.1 Policy

Table 7.1 Recent Period, Policy: Objectives, Targets, Approaches & Actions

Policy Name	*Objective*	*Targets*	*Approach to Innovation*	*Actions*
Economic Renewal Programme	Overall aim: to drive economic growth and prosperity across Wales. Introduces sector-based approach. Priorities include: infrastructure, improving the business environment, skills, and business support. Ushered in large scale changes to the WG's approach to the economy.	The ERP introduces 6 sectors where support will be focussed, with another three later added in 2011, each with a sector panel to provide advice and guidance to the Welsh Government.[12] Business support changes from grants to re-payable loans.	Innovation is a key priority: focus is on creating the right environment for innovation. Infrastructure emerges as important issue. Triple helix approach remains strong, enhancing role of universities as drivers and improving communication with business sphere.	Improving government-business communication: sector panels established and links with "anchor companies". The WG is increasingly concerned with building relationships with these companies to maintain and strengthen their presence in Wales. Support delivered according to key sectors.
Science for Wales	The second science policy, aims to increase the research base in Wales to foster innovation and economic growth. Strong economic rationale: emphasis on collaboration with business and commercialisation of knowledge for economic gain. Aims to build research capacity and networks across Wales.	Sêr Cymru and National Research Network programmes introduced to attract scientists to Wales and build up momentum in key "grand challenge" areas. Sector based approach: focus on four "grand challenge" areas that overlap but do not match exactly the ERP sectors.	Linear understanding of innovation emerging from (university based) R&D. Triple helix approach to using universities as innovation drivers. Learning region approach: building science and research networks and improving the human capital by attracting "star researchers".	The science policy further embeds the trends that have emerged in recent years in Welsh policy of viewing universities as key innovation drivers, moving towards a sector-based approach to economic development, and improving the hard and soft elements of the knowledge infrastructure.

[12] The six original sectors are ICT, energy and environment, advanced materials and manufacturing, creative industries, life sciences, financial and professional services. The three additional sectors are construction, tourism, and food and agriculture.

Policy Name	*Objective*	*Targets*	*Approach to Innovation*	*Actions*
Innovation Wales	WG's second innovation policy, the first for 10 years. Response to requirement from EC that regions prepare innovation strategies for next round of structural funds in 2014. Repositions innovation as a key priority within the Welsh Government's overall approach.	Increase participation of universities and firms in UK and EU level programmes. Moves towards fewer but bigger innovation programmes with "transformative effect" on research and innovation during the next round of structural funds.	Returns to a wide and systemic approach to innovation, which has been lacking in the Welsh approach since the early period. Also takes into account social and public sector innovation, which have not been seen in Welsh innovation policy to date.	References smart specialisation agenda, Horizon 2020 and Grand Challenges- strong influence of EU level. Further evolution of sector based approach to four domains based on the science policy's "Grand Challenge areas".[13]
Wales Infrastructure Investment Plan for Growth and Jobs	Welsh Government's approach to infrastructure investment to 2014-15. Rationale: funds are increasingly scarce for government to spend on large projects, and need to leverage European funding more effectively in the coming round of structural funds.	£3.5bn allocated to infrastructure over three years, part of £15bn projected for whole decade. Priorities: transport, housing, telecommunications, energy industry, educational estate, public services, and enterprise zones.	Stimulate economic growth through strategic investments, and to create the right environment for innovation and enterprise in Wales. Not directly innovation related, but highlighted by several stakeholders as crucial for the Welsh economy.	Broadband as key infrastructure priority enabling innovation and commercialisation of digital technology by Welsh businesses. Follows sectoral approach guiding economic policy supporting the different infrastructure requirements of the various sectors.

[13] The domains are: life sciences and health; low carbon, energy and environment; advanced engineering and materials; and ICT and digital economy.

Policy Name	*Objective*	*Targets*	*Approach to Innovation*	*Actions*
Programme for Government	Innovation and the economy are key priority areas as part of the core aim of a more innovative and prosperous Welsh economy. Jobs and economy are "overriding priorities", signalling a move back to prioritising economic policy compared to the previous period.	Key actions: improve the relationship between WG and business; support high performing, quality companies; promote trade and investment opportunities; improve public procurement; build strong links with anchor companies; enterprise zones; STEM careers etc.	Innovation is one of the key principles guiding the Welsh Government's approach to the economy, alongside infrastructure, skills, and improving the business environment. These are the same priorities that we have seen across the study period.	Sustainable development, skills and employment remain important priorities but there is more of an economic focus overall compared to the previous period. The approach to the economy has not changed significantly as the same priorities have remained throughout.
City Regions Final Report	Spatial approach to planning and policy predicated on concept of city regions. Rationale: cities as core economic drivers and need to spread the prosperity they create across Wales.	Recommends WG takes a city regions based approach to policy making focussing on 2 city regions in South Wales: one in the Swansea area and one around Cardiff and the Valleys.	Not directly innovation related, but advocates geographical clustering around urban centres. Strong economic rationale for taking this approach, cities as economic drivers.	Also recommends linking up the North East part of Wales with North West England, but does not see this as a city region of its own right.

7.1.1 Economic Renewal Programme (ERP)

The *ERP* (WAG, 2010b) is the Welsh Government's most recent economic policy, which introduces significant changes to the economic agenda by introducing a sector-based rationale to policymaking and delivery of innovation supports. Innovation is a strong theme in this policy in contrast to the previous economic policy, in which it was largely side-lined in favour of other priorities (WAG, 2005c). As well as channelling support to particular sectors, another major change is initiated by the *ERP* to the way that government funding is delivered to businesses in Wales; it calls for grants to be replaced with repayable loans in an attempt to address the perceived grant culture amongst Welsh businesses (WAG, 2010b). This development was discussed at length with interviewees and was particularly unpopular amongst the business community, leading to a sharp drop in the number of businesses accessing support, as recognised by policymakers:

> *We went through a phase of much of the government support becoming repayable and we saw a negative impact on take up from companies. (Senior Policymaker B)*

> *So there would be no more grants so people thought "Oh no more R&D funding". So I suppose there was a period of time where people were confused over whether the R, D & I was there or not. (Welsh Government Industry Liaison Officer)*

The Welsh Government reversed the decision little over a year later, responding to advice from the business sphere and sector panels to do so. Respondents sitting on the sector panels explained how this was one of the first actions recommended:

> *The first thing that we did was that we persuaded government to reverse its policy of making R, D & I support repayable... So the move to non-repayable has certainly given us over the last year a big boost in terms of our level of activity. (Business Person D, Sector Panel 3)*

This is a good example of a change introduced by government without enough prior consultation with the business sphere; business respondents saw this as a historic problem in the work of the Welsh Government. Recent efforts to improve the engagement and communication between government and business are recognised by various interviewees, such as the commitment by the Welsh Government in the *ERP* to improve the way it interacts and works with the business sector (WAG, 2010b). Specifically, the *ERP* introduces the sector panels, and aims to establish relationships with anchor companies in Wales. It is interesting to see this return to inward investment as a priority after the strong swing towards supporting indigenous innovation and entrepreneurship in the early section.

The trend of relying on universities as drivers continues in the recent period with programmes around universities and their third mission activities. The *ERP* marks a starting point for a new era of innovation and economic policy in Wales, and sets the agenda for restructuring of the Welsh Government's approach to the economy along a sector-based rationale; it sees the return of innovation as a key priority and calls for dedicated science and innovation policies to follow.

7.1.2 Science for Wales

Science has become an increasingly important priority in the recent period with the establishment of the Office of the Chief Scientist and the Chief Scientific Advisor for Wales and the publication of the second science policy (WG, 2012b). There is a strong

economic rationale running throughout the science policy concerning maximising the impact of science and research. Continuing the trend throughout the study period, the economic role of Welsh universities is further emphasised. *Science for Wales* contains learning region elements, aiming to build up knowledge and learning networks and turn Wales into a "learning country". The sector-based approach is further iterated, with four "grand challenge" areas chosen, slightly different to those set out in the *ERP*. This has caused some confusion amongst stakeholders trying to access support because they do not know which sectors to reference:

> *The sectors changed during the programme period in terms of their policy. There have been changes in the way they want us to actually target funding. Which we found frustrating in dealing with as well. It's confusing... Because in these bids you have to reference these things... So it's difficult. (University Technology Transfer Officer D)*

A reason given for the shift from nine sectors to four grand challenge areas is political change: the previous economic minister was Ieuan Wyn-Jones of Plaid Cymru, who pushed the sector-based approach; when the current (Labour) government took charge of the economic department the broader grand challenge areas were introduced. The concept of grand challenges aligns the Welsh Government's approach with smart specialisation, currently gaining currency at the European level. *Science for Wales* aims to improve the knowledge infrastructure in Wales; both the "softer" elements such as human capital and knowledge, and the "harder" aspects such as communications infrastructure and research institutions. The absence of publically sponsored research organisations in Wales is highlighted, and the policy calls for more inward investment in research centres and institutes for the potential economic benefits they can bring. At present, there is only one stand-alone Research Council facility in Wales, in Bangor, and

some embedded within Welsh universities, but these are perceived to be too few. A greater presence of publically sponsored research institutes in Wales could have positive effects on the wider innovation system and firms.

The new science policy has a strong innovation element running throughout, and stakeholders were positive about the policy development of having a dedicated science strategy with links between the two agendas.

> *[Science and innovation] are increasingly interlinked in policy; it has developed enormously. There are more direct links from science to innovation policy... Awareness of commercialisation possibilities amongst scientists is higher than in the past. (Senior Policy Advisor A)*

This insight leads us onto the most recent of the important policies in this period, which is closely linked to the science policy: *Innovation Wales* (WG, 2013b).

7.1.3 Innovation Wales

The role of the European level in driving this policy is visible: *Horizon 2020, Grand Challenge* areas, and smart specialisation are all referenced within this document (EC, 2011; WG, 2013b). The impetus for a new innovation policy was the requirement from the EC that regions prepare smart specialisation strategies in advance of the next round of structural funds, as explained by policymakers:

> *The concept of smart specialisation has emerged in Europe; it's grown out of the triple helix and various other things that have happened in Europe, Innovation Union. And we are due for a fresh round of Structural Funds in 2014. So all those things have sort of come together at one time. We need a smart*

specialisation strategy; we needed a new innovation policy anyway. (Senior Policymaker B)

This is similar to the situation in the early period with the *RTP* and *IAP*, which were also driven by the need to meet the European Commission's requirements. *Innovation Wales* is submitted for peer review to the smart specialisation platform to ensure that it meets the EC's requirements. In line with the approach advocated by smart specialisation, *Innovation Wales* sees a move towards supporting fewer but bigger innovation programmes. There is a perception that past structural funded programmes have been too small scale and dispersed to have a positive impact on the Welsh economy.

The smart specialisation methodology is understood as the prioritisation of certain clusters to develop, and is employed as a rationale behind the selection of four domains where investment will be prioritised (WG, 2013b). The interpretation of the concept by Welsh policymakers is quite closely related to cluster theory and does not account for the full smart specialisation approach, notably missing is the process of entrepreneurial discovery to decide upon the sectors to focus on (Foray et al. 2009, 2011). As a result, there are some issues with the sectors that have been chosen by the Welsh Government to support, discussed in section 7.2.1 below.

The "innovation ecosystem" (WG, 2013b) concept features in *Innovation Wales*, and was discussed by several policymakers interviewed. This policy references the Welsh, UK and EU innovation ecosystems. Interviewees who used the term were asked to further explain what they meant by it, and there were a variety of definitions given:

Innovation ecosystem. Yeah very topical.... We're looking at innovation ecosystems right now. (Senior Policymaker A)

> *And we try to build what I call an ecosystem. So an ecosystem would mean there are universities, small companies, large companies, public sector - ecosystem and a partnership. (University Technology Transfer Officer B)*

> *Ecosystem is a word which is open to criticism as jargon but it is the word used in the UK life sciences strategy and all sorts of other documents. It's, if you like, the new "networks". The idea being that innovation takes partnership between academic, business, clinical and investor communities. (Civil Servant F, Sector Team 2)*

The concept is loosely defined, as the various explanations above illustrate, but it is quite similar to the systems of innovation idea, in particular the multi-level perspective that can be regional, national, or supranational, and the manner in which it incorporates different actors and institutions. Despite this systemic language employed, this strategy is still focussed on the more traditional science and technology aspects of innovation (WG, 2013b).

The sector-based approach, introduced in the *ERP* (WAG, 2010b), is evolved into four key domains, which build directly upon the science policy's "grand challenge" areas. It is not clear what impact the changes to the sectors will have on the wider structure of the governance of innovation and economic policy in Wales regarding the nine existing sector teams. Sector leads and panel members were questioned about the future of the approach, but were unclear as to what this would be as the panels were originally set up to function for three years.

Another departure that *Innovation Wales* makes from past policies is the incorporation of innovation in the public sector and procurement as drivers of innovation in the private sector. This is the first time we have seen procurement addressed in depth at the policy

level, and suggests a co-ordination of supply and demand side approaches that have not characterised the Welsh innovation approach to date. The following section addresses the other policies that have been identified as important to the innovation agenda.

7.1.4 Innovation-Related Policies

The economic, science and innovation policies all prioritise improving the infrastructure in Wales as a key enabler of innovation and economic growth, and the recent period also sees the publication of a dedicated infrastructure investment plan (WG, 2012c). This plan aims to stimulate growth through strategic investments, and to create the right environment for innovation and enterprise in Wales. Rolling out next generation broadband is high on the Welsh Government's agenda, in this plan as well as the economic and innovation policies (WAG, 2010b; WG 2012c; WG 2013b). There is an assumption that improving broadband provision across Wales will have significant positive impacts on innovation and the economy (WAG, 2010c), and this was certainly a view held by several interviewees. Broadband is an important priority and respondents are supportive of the investments being made by the Welsh Government:

> *Their investment, Digital Wales, where they're trying to bring up the broadband speeds. Absolutely great, infrastructure like that where only government can kind of make it happen is critical. (University Technology Transfer Officer A)*

> *With broadband connectivity across Wales I think access to technology is going to be massively important for Welsh businesses and the leadership that presents. (Director of Business Representative Organisation B)*

> *There is a national strategy - Digital Wales, and we've just adopted that on a local level and said "right how can we make this happen quicker and more effective on a local level?"... So what that's showing is we get a lot more benefit*

because things happen sooner, quicker, with relatively little investment. (Local Government B)

Infrastructure is certainly a high priority, and is seen as a barrier to innovation and economic growth in Wales. Attempts to address this are generally welcomed by stakeholders, especially those from the business sphere who are particularly concerned with what they perceive to be the poor state of the transport and communications infrastructure.

The Welsh Government has a history of employing spatial planning in its approach to the economy and the latest iteration of this is a move towards city regions as a model for policy making and planning. The rationale behind this approach is that cities are core economic drivers, and their potential could be harnessed to encourage growth across Wales. The city regions were discussed by several stakeholders interviewed, and there were mixed opinions about the concept, discussed in Section 7.2.3 below as actions are currently underway to implement the city regions.

7.2 Programmes

In recent years there have been a number of programmes and actions implemented taking a cluster-based approach to innovation and economic development, following the overarching sector rationale introduced by the *ERP*. Another recent development is the increasing investment in the knowledge infrastructure with programmes to build networks across Wales; the learning region approach to innovation becomes increasingly important. Whilst there are still a number of triple helix style programmes at this time, they are dominating the innovation supports less than in the previous period, in large part due to the wind down of the *Techniums* and the introduction of a new suite of programmes following the economic and science policies (WAG, 2010b; WG,

2012b). This section examines the main programmes and actions implemented in the recent period, followed by a briefer discussion of the other programmes that are smaller or less directly related to the innovation agenda.

Table 7.2 Recent Period, Key Programmes: Approach, Actions & Stakeholder Reviews

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
Sector Based Approach-First Iteration (2010)	Selects six sectors to focus support, seen as having the most growth potential and where the WG could add the most value.[14] Led to the re-organisation of the WG's business and economy department around sector groups and establishment of advisory panels. It also introduces a sector-based rationale to delivering innovation supports and the sector teams have set up their own dedicated funds for businesses in their sector.	Strong swing in the direction of a sector-based approach represents a move towards cluster policy because of the degree of co-location that will take place. Innovation is central to the sector teams' and panels' activities but their remits go beyond innovation to wider business and economy issues.	Dedicated sector funds set up. E.g. Life Sciences Investment Fund to promote the growth of life science businesses, Digital Development Fund to meet needs of creative industries but only £2m compared to life sciences £100m. Each sector team has dedicated strategies and actions.	Stakeholders are divided over whether the sector-based approach is the right one. Some see it as good, others think that government should not be "picking winners". Some question whether the correct sectors have been chosen whether they are areas where Wales has real advantage or more like a wish-list of fashionable sectors.
Sector Based Approach-Second Iteration (2012)	*Science for Wales* (WG, 2012): four sectors are selected as "Grand Challenge Priority areas", similar but not corresponding directly to the economic sectors. Activities in these Grand Challenge areas are clustered geographically around, for example, the opto-electronics	The sector-based approach taken in the science policy blends the cluster and network approaches because it is concerned with creating or strengthening specific centres of excellence around research and business in certain	Unclear to what extent the sectors in the ERP and the Science Policy are complimentary and co-operative. They have developed independently and are not explicitly linked together, though we see a great degree of overlap between them. Question	Some stakeholders expressed confusion about the different sectors selected in the economic and science policies. Practically, this makes it difficult to apply for funding because they don't know which sectors to reference. Overall,

[14] This was a two staged approach, with the first 6 sector teams set up almost three years ago, and an additional three added a year later. These sector teams are ICT, energy and environment, advanced materials and manufacturing, creative industries, life sciences, and financial and professional services, to which were added construction, tourism and food and farming at a later date.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
	cluster in St Asaph and the large research universities in the South.	sectors, but also creating networks across the whole of Wales in these sectors.	whether they both compete for resources and prevent the other from functioning as effectively.	choosing priority areas to focus on is seen to be a good idea in a context of limited resources.
Sector Based Approach- Third Iteration (2013)	The sector-based approach has recently experienced a further iteration with the publication of *Innovation Wales* (WG, 2013). Four sector groupings are selected, directly corresponding to the Grand Challenge areas, and related to the ERP's sectors but not matching exactly.	Unclear whether the change from 9 "sectors" to 4 "domains" affects the governance of innovation and economic development in Wales, and whether the business and economy department undergoes another re-organisation.	These are referred to as "domains" rather than sectors, and the four are: life sciences and health; low carbon, energy and environment; advanced engineering and materials; and ICT and digital economy. In line with smart specialisation agenda.	Stakeholders are not sure of the future of the sector panels in light of the changes introduced. Most were positive about the existence of the panels and would like to see them continue, but perhaps in a slightly amended format.
Enterprise Zones	Enterprise zones aim to attract businesses within a certain sector to a particular location through incentives and providing appropriate infrastructure: tax breaks, investment subsidies, and fast- track planning regulations, enhanced capital allowances, business rate incentives, and rolling out next generation broadband. Currently there are 7 enterprise zones,[15]	Following the approach advocated in cluster theory of encouraging the geographical co-location of firms and organisations in the same or similar sectors. The zones chosen by the Welsh Government are meant to represent pre-existing advantages or specialisms, in line with the approach advocated by cluster theory.	Business rate scheme provides £20m over 4 years to financial supports for business rates liabilities incurred by SMEs in the seven zones. Cardiff CBD enterprise zone, ties in with the WG and Cardiff Council's plans to regenerate the CBD in order to make it a more attractive location for the financial and professional services sector.	Mixed reviews. Some problems in the implementation mean the programme has not progressed as it should or delivered results. Concerns about areas outside the zones and whether they will lose out.

[15] These are: Cardiff CBD, focusing on the financial sector; Ynys Mon, for the energy sector; the advanced manufacturing centre in Deeside; aerospace in St. Athan; Snowdonia for energy and environment and ICT; Haven waterway also for energy and environment, and the automotive sector in Ebbw Vale.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
	corresponding to the ERP sectors.			
City Regions	Creating city regions in Wales as a means through which to better deliver economic policies. The regions centre around the three cities of the south - Cardiff, Newport, Swansea - and the north east. This policy is still in its early stages, and it remains to be seen what actions will be taken, potential to develop urban clusters.	This approach is further moving the Welsh economic development and innovation agenda in a cluster oriented direction, which sees the geographical concentration of firms and organisations, but it remains to be seen to what extent this will be sector specific.	The first city region was formally launched in July 2013- the Swansea Bay city region, with a board set up, and one of its main objectives is to use the next round of structural funds more strategically and successfully.	Very mixed reviews, some stakeholders strongly for or against the approach. Again, concerns over areas that are not included, especially rural Wales which tends to be poorer and arguably more in need of economic development.
Digital Wales	Provides broadband (of at least 30Mbps) across Wales, improve mobile and wireless coverage and also provide the Welsh population with the skills to utilise digital technologies. The Digital Development Fund is extended until March 2016, aims to help creative industries businesses to exploit new markets through digital technology. Initially launched in 2011 as a pilot, with a £2million budget, but has been extended.	In the learning region literature the importance of the knowledge infrastructure of a region is key as this enables knowledge and learning to be shared and utilised for economic development. There are wider human capital elements of the programme that are developing ICT skills for greater economic participation of the Welsh people.	Objectives: make Wales a more inclusive, sustainable and prosperous society; drive economic growth through creation and commercialisation of digital technologies and help Welsh companies to exploit these developments; make public and government services easier to access, more efficient and convenient.	The WG's efforts to improve broadband communications are widely supported by stakeholders from the different groups because broadband is seen as a major barrier to economic development and innovation. There is disagreement over how well the programme is progressing.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
National Research Networks and Sêr Cymru	Sêr Cymru aims to attract world leading scientists to Wales, in the Grand Challenge subject areas. NRN, again in the priority areas, aim to link up research groups across Wales in order to share knowledge and drive growth in these areas of the economy.	Learning region and network approach to innovation, creating networks. Strong human capital elements echoes of Florida's creative class but applied to scientists and researchers.	The rationale behind this human capital investment is to enhance the research capabilities of Welsh universities so that they achieve more success in accessing research funding and essentially perform better in the selected areas.	Discussed by several government and university respondents but not by business stakeholders. Seen as a positive development to link up the science and innovation agendas.

7.2.1 Sector-Based Approach

A series of actions have been implemented along the sector-based rationale, following the publication of the three main policy documents in this period (WAG, 2010b; WG, 2012b, 2013b). The sector-based approach has evolved in three distinct phases following these policies' publications, with different developments at each stage (see Table 7.2). This trend was widely discussed, and there was disagreement over whether it is the best approach to encourage innovation and economic growth in Wales. For some stakeholders the sector-based approach is appropriate:

> *I think the priority sectors on the whole are a good idea. And to marshal our resources on those areas that are going to pay the greatest dividend. (University Technology Transfer Officer A)*

Whereas others do not see it as the best way to support businesses and economic growth:

> *It's the wrong way of looking at it. Should be looking at fast growing firms... Picking winners along a sectoral basis is always problematic. (University Professor 1)*

Academic respondents were especially keen to comment on the suitability of the approach. A particular point of contention is the choice of the economic sectors to support, whether or not the correct sectors were chosen. The following comments highlight the perceived lack of research into Wales' strengths in the first instance:

> *I don't think there's been enough research on their part to identify the right sectors. Because I'm not sure of the rationale for choosing those sectors. (University Technology Transfer Officer C)*

It is a focussed wish list in industries we'd like to be good at but a lack of background analysis. (University Professor 1)

I think people might be looking entirely the wrong way. And a few well placed questions could say, well, hold on. This is what everybody in the world wants to do, what makes Wales think that it can outcompete places like Silicon Valley? (Local Government D)

I think definitely we mustn't look at all those other places in the world and just be a mini version - that isn't going to work. (University Technology Transfer Officer B)

The comments above highlight stakeholders' concerns over the sectors chosen, and the problems building competitive advantage in areas that are stronger elsewhere. These views echo wider debates within the literature concerning sector-based approaches and whether governments should be trying to pick winners. Cluster theory (see Porter, 1998) suggests that governments cannot create clusters from scratch, but should build upon pre-existing strengths; this could be especially difficult for governments in weaker regions lacking already strong sectors.

A development much discussed by interviewees from the different groups was the creation of the sector panels. The panels were established to advise minsters on the opportunities and needs of the different sectors and to help identify opportunities for growth; they are made up of representatives from the business, university and public sectors. On the whole, the establishment of the sector panels is well supported by interviewees because of perceived improvements in the level of communication between government and other stakeholders that they have introduced.

> *I do think the expert panels are a good move. Generally speaking, to have people advising government who are respected in their area, who generally know what business needs and how business operates to be advising government, that's very good. We just need some demonstration that the advice is being taken. (Wales Director of Business Representative Organisation A)*
>
> *Sector panels are vitally important in making sure that Government is aware of the latest thinking within the business community. (Assembly Member A)*

As these comments explain, the panels provide a framework for integrating expert advice into the policymaking process. However, because the panels have no formal policy role, the economic Minister is not obliged to act upon their recommendations; they do not hold the government to account or scrutinise its work. The panels' remits are quite loosely defined, and it is not clear exactly what impact the panels are having on policy development; stakeholders not involved in the panels knew relatively little about their role and work being carried out. Interviews with panel and sector teams revealed the variety of roles played by the different panels, and members had mixed views on whether their recommendations were actually being acted upon. Some see the panels actively influencing policy development and decisions:

> *The first thing that we did was that we persuaded government to reverse its policy of making R, D & I support repayable. So we persuaded minister to do an about face... And that become non-repayable. (Business Person D, Sector Panel 3)*

Others explain a much "softer" role as panel members, responding to the Welsh Government rather than driving the agenda and decisions.

We provide a sounding board when policy initiatives are developed. (Business Person G, Sector Panel 4)

It's about the officers coming forward with the plans and then discussing them with the panel so the panel can give constructive feedback. (Business Person F, Panel 4)

This selection of comments illustrates the variation in roles and activities on a panel to panel basis. This heterogeneity makes evaluation or judgement on how useful or successful the panels are difficult, but on the whole the approach is popular amongst the stakeholders interviewed. A negative aspect is the fact certain individuals' interests are promoted through their position on the panel as sector experts.

I do quite like the sector panel approach except that there is a real danger that the interests of the panel members will begin to dominate. And the loudest voices will get what they want and everybody else will nod politely and just give up the argument. (Ex-WDA Senior Official A)

[The sector approach] all depends on the individuals that are there. (Wales Director of Business Representative Organisation D)

As a result, it is difficult to summarise whether or not the sector panel approach is successful or not, because of the variability of the panels and the individuals driving them. Generally, panel members were positive about the experience, and wanted the approach to continue either in its existing or in a refreshed form. At the time of research, the future of the sector panels was unclear. Whilst the wider sector-based approach proved to be divisive, the introduction of the sector panels was positively received.

7.2.2 Enterprise Zones

Another recent development in Wales that aims to encourage the geographical co-location of businesses in certain sectors is the creation of enterprise zones in response to the reintroduction of the approach at the UK level. Enterprise zones were first introduced in the UK in the 1980s, with mixed results. Both the UK and Welsh Government stress that the current iteration will not replicate the previous attempts, but will take a bespoke and selective approach in the different locations. The Welsh enterprise zones differ from those in England because they are sector specific; they are not strictly an innovation approach because the primary focus is on business growth and job creation. The zones are part of the wider trend in Wales whereby cluster-based approaches have recently grown in importance and dominate the economic and innovation actions at the current time.

A number of stakeholders discussed the enterprise zones; opinions of the programme were fairly mixed. The business stakeholders had more positive attitudes towards the programme than the academic community. However, these positive statements are often tempered with a criticism of the programme's progress, problems in its implementation, or issues with the design. As with other programmes reviewed, whilst the underlying idea behind the programme is seen to be a good one, problems arose in the implementation meaning it has not yet had much of an impact.

> *The announcement of the enterprise zones, although it's created a certain amount of turmoil for want of a better description, we feel that's a positive statement. But what now needs to happen is those enterprise zones need to be brought to life. (Director of Business Representative Organisation B)*

Several respondents highlighted the slow pace of action and lack of visible results. The programme is criticised for being so slow in getting off the ground.

> *You have the Enterprise Zones now, and what's going to come out of them? Not a lot has happened on those. (Policy Advisor, Business Representative Organisation C)*

Others expressed doubts over whether the enterprise zones would produce the desired effects due to the lack of funding allocated to the programme. On a more fundamental level, concerns were raised over the net benefit enterprise zones will bring, and whether growth in one locality will be at the expense of others.

> *Is it going to be any more than people moving around- what's the value added? Is it not actually going to be a lot of displacement? How are they actually going to change? (University Technology Transfer Officer A)*

The decision by the Welsh Government to make the enterprise zones sector specific was also criticised by some, who prefer the generic approach taken by the UK government.

> *Enterprise zones are very good but I think we need more generic ones. (Business Person J & Director of Business Representative Organisation F)*

On the positive side, business stakeholders involved in the process of developing the programme praised the "hands off" approach taken by the Welsh Government and involvement of the private sector in the development of the different zones' strategies.

> *I think the strategy direction from government was helpfully hands off - "we'd like to do something what do you guys think?" And it was a great place to start because all the private sector people joined the board and said "This is great. We haven't got government telling us it's going to be like this, we can say what*

the hell we want to do." And it was a great place to start. (Business Person D, Sector Panel 3)

It is too early in the life of the programme to make conclusions about its success or otherwise, but there is a reasonable level of support for the approach from the business respondents. The academic stakeholders are less convinced. As for the government actors interviewed, discussion of enterprise zones was surprisingly limited considering it is one of the main economic programmes at the current time. When the approach was discussed it was within the context of the sector strategies, and there seems to be a large degree of overlap between these approaches at the policy level. It will be interesting to see how the approach fares in Wales and England, with the possibility of making comparisons between the two paths followed (sectoral/general) and also with past approaches. The enterprise zones are certainly contributing to the current trend in Wales towards cluster-based and smart specialisation approaches because they aim to build up geographical agglomerations of business activity in specific sectors and locations across Wales.

7.2.3 City Regions

The rationale behind the city region approach is that it can create jobs, boost prosperity, and encourage inward investment through better co-ordinated policy making and implementation (WG, 2012a). Whilst not being an innovation programme in the narrow sense, these are all issues that overlap significantly with the innovation agenda. Also, it was one of the current actions most discussed by interviewees. There is alignment between multiple actions taking place (enterprise zones, sector strategy, Central Business District development, city region) towards creating geographical clusters in particular places. For example, the Cardiff city-region is focussed on financial and

professional services, and the north east Wales area on the opto-electronics and manufacturing sectors.

As the city regions have only recently been launched there are few existing actions to discuss; the first city region launched in Swansea in the summer of 2013. The approach is seen as an important development in the Welsh Government's approach to innovation and the economy, and interviewees were divided over whether the city regions approach is appropriate or not. Some were positive about the approach, especially about the potential it has to bring together the different stakeholders and link up policymakers at the local level:

> *[City Regions] will probably be a good idea because everyone will need to work together really. (University Technology Transfer Officer D)*
>
> *I also believe that the city region approach can assist. (Assembly Member B)*
>
> *City regions generate economic prosperity wherever you are in the world... What we've got to understand is you need to generate that city region concept to create power. (Director of Business Representative Organisation B)*

Others were doubtful about whether the approach has much potential in Wales. Some felt strongly that it is not a realistic idea:

> *The city regions fiasco. It's a non-starter. (University Professor D)*

Doubts were expressed over whether stakeholders from the different parts of Wales will be able to work together successfully due to negative experiences of joint working in the past.

> *It's really very tribal, so I don't think city regions has got a hope in hell personally, not in Wales. (Policy Advisor, University Representation Organisation A)*

A potential problem with the city regions approach is that rural Wales could miss out as a result of the strategic economic planning being focussed on developing urban areas.

> *The city regions proposal offers opportunities but also threats for the areas outside the city. (Assembly Member B)*

As the approach is relatively new it is difficult to provide definitive evaluation and stakeholders could not comment on how successful it has been, only on how appropriate the approach is in theory. When interviews were conducted, the city regions had not yet been launched and the concept was still very much in the policy development stages. The city regions have the potential to further contribute to the clustering agenda because of the focus on the perceived strengths of the different regions and efforts to develop certain sectors.

7.2.4 Digital Wales

There has been a growing trend in recent years towards addressing the hard and soft infrastructure in Wales to help create a better environment for innovation and economic growth. The previous section explained how this is taking place at the policy level, and specific actions have been implemented to attempt to improve the state of the Welsh innovation infrastructure. An example is the *Digital Wales* programme, which aims to roll out next generation broadband across the whole of Wales and to ensure that individuals and businesses have access to it. Broadband infrastructure emerged as a key priority for stakeholders, and is seen as a barrier to business growth especially in rural areas; there is also an implication for social inclusion as more services become digitised.

[We need] great infrastructure - great broadband, not just speed: reliability and robustness. (Civil Servant K, Sector Team 5)

We need much more investment from the Welsh Government in partnership with the private sector to improve our infrastructure. That includes the infrastructure that involves broadband etc. (University Professor B)

Trying to get all businesses to have next generation broadband rolled out to take advantage of technology, but to also we need to really focus on that digital cluster. (Director of Intermediary Organisation)

The broadband and communication infrastructure development is brought together under the *Digital Wales* programme. The Welsh Government views the programme's progress positively: a review of *Digital Wales* (WG, 2013a) finds that digital exclusion in Wales has fallen to its lowest level, but this is still at 27%. Government respondents were overwhelmingly positive about the progress being made in delivering *Digital Wales*:

You can see a continued investment going into transport systems. And if broadband is the transport infrastructure of tomorrow then that's being sorted out too. (Senior Policymaker D)

[The Welsh Government is] doing a brilliant job with the IT infrastructure. (Ex-WDA Senior Official B)

Other stakeholders were less positive about the programme's progress:

They are heavily behind with broadband connectivity across Wales and I think access to technology is going to be massively important for Welsh businesses and the leadership that presents. (Director of Business Representative Organisation B)

Respondents from across the different stakeholder groups were supportive of the Welsh Government's efforts to improve broadband, as the comments below illustrate:

> *We're particularly pleased and supportive of the commitment to broadband (Director of Business Representative Organisation B)*

> *Absolutely great, infrastructure like that where only government can kind of make it happen is critical. (University Technology Transfer Officer A)*

The focus of the programme is undergoing a shift from mostly being infrastructural towards the "softer" elements of training and widening access to digital technologies. Innovation and economic development are at the core of the programme; if businesses across Wales have better access to the internet and digital technologies, the rationale is that they will become more competitive, able to communicate and collaborate, and to keep up-to-date with developments worldwide in their business area. Communications and wider infrastructure is undoubtedly an important element that needs to be in place to allow for economic growth to take place, but may not automatically stimulate greater innovation activity as is hoped.

7.2.5 National Research Networks and Sêr Cymru

The recent science strategy (WG, 2012b) introduces two new programmes to attract more researchers to Wales and build up knowledge networks in the grand challenge areas: *Sêr Cymru* and *National Research Networks*. The premise behind the *Sêr Cymru* scheme, to which £50 million has been allocated, is that attracting excellent researchers in the priority areas will create momentum and an academic atmosphere that will attract more knowledge workers.

> *Sêr Cymru aims to bring in superstars and bright young things. We want to get a community of scientists and engineers, networks. (Civil Servant H, Sector Team 3)*

There was relatively little discussion with interviewees of the science policy and these two main programmes, considering they are so recent and overlap to a great extent with the innovation and economic agenda. Respondents who did highlight the science policy were university stakeholders and policymakers involved in the strategy but not the business stakeholders; the programmes focus on universities as research and innovation drivers. University respondents highlighted the science policy and the programmes it introduces as a good development and see interventions of this sort as an important part of the wider innovation approach.

> *[Science for Wales] is great, it's a good development. I also think these investments like Sêr Cymru are important and it's the kind of level of things we need to do. (University Technology Transfer Officer A)*

> *There's the idea of Sêr Cymru and the networks that go around that... There's an absolutely explicit recognition that that pushes out into innovation and that will be linked to the innovation strategy when that's written. (University Technology Transfer Officer D)*

Policymakers see innovation and science becoming increasingly interlinked both at the policy and programme level. The rationale behind these programmes is that the Welsh economy will benefit from the wider economic impacts that attracting more highly educated, skilled and thus paid people would have. One respondent described these programmes as taking a "Floridian" approach, thus aligning them with ideas surrounding the learning region and creative class (Florida, 2006).

> *The [Sêr Cymru] vision is to create leading centres of research, recognised internationally. It is hoped that this in turn will lead to new spinout businesses and also attract major international businesses to relocate to Wales to be where the action is. (Civil Servant G, Sector Team 2)*

Again, it is difficult to provide any evaluation of the success or failure of this programme because it has only recently been implemented. Although policymakers were overwhelmingly positive about the programme and see it is a major element of the current approach to innovation, it is confined to developing and strengthening the university sphere rather than private sector research and innovation. This insight is supported by the fact that business stakeholders did not discuss the *Sêr Cymru* and *NRN* programmes, or the science policy, at all. They can be seen as continuing the trend seen throughout the study period of delivering innovation supports that are predominantly focussed on driving innovation through the university sector.

7.2.6 Other Innovation-Related Programmes

As with the previous periods, there were some smaller programmes and actions implemented over the last few years that were highlighted, but were less frequently discussed than those presented above, smaller in scale, or less central to the innovation agenda. These are briefly reviewed and analysed here.

Table 7.3 Recent Period, Other Programmes: Approaches, Actions & Stakeholder Reviews

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
High Performance Computing Wales	Aims to create a pan-Wales network of computer clusters providing state of the art computing capability, technology, infrastructure, and facilities. Launched in 2010, at a cost of £40m made up of £5m from the Welsh Government/HEFCW, £19m through EU structural funding, £10m from BIS, and other investments from individual institutions and private sources.	Learning region: providing knowledge infrastructure so that research, innovation and skills development can take place for wider economic benefit. Cluster and hub model to build up critical mass in companies and researchers using high-tech computing. Elements of triple helix because it aims to speed up innovations from university research into commercial products.	The main computing hubs are in Swansea and Cardiff, with links to the other Welsh universities and also the Technium network. HPC was expected to create 400 new jobs in the private sector, and assist 100 innovation collaborations between universities and industry in Wales; it is too soon to know whether these targets will be met as it is a five year project.	Highlighted by government and university but not business stakeholders. As with other programmes, the underlying idea is seen as a good one, but the implementation has been less good. Also some raised questions about whether there is enough demand amongst Welsh businesses to use the service.
ASTUTE	ERDF funded: aims to grow the manufacturing economy in Convergence Wales through enabling the adoption of more advanced technologies and improving the sustainability agenda. Targets the automotive and aerospace sectors, to create higher value and sustainable goods and services and bring them to	ASTUTE fits into the triple helix category because it provides funding and support for universities and businesses to work together to encourage growth in high-tech manufacturing sectors. Brings together most of the universities in Wales with high-tech manufacturing companies.	There is a degree of overlap between the ASTUTE programme and some other programmes highlighted here; for example, the ASTUTE office is actually based in the Digital Technium in Swansea, and works with the industry fora.	Limited discussion by business stakeholders, due to sector specific nature. Of this limited discussion it received generally positive reviews, which is unusual for a triple helix style programme, which generally have proved unpopular with business respondents.

Programme/Action	*Description*	*Approach to Innovation*	*Actions*	*Stakeholder Reviews*
	a global market.			
Re-Act 2	Launched in April 2011 replacing the existing Re-Act programme. Focuses on training and up skilling individuals towards supporting companies to create jobs and take on people who had been made redundant by reducing the amount available to individuals by £1000 and increasing the amount available to companies by the same amount.	Learning region: see section above on Re-Act 1.	Re-Act 2combined the two approaches from Re-Act (providing support for individuals to undertake training) and Pro-Act (providing financial support to companies to re-train rather than lay off staff), focussing more resources on the companies rather than individuals.	Re-Act proved to be surprisingly popular amongst stakeholders from the different groups and was highlighted by several respondents as an example of a good intervention by the Welsh Government.

As well as *Digital Wales*, the Welsh Government has launched *High Performance Computing Wales* (*HPC*) to improve the high-tech and knowledge infrastructure. The programme has been formally reviewed (High Performance Computing UK Special Interest Group, 2010), and was discussed by interviewees from the university sphere. *HPC* was not highlighted by business stakeholders, and as is the case with the other programmes discussed above may be having more impact on and is geared towards the university sector.

A positive aspect of *HPC* is its structure, employing a hub and spoke model based around Cardiff and Swansea as the hubs and the other Welsh institutions as the spokes; this provides access to companies and researchers across Wales. Another positive element is the user focus of the programme; whilst it is based within Welsh universities the emphasis is on user-focussed research outputs with significant economic impact. The programme is seen as having the potential to create stronger links between the academic and industry partners, however it is not clear at this stage how successful it has actually been in creating those links. From the university perspective, the programme is helping to encourage collaboration between universities and businesses:

> *We have HPC Wales... All these things are aimed at helping individuals and small businesses in Wales to get access to innovative ideas that universities are generating, and to work on things together. It's a way of de-risking the cost of collaborating with the University for a small business. (University Technology Transfer Officer D)*

However, the lack of discussion of the programme on the part of business stakeholders leads us to question to what extent this is the case. Issues with the programme's implementation may be preventing it from having the desired wider impacts on Welsh

businesses, and if these issues can be resolved perhaps the programme will achieve greater success in the future.

> *I've been involved in HPC Wales which, although it has great potential, had a really difficult birthing phase... Little bureaucratic issues that really hold the programme back from what it wants to do, be it state aid or timesheets. (University Technology Transfer Officer A)*

There is a danger that high tech infrastructural investments such as *HPC Wales*, as with the *Techniums*, are not utilised to their full potential; it is a wasted resource if local firms and organisations are not utilising the facilities on offer.

> *Cathedrals in the desert is the term that tends to be used for them... Terrific tech centres with very little going on inside them or around them. (Ex-WDA Senior Official A)*

The key question is whether there will be enough businesses in Wales with the needs, capabilities and capacity to exploit this resource, especially SMEs. Examining the case studies provided by the programme, many of the projects are actually university based.[16] Again we see an example of an innovation programme focussing on innovation originating from R&D in the university sphere with the aim of encouraging collaboration between universities and businesses along the lines of the triple helix model. To what extent this multi-stakeholder collaboration is actually taking place is unclear, and it seems that the main beneficiaries of the project are the universities.

There is a strong precedent in Wales of programmes taking a triple helix approach to innovation; these are less prominent in the recent period than in the previous period, but still have an important presence amongst the mix of programmes. A recent example of

[16] Case studies provided on the website http://www.hpcwales.co.uk

such a programme is *Advanced Sustainable Manufacturing Technologies* (*ASTUTE),* which brings together Welsh universities and high-technology manufacturing companies. A positive aspect of the scheme is that it is open to a wide range of Welsh businesses, not being restricted to SMEs, as is the case with some other supports available. The programme was discussed by respondents from the business sphere, and so is analysed here, but because it is focussed specifically on the automotive and aerospace manufacturing sectors it has quite a narrow sphere of impact. Reviews of the programme were positive, and it is interesting to find a programme that aims to encourage university-industry collaboration receiving positive reviews from the business stakeholders.

> *The ASTUTE programme I think goes some way to answer how to small companies collaborate with a number of universities. I think that is a very interesting programme. (Business Person D, Sector Panel 3)*

The other programme that emerged as important during the recent period is *Re-Act 2*, a renewal of the original *Re-Act* programme, which compared to the previous iteration, shifts the focus away from individuals towards the businesses. *Re-Act 2* was not discussed by respondents separately from the original programme, but is important to highlight here because it was deemed successful by the Welsh Government and renewed to 2015.

7.3 Conclusion

To summarise the findings of this chapter: there has been a return to innovation policy and a greater focus on the economy relative to the middle period where there was a shift towards other priorities such as sustainability and education. There are three policies published during this period that address innovation as a central issue – the economic,

science, and innovation strategies – and a number of programmes are being implemented with innovation at their core. The requirement by the European Commission for its member states and regions to produce smart specialisation strategies (known as RIS3) (EC, 2011; Foray et al 2009, 2011) has pushed innovation back to the top of the Welsh Government's agenda and spurred action at the policy level.

A number of actions have been recently undertaken that relate to innovation and economic development, which were frequently discussed by interviewees. There has been a large amount of activity in the innovation and economic development area in recent years. In particular the recent introduction of a sector-based approach to economic development, enterprise zones, and city regions emerged as important recent developments. A swing towards a cluster-based approach is visible, with several key programmes implemented that encourage the geographical agglomeration of particular sectors. The triple helix and learning region approaches both have a presence in the policy mix during this period, but the systems approach has fallen off the agenda with no programmes or actions implemented in this vein.

Because the programmes implemented in this period are recent and have yet to run their course, it is difficult to make conclusions about their success or usefulness at this stage. It remains to be seen what programmes are implemented following *Innovation Wales* and the next round of structural funds from 2014-2020, and whether the increasing rhetoric of systems of innovation and "innovation ecosystems" present at the policy level is translated into actions and programmes.

8 Synthesising the Evolution of Regional Innovation Policy

8.1 Introduction

In previous chapters, the conceptual framework combining the four interactive innovation theories has been employed in the analysis of Welsh innovation policies and programmes. In this chapter the analysis from the previous three chapters is brought together and a model is proposed for mapping out innovation interventions according to the theoretical approach to innovation that they take. This enables a comparative analysis of the Welsh case study, drawing on each of the four key innovation theories. A programme map is presented, which is then divided into the three time periods defined to examine the theoretical evolution of Welsh innovation interventions. The final stage of analysis is to add the stakeholder evaluations of the programmes to explore which types of approaches can be considered more or less successful in Wales.

As explained in the literature review, there is a precedent for utilising theory in the empirical analysis of innovation policy, and frameworks have been proposed by other academics that either apply one theory exclusively or combine different theoretical elements (e.g: Elder and Georghiou, 2007; Flanagan et al. 2011; Gil et al. 2003; Nauwelaers and Wintjes, 2003; McCann and Ortega-Argilés, 2013). A framework is developed that combines four of the most prominent theories for studying and implementing innovation policy: systems of innovation, clusters, the learning region, and the triple helix. Rather than choose one of these theories and apply it normatively, a multi-theoretical framework is proposed, which utilises the four theories in a comparative manner and explores their applicability and usefulness when studying innovation policy in a weaker region. This proposition requires testing, and this chapter explores how, and indeed whether, the application of the multi-theoretical framework

can elicit new and interesting insights about the case study. Table 8.1 provides a reminder of the four theories that comprise the framework, and the programmes that have been analysed in the previous chapters.

Table 8.1 Key Theoretical Approaches to Studying Innovation Policy from the Literature Review

Theoretical Approach	*Key Characteristics*	*Examples (Literature)*	*Examples (Wales)*
Systems of Innovation	Innovation as evolutionary and interactive; wide range of actors and institutions involved; two main geographical approaches are regional and national.	RTP, EU, OECD, VINNOVA, World Bank, UNCTAD, UNIDO (Cooke, 2003; Edquist, 2005; Lundvall, 2007; Morgan, 1997).	RTP, IAP, EAP.
Clusters	Geographical agglomeration of firms in certain sectors; clusters as key drivers of national or regional competitiveness; influential policy blueprint.	Silicon Valley, Italy, Cambridge, Turku. (Huggins and Izushi, 2007; Saxenian, 1994; Piore and Sabel, 1984; Asheim et al., 2006; Castells and Hall, 1994).	Accelerate, Sector Fora, Sector Based Approach, Enterprise Zones, City Regions.
Learning Region	Emphasises knowledge and learning processes and networks as the driver of innovation at regional scale; has proved especially popular in European contexts.	Wallonia, Dutch Limburg, RIS, EU (Nauwealers and Wintjes, 2003; Bellini and Landabaso, 2007; Asheim, 2012).	NRNs and Sêr Cymru, Digital Wales, HPC Wales.
Triple Helix	Less geographically delimited; focuses overwhelmingly on the three spheres of university, industry, and government and their interactions to drive growth.	Pittsburgh's High Tech Council, Recife Brazil Science Park Board, the Knowledge Circle of Amsterdam, and New England Council (Etzkowitz and Ranga 2010).	KTP, Spin Out Wales, CETICs, Technium, A4B, Cardiff Innovation Network, KESS, Know How Wales, Expertise Wales Portal, ASTUTE.

8.2 Creating a Policy Map

Rather than re-examining each specific programme or action (see Chapters 5, 6, and 7), this chapter looks at the overall trends that we can derive from this analysis as to how the Welsh approach to innovation can be understood theoretically, and how it has

evolved in the fifteen years since devolution. A policy map is created, which provides an interesting visual representation of innovation programmes according to the theoretical approach they take.

Figure 8.1 maps out the interventions and programmes that emerged as important across the study period. It draws on the analysis in the previous three chapters to allocate each programme to a theoretical category, and displays this categorisation visually. If a fuller analysis of the programmes discussed is required the reader is directed to the summary tables in the previous three chapters. The methodological process by which this was undertaken is explained in 4.4.1.3. Figure 8.1 presents the map of Welsh innovation supports over the whole study period; in the following sections this will be de-constructed into the three time periods.

The different theories are presented as separate but overlapping ellipses to represent their distinct yet interwoven nature. Whilst each provides a unique understanding of innovation and how best to encourage it, they are underpinned by the common principles of innovation as an evolutionary and interactive process. The boundaries between the different theories are represented as dotted lines, illustrating their porous and changeable nature. This allows for the fact that programmes could move between categories as they change and evolve; the theoretical model is flexible and evolutionary to reflect the nature of the innovation process itself.

The boundaries between innovation policy and other policy spheres are likewise porous and fuzzy; other policy spheres influence the innovation agenda to a large degree and should not be excluded from the model. In the centre is the overall goal to create a knowledge-based economy, to which all theories aspire, and which has emerged as the key stated rationale behind the Welsh Government's approach to innovation and

economic development in the policy over the study period. As the previous chapters have explained, some programmes or interventions can be considered more important or significant to the innovation agenda than others and the diagram accounts for this by representing these in bolder font. This illustrates the relative importance or significance of the different approaches as well as the number of different programmes implemented within each category.

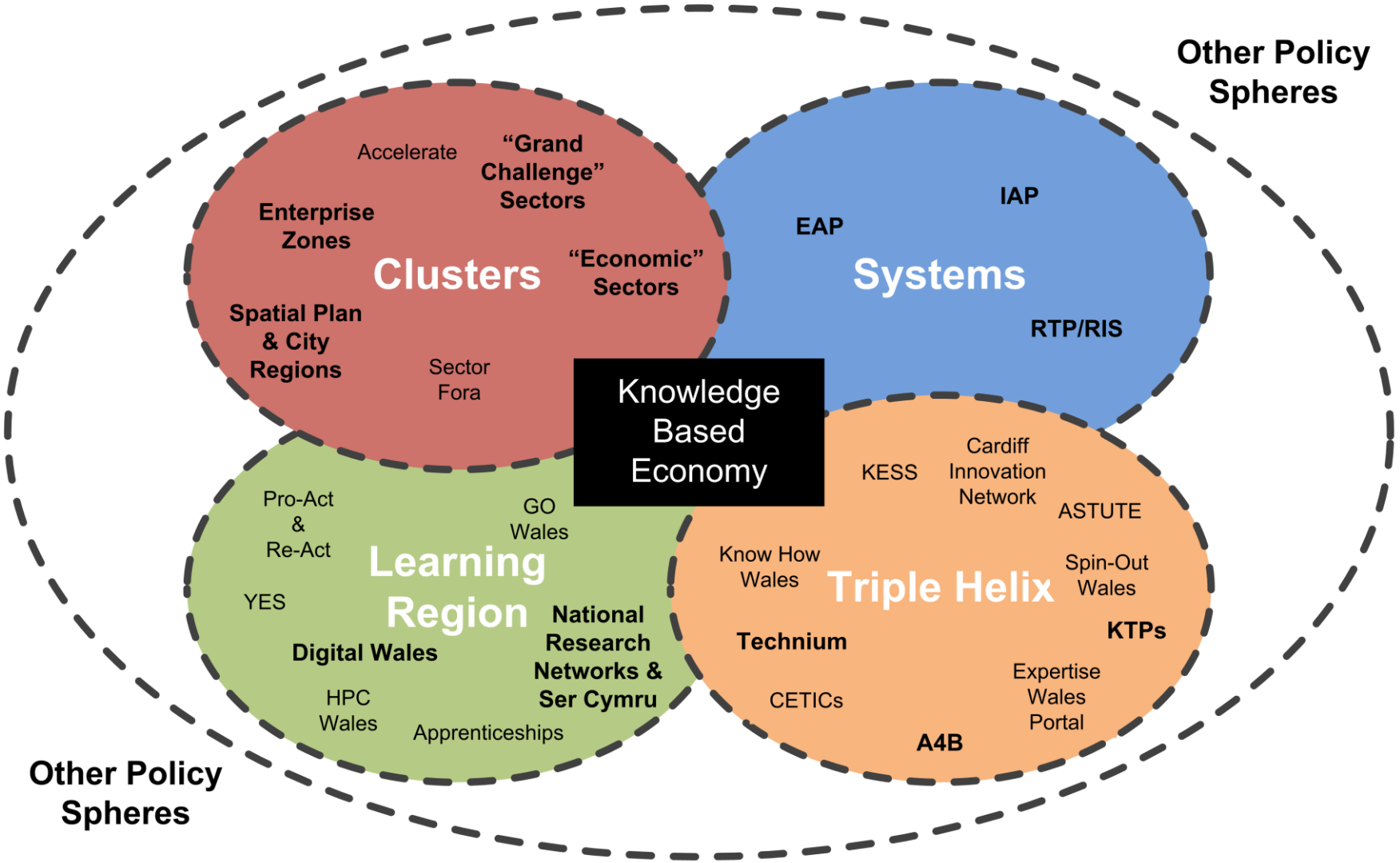

Figure 8.1 Map of Interventions (1999-2014)

Figure 8.1 illustrates which approaches have been most commonly implemented, and also where the most significant interventions lie. It allows us to gain a theoretical understanding of Welsh innovation interventions, and presents a number of interesting headline findings:

- Systems: this is the least popular approach in terms of the number of interventions implemented; we see only three actions implemented in this category. However, these are all important and large scale interventions that are central to the innovation agenda.
- Clusters: the cluster-based approaches are both numerous and significant, with four major interventions following this approach.
- Learning region: there are seven programmes following this approach, but they are for the most part less significant or smaller interventions. Many of these relate to education and training, and this is certainly an important issue when considering innovation and economic development in Wales.
- Triple helix: interventions following the triple helix approach are the most numerous in terms of numbers implemented; there are three significant programmes and several smaller programmes.

The policy map reveals the triple helix and cluster approaches as the most prominent over the whole study period, and the systems and learning region approaches are less so. A possible reason for this is the relative accessibility and policy-friendliness of the different theories. The systems and learning region approaches are more complex and "fuzzy" (Markusen, 2003), and less prescriptive about the actions policymakers should take. They do not provide a checklist to be followed and are less well packaged and presented in comparison to the cluster and triple helix theories (see: Etzkowitz & Leydesdorff, 1997; Porter, 1998).

What the policy map does not show is how innovation policy in Wales has evolved over time, and this is an important limitation. This study, and the theoretical framework it employs, understands innovation as evolutionary and dependent on its geographical and historical contexts. In light of this, a chronological element has been added to the policy map, which takes the structure of the previous three chapters and examines how the approach has evolved from a theoretical perspective. The following section addresses each time period in turn, splitting the policy map in order to draw out the evolutionary trends and also simplify the diagram somewhat.

8.3 Chronological Evolution

8.3.1 The Early Period (1999-2003)

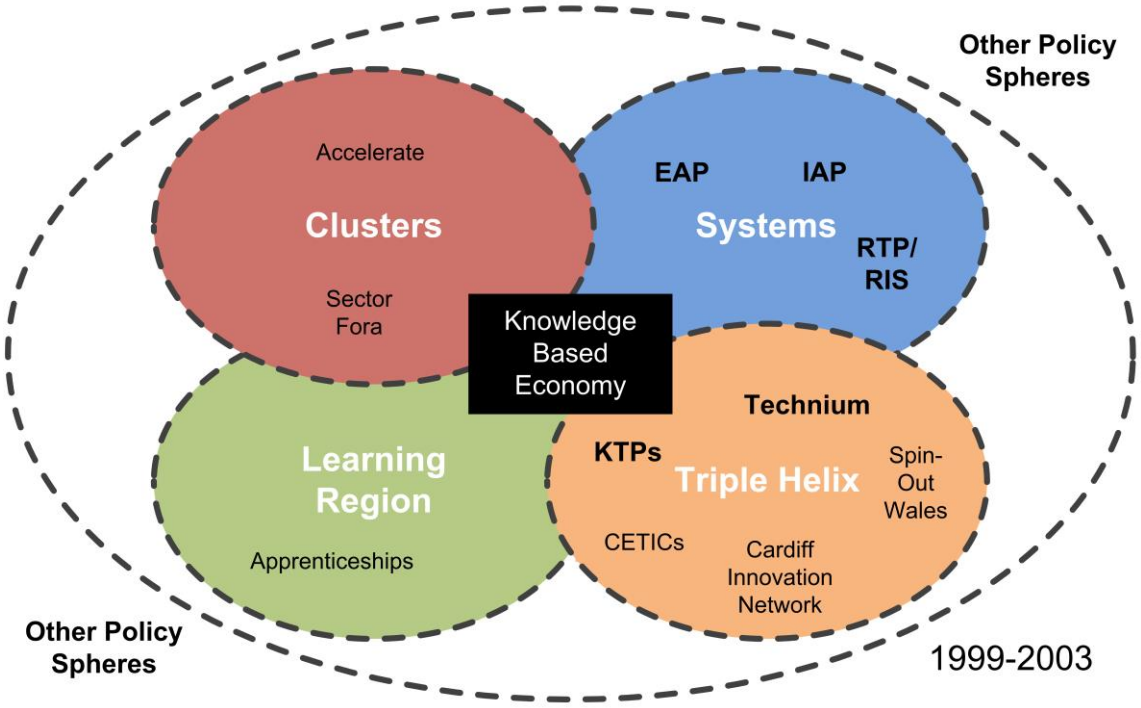

Figure 8.2 Map of Interventions in the Early Period

Figure 8.2 shows the actions implemented only during the early period, mapped onto the theoretical framework. The prominent approaches to innovation in Wales during this early period followed the SI and triple helix approaches to innovation (Lundvall, 1988; Etzkowitz

& Leydesdorff, 1997). The three programmes that were most prominent in the early period were the *RTP-EAP-IAP* suite, which all took a similarly systemic approach to innovation. These were all major interventions, dominating the Welsh innovation approach at this time. The previous chapter has explained how at the policy level the systemic approach was prominent, and because these policies also had implementation plans this is where the majority of actions were indeed concentrated. There is a strong connection during this early period between the theoretical approach to innovation present in the policy and the actions that were actually implemented.

Triple helix based approaches were also important at this time, with the introduction of the *Technium* programme, which became the largest innovation programme in Wales. The *KTP* programme was already operating in Wales and is not a Welsh Government intervention, but has a sustained important presence over the study period. There were also three smaller programmes in the triple helix domain - *Spin Out Wales*, *CETICs*, and *Cardiff Innovation Network* - which have varying importance and success amongst the innovation supports implemented. In short, the triple helix approach has the most actions in terms of number, but the SI approaches dominate due to their scale and importance. There were fewer learning region and cluster-based approaches; we can see these as gaps in the Welsh Government's approach in the early years.

These insights can be represented visually to show the relative concentration of the different approaches during the early period (Figure 8.3):

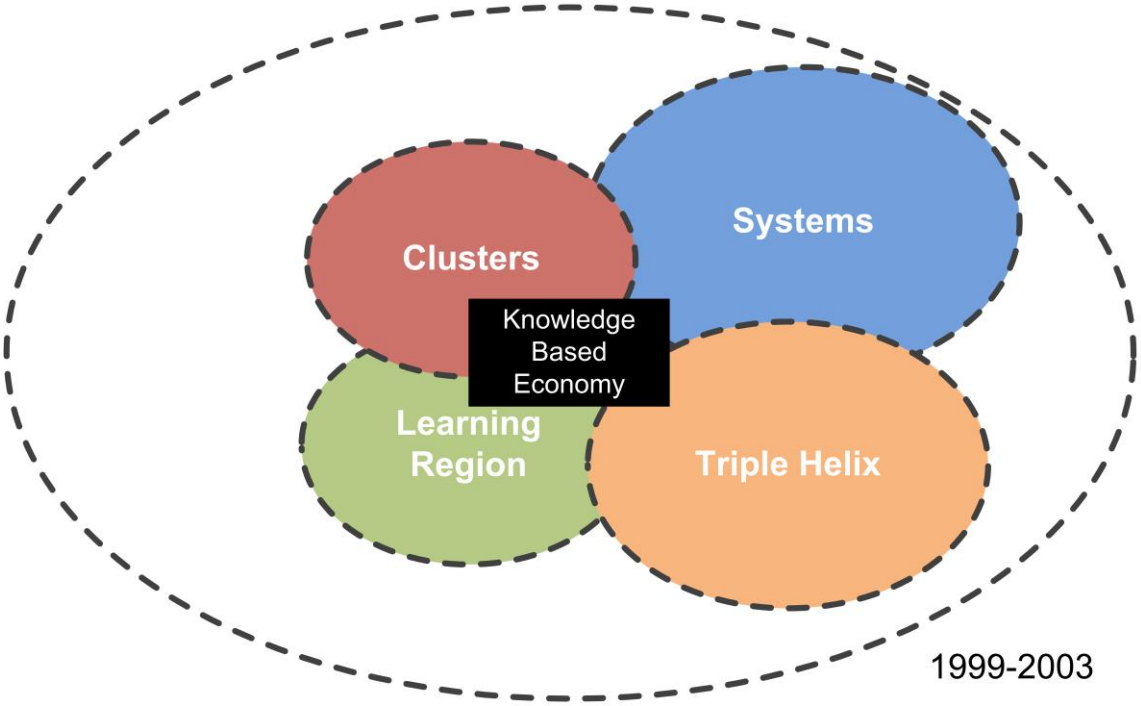

Figure 8.3 Visual representation of WG's approach in the Early Period

This diagram does not express a quantifiable or measured value; it provides a visual representation of which theoretical approaches are more or less important during the early years. It shows the dominance of the systems approach, the importance of the triple helix, and the relative absence of clusters and learning region based approaches. The European level is found to be important in the early years, steering the Welsh approach to innovation in the direction of the RIS approach in line with Morgan's (1997) analysis. As section 8.3.3 explains, the recent period again sees the Welsh innovation approach influenced by policy developments at the European level, continuing this trend.

8.3.2 The Middle Period (2003-2009)

Figure 8.4 repeats the mapping process for the middle date range. The key trend we can see during this period is the shift away from a systems logic, with a wider range of programmes introduced. The *RTP* and *EAP* phase out, significantly reducing the dominance of the systems approach. The triple helix approach becomes prominent with the large scale expansion of the *Technium* programme to 10 centres across Wales and the amalgamation of the smaller

approaches relating to third mission activities into *A4B*. Indeed, three of the main programmes during this period fall under the triple helix category (*KTP, Technium,* and *A4B*), echoing the analysis provided in previous chapters which explains how the innovation agenda became increasingly driven through education policy and programmes. The programmes rely on universities as the main innovation drivers, a trend that has been noted in approaches to innovation worldwide in recent years (Etzkowitz, 2008; Leydesdorff and Sun, 2009; Li et al., 2013); the Welsh Government is certainly not alone in attempting to drive innovation through universities.

The learning region approach also becomes more important as skills and training programmes are introduced, again reflecting the wider policy trend towards education during this period. There is an increase in investment in the knowledge infrastructure, following the rationale advocated by the learning region theory (Rutten & Boekema, 2007). The approach to innovation widens, with more numerous but smaller programmes being implemented, lacking the frameworks provided by the *RTP, IAP* and *EAP* to tie them together under a common logic.

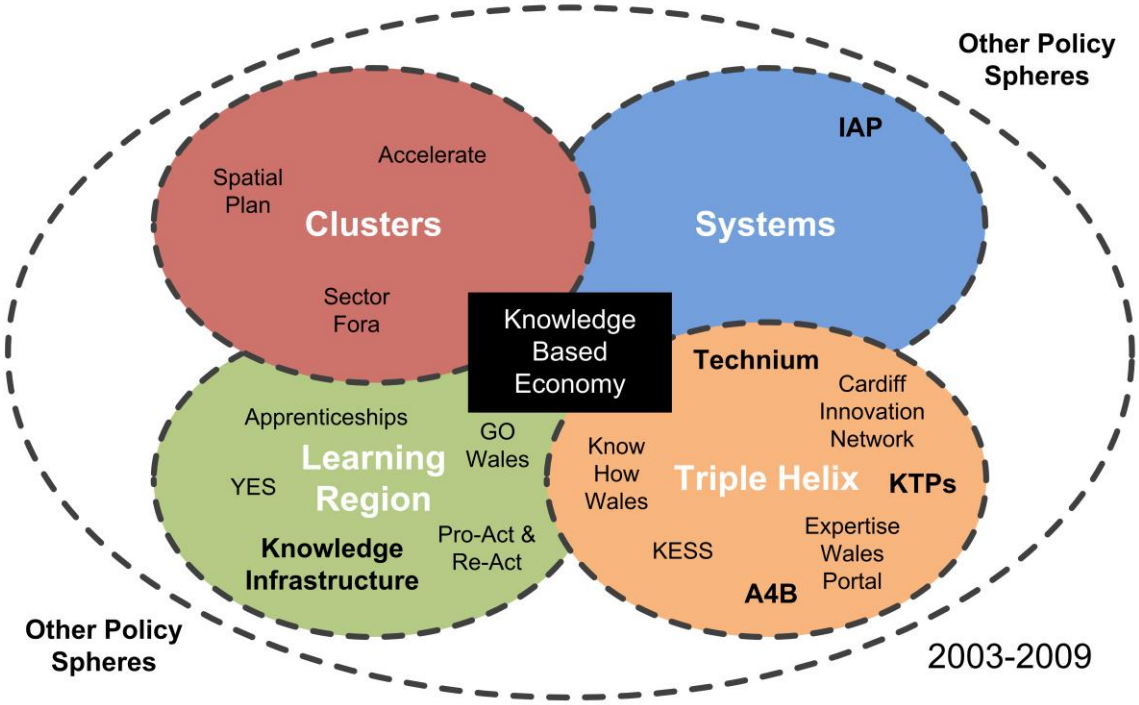

Figure 8.4 Map of Interventions in the Middle Period

Compared to the early period there are a greater number of programmes and actions dispersed across the four theoretical approaches. There are more programmes overall, and most of them are smaller in scale or considered less central to the innovation agenda. The dispersal of innovation interventions follows the policy analysis presented previously, which shows the innovation agenda being driven through a number of different policy spheres, lacking an overarching innovation policy. In particular, the centrality of education policy is recognised during the middle period, which in practical terms manifests itself through an increase in the size and number of triple helix interventions.

Again, a visual representation is provided (Figure 8.5) to illustrate the key trends. It highlights the prominence of the triple helix approach during this section, where the largest and most relevant programmes are located. It also shows the sharp decline in the systems approach with the ending without replacement of the core programmes during the early period which explicitly followed an RIS framework (Cooke, 1992). Both the clusters and learning region approaches to innovation policy become more important at this time and the

overall picture is one of a more dispersed and varied approach to innovation compared to the previous period.

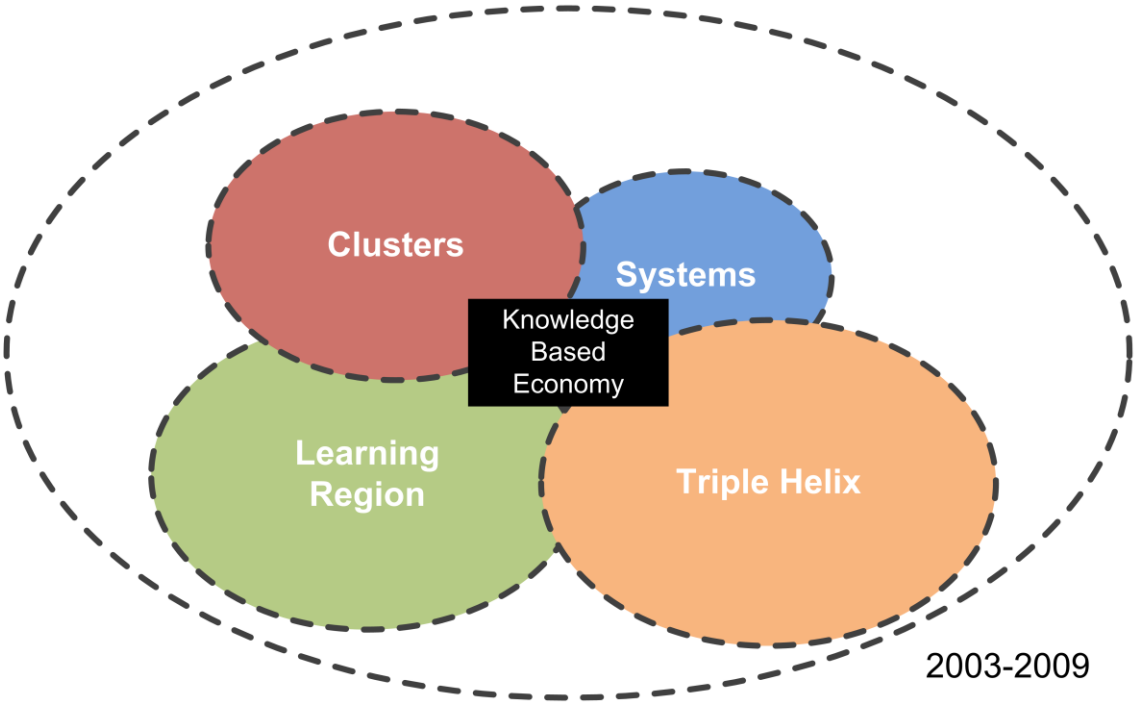

Figure 8.5 Visual representation of WG's approach in the Middle Period

8.3.3 The Recent Period (2009-2014)

When the programmes are mapped theoretically for the most recent period (Figure 8.6) we can see another shift in the Welsh Government's approach. The systems approach has completely disappeared in terms of the actions being implemented; none of the significant innovation programmes are working towards enhancing the system and culture of innovation in Wales at the present time. As the policy analysis in the previous chapter explained, there is a growing use of the systems language and ideas in the most recent innovation policy (WG, 2013b), but it remains to be seen what programmes and actions actually arise from this and whether rhetoric becomes reality. A gap is found in the Welsh Government's approach because it is lacking programmes or actions to strengthen the system of innovation and help

create a culture of innovation in Wales. Culture is perceived to be a significant issue in Wales in terms of barriers to innovation, and perhaps taking a more systems-based approach could help address this (Lundvall, 1992; Edquist, 2005).

With the demise of the *Technium* programme the triple helix approach becomes less dominant compared to the previous period where the majority of the major interventions were in this domain; *A4B* and *KTPs* continue to comprise an important part of the innovation infrastructure. There is a swing towards cluster-based approaches, which are both numerous and central to the innovation agenda during this period. The previous chapter has explained how this is the case at the policy level, with the discourse and language of clusters and smart specialisation featuring heavily in the policy documents; this is reflected in the interventions implemented. Actions following the learning region approach also become more important with the introduction of *National Research Networks* and *Sêr Cymru* as important programmes in the domain of science and innovation, and also some smaller programmes such as *Pro-Act/Re-Act* and *HPC Wales*.

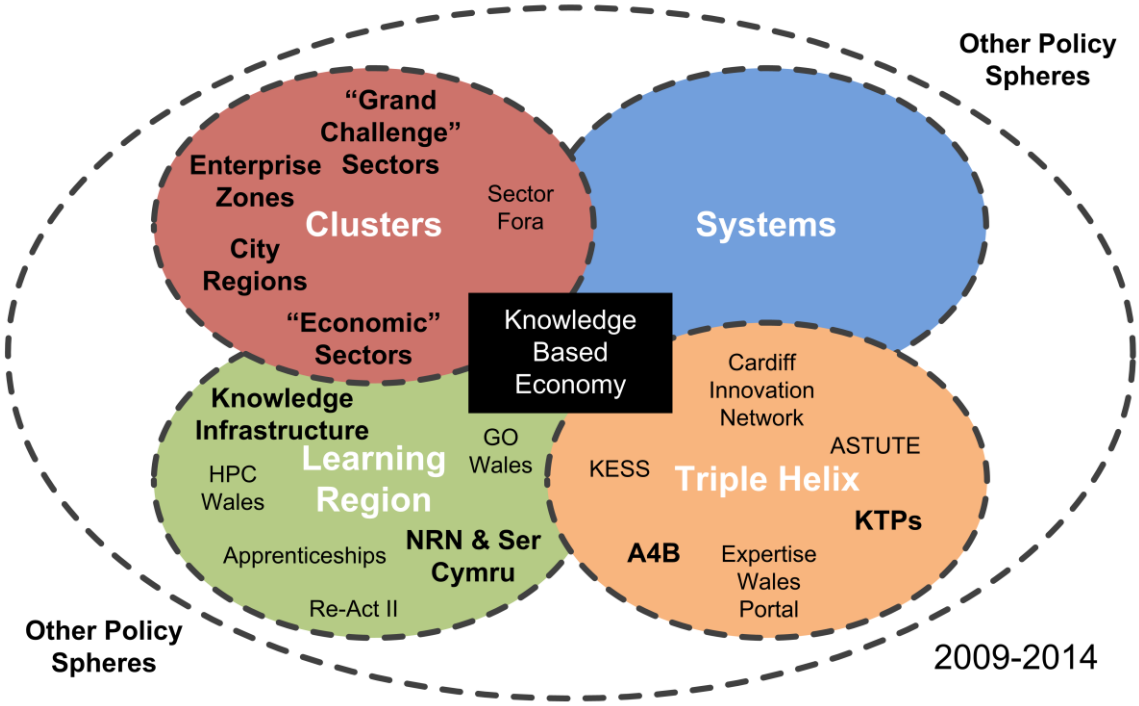

Figure 8.6 Map of Interventions in the Recent Period

Figure 8.7 below illustrates the dominance of the cluster based approach as innovation support is becoming increasingly focussed on developing certain economic sectors. The demise of the systems interventions reduces the variety of the Welsh Government's approach overall compared to the previous period. The triple helix remains important during this period with several of the programmes continued from the middle section and universities still conceptualised as important innovation drivers. However, the decline of the *Technium* programme, which is the largest intervention featured, reduces the overall influence of the triple helix approach. There is a match between policy and programmes in this period: as the innovation agenda is driven by economic and innovation policy rather than education policy, the actions implemented move away from tripe helix to more cluster-based approaches.

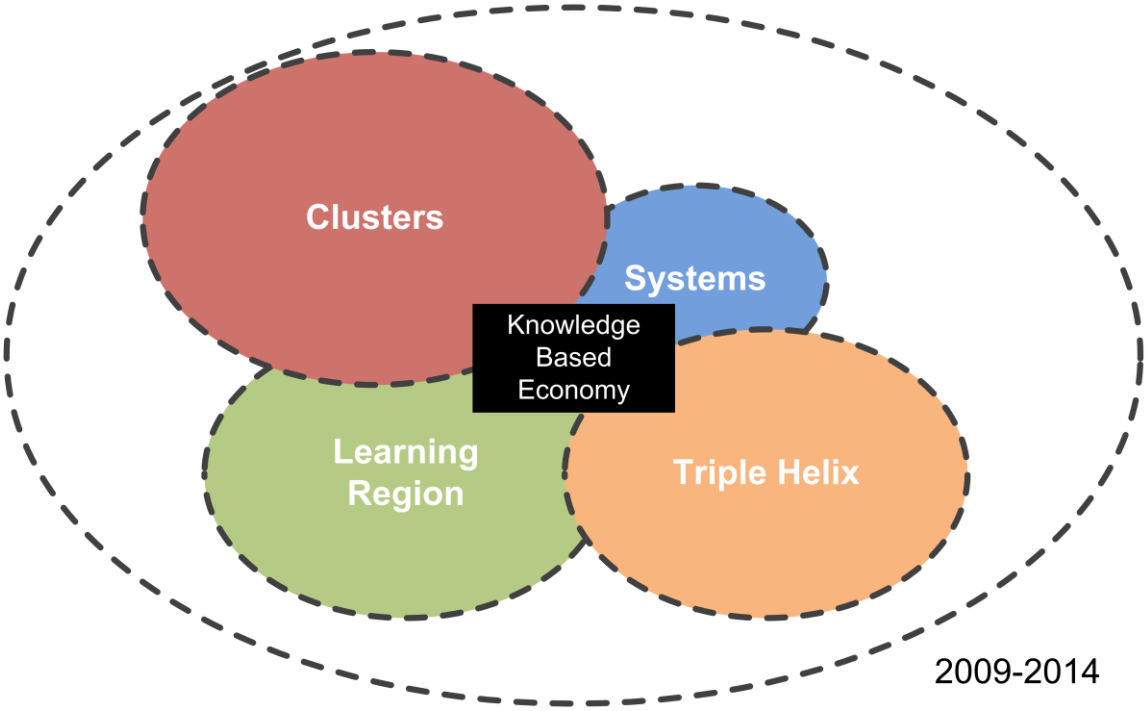

Figure 8.7 Visual representation of WG's approach in the Recent Period

To summarise the chronological trends in the Welsh Government's approach, the early period was characterised by the dominance of the systems of innovation approach, specifically the RIS variant as driven by European policy trends (Cooke, 1992; Morgan, 1997). During the middle period the innovation agenda became increasingly driven by education policy in the absence of innovation and economic strategies, and as a result the important interventions implemented during this time take a triple helix approach premised on universities as the main innovation drivers (Gibbons et al., 1994; Etzkowitz & Leydesdorff, 1997; Jones-Evans and Bristow, 2010; Thomas and Henderson, 2011). The most recent period sees a shift towards a cluster approach (Porter, 1990), with a sector-based rationale dominating the approach to economic development in line with the smart specialisation agenda being pushed down from Europe (Foray et al., 2011; McCann and Ortega-Argilés, 2013).

The other aspect of analysis presented in the past three chapters is the evaluative dimension, where the opinions of various stakeholders are presented alongside the policy review. In the next section this evaluative aspect is added to the theoretical analysis to build up a picture of which types of approaches have proved more or less successful or useful. As well as utilising the theoretical framework to analyse the Welsh case in a more nuanced, sophisticated, and informed manner, this study aims to feed back into the theory itself by questioning the applicability and usefulness of the different theoretical approaches in the context of a weaker region. An important dimension of this is exploring which types of approaches have proved more or less successful in Wales to date.

8.4 Evaluation of Approaches

The policy map provides an interesting approach to the study of regional innovation policy, providing a visual representation of the evolution of innovation interventions. The policy map is designed to be applicable to other case studies; it is populated with the Welsh interventions, but could be replicated in other contexts. The sections above have provided a theoretical understanding of the evolution of the Welsh Government's approach through the actions and programmes implemented, but do not tell us how successful or otherwise these have been.

Table 8.2 summarises the reviews of the various programmes, as presented in the previous three chapters, categorised according to theoretical approach. This is a significant simplification of the analysis, and of course the picture is much more complicated and nuanced than this table suggests, but in order to conduct some wider analysis of the key trends and patterns it is necessary to simplify the rich qualitative data somewhat. The reader is asked to refer back to chapters 5, 6 and 7 for the more in-depth discussion of each programme. Where there is some further information required to qualify the summary of the evaluations of the programme this is provided, for example if a programme received strongly positive reviews but only from stakeholders in certain groups, or there is consensus that some

aspects of a programme are good but others are poor. The programmes are listed chronologically in line with the structure imposed across the whole thesis.

Table 8.2 Evaluation of Programmes According to Theoretical Approach

Programme/Intervention	*Theoretical Approach*	*Evaluations*
RTP	Systems	Positive
EAP	Systems	Positive
IAP	Systems	Positive: systemic underpinning is good, but failed to achieve results/impact
KTP	Triple Helix	Positive: but not mentioned by business stakeholders
Accelerate	Clusters	Positive
Sector Fora	Clusters	Positive
Apprenticeships	Learning Region	Positive
Spin Out Wales	Triple Helix	Negative
CETICs	Triple Helix	Negative
Cardiff Innovation Network	Triple Helix	Positive
Technium	Triple Helix	Negative
A4B	Triple Helix	Positive: not mentioned by business stakeholders
KESS	Triple Helix	Positive: limited discussion and not mentioned by business stakeholders
Know How Wales	Triple Helix	Negative: limited discussion and not mentioned by business stakeholders
Expertise Wales Portal	Triple Helix	Negative: implementation seen to be problematic
Pro-Act	Learning Region	Positive
Re-Act	Learning Region	Positive
GO Wales	Learning Region	Positive
YES	Learning Region	Positive
Sector Based Approach	Clusters	Mixed
Enterprise Zones	Clusters	Mixed
City Regions	Clusters	Mixed
Digital Wales	Learning Region	Positive: idea is good, but implementation seen to be problematic
National Research Networks and Sêr Cymru	Learning Region	Positive: not mentioned by business stakeholders
HPC Wales	Learning Region	Positive: idea is good, but implementation seen to be problematic
ASTUTE	Triple Helix	Positive: limited discussion due to sector specific nature (automotive and aerospace)

The Welsh Government's efforts in delivering innovation related programmes and actions can be seen in a broadly positive light. It is interesting that so much agreement exists over the programmes that were reviewed positively, and that whilst the original idea behind the programmes was often good the implementation was poor. This is a recurring theme in Welsh innovation supports, and one of the main findings of this study is that several programmes had a sound foundation but did not deliver results.

Of the four approaches, the programmes that emerge from the analysis as the most positive are those taking the systems and learning region approaches to innovation. However, there are relatively few systems-based approaches, and those that exist are the older interventions. In terms of the learning region approaches, there are several of these across the study period, especially in recent times, but they tend to be smaller in scale or less centrally connected to the innovation and economic agenda. Indeed, the most significant programmes in terms of scale and dominance of the innovation approach are in the clusters and triple helix spheres. Nevertheless, the overwhelmingly positive perceptions of the systems and learning region approaches suggest that they could be a promising avenue for the Welsh Government, and perhaps governments in weaker regions generally, to pursue; certainly they warrant further application and testing in this context. There is a pradox apparent, that the approaches most positively reviewed have been the less prominent in the Welsh Government's approach. This could be a result of practical issues in trying to implement these theoretical approaches, discussed further in Chapter 9.

The least positively reviewed programmes fall under the triple helix category; these interventions have received very mixed reviews. Some are viewed positively, but others are overwhelmingly seen as failures (for example, the *Technium* programme). Even those that recieve positive reviews cannot automatically be considered as successful because they have been largely ignored by the business stakeholders interviewed, suggesting they are not having

much of an impact on the business sphere. The experience of triple helix style programmes in Wales is mixed, and this thesis questions the strategy of attempting to drive innovation through universities without a strong business sphere to absorb this and engage in such activities. In the language of the triple helix, the spheres are unbalanced with the business helice being relatively weaker than the government and university ones (Etzkowitz, 2008; Etzkowtiz & Leydesdorff, 1997).

The cluster programmes, many of which have been introduced in recent years, receive mixed reviews. Evaluating or reviewing this group of interventions is difficult because they are so recent, and not enough time has passed to assess how succesful or otherwise they have proved. Stakeholders are very much divided over these approaches; some are concerned about the sectors that have been chosen, others are worried that certain areas will be excluded from economic development; espeically the more rural and peripheral parts of Wales. It remains to be seen how successful these interventions prove to be, but with the growth of the smart specialisation agenda across Europe (Foray et al. 2009, 2011) we can assume they will be a presence in Wales for the forseeable future.

8.5 Conclusion

This chapter has analysed the wider trends identified utilising the theoretical framework developed at the outset of this study. This has revealed an interesting analysis of the Welsh Government's approach whereby we can see the shifts, ebbs and flows of the various approaches to innovation and the changing nature of the Welsh Government's role in driving innovation over time. The overarching logic of the evolution of innovation policy in Wales is that we can see three distinct periods characterised by different theoretical approaches: the early period we can see the systems of innovation, and in particular the RIS logic, dominating the policy approach (Cooke, 1992; Lundvall, 1988); in the middle period the triple helix emerges as the guiding rationale as the innovation agenda is increasingly driven through

higher education policy and programmes (Etzkowitz & Leydesdorff, 1997); and in the most recent period the cluster approach dominates (Porter, 1990). Learning region based approaches (Florida, 1995; Morgan, 1997; Rutten & Boekema, 2007) have also become increasingly important but have not dominated the approach to innovation during any period.

The key trends in programmes implemented across the study period largely reflect the policy evolution. In terms of the perceived success of these various approaches, there is a surprising degree of support for the Welsh Government's efforts. Generally, programmes and actions receive positive reviews, though the learning region and systems approaches emerge as the most positively perceived and the triple helix interventions less so. There is a paradox here, whereby the more positively reviewed approaches have been less dominant in the Welsh Government's overall approach (the systems and learning region style programmes), and the dominant approaches (clusters and triple helix), which have been most commonly implemented, have received mixed reviews.

This chapter has explained the process of evolving the conceptual framework into a tool that can be used to map and analyse "real-world" innovation interventions. This builds on past attempts identified in the literature to analyse innovation policy through the lenses of innovation theories (Elder and Georghiou, 2007; Flanagan et al. 2011; Gil et al. 2003; Nauwelaers and Wintjes, 2003; McCann and Ortega-Argilés, 2013). The analysis has provided examples from the Wales case study of how programmes can be critiqued using the framework. It is suggested that the same framework could be used in other regional contexts; this is an important route for further research. Combining theories into a framework is found to be an interesting and useful practice that can provide us with a richer understanding of a case study, and allows us to make more informed and sophisticated policy recommendations. It supports the proposition made at the outset that a combined theoretical approach provides

more sophisticated and nuanced analysis, and more interesting findings, than applying one theory normatively.

The following chapter draws on the analysis of this and the last three chapters to present conclusions and policy recommendations of the study, and to feed back into the theory itself using insights gleamed from the Wales case.

9 Discussion & Theoretical Contribution

This penultimate chapter links directly back to the literature review presented in Chapter 2, considering how the findings of this research can enhance the theory and build on past research. It is structured around the four key theories of innovation that have been employed and explored throughout the thesis, presenting the benefits of challenges of each when applied to the Wales case study, and makes recommendations as to how each can be improved and rendered more applicable to the weaker region context. It draws on the multi-theoretical framework as presented in the previous chapter, feeding the insights gained back into the past work that has been conducted.

9.1 Systems of Innovation

9.1.1 Overview

The systems approach dominated the Welsh Government's efforts during the early period, with policies and programmes taking an RIS approach to innovation. This closely aligns the Welsh innovation approach with the EC's agenda at that time to encourage regions to create their own regional innovation plans (Asheim, 2012; Morgan, 1997). The *RTP*, *EAP*, and *IAP* aimed to build an innovation culture in Wales, taking a wide approach to the institutions and organisations involved in innovation, thus following the broad approach recommended by SI's key advocates (Freeman, 2002; Lundvall, 2007). However, the systems approach lost its dominance from 2003 onwards, which is somewhat surprising considering the relative popularity of the early programmes and calls for a return to a systems-based approach at present. There is evidence of this happening; *Innovation Wales* makes reference to strengthening the "Welsh system of innovation" (WG, 2013b).

There is a direct link between the presence of innovation policy and dominance of systems approaches; when innovation is high on the Welsh Government's agenda, as in the early period and at present, policy takes a broad and evolutionary, or systemic, approach to innovation. But in the intervening decade, when innovation was being loosely dealt with in education, science, and economic policies, a much narrower approach based on an "innovation push" prevails (Cooke & Clifton, 2006).

9.1.2 Benefits

There are two main reasons why the systems approach is an appropriate framework for this study: the inclusion of a wide range of actors and organisations, and the incorporation of cultural and institutional dimensions at the heart of the theory. An innovation system is conceptualised as consisting of elements and relationships that interact in the production,

diffusion, and deployment of knowledge (Lundvall, 1992). The systems approach takes a broad view of the actors involved: as well as the usual stakeholders (firms, universities, technical institutes), it factors in a wide array of intermediate institutions such as trade associations, chambers of commerce, professional associations etc. (Edquist, 2005, p.17; Morgan, 2007, p.105). Other actors found to be important in the Welsh system are social enterprises and credit unions; in weaker regions there may be a wider range of actors involved, and the role of NGOs and intermediary organisations may be enhanced in light of a weaker business sphere. These should be taken into account when studying innovation, but also when designing and implementing innovation policy.

Another element of the systems approach that makes it appropriate in this context is the importance placed on soft institutions and culture. The systemic understanding of innovation is dependent on geographical and historical context, and institutions are seen as central elements in enabling innovation (Edquist, 2005, p.24/26; Gregerson and Johnson, 1996, p.8; Lundvall, 1992). This is the only one of the four theories that explicitly builds culture into its framework as a factor that can and should be analysed and considered when studying innovation. Culture emerged as a crucially important factor throughout the study; it can be considered an important barrier to innovation and economic development in Wales, further embedding the problems associated with regional "path-dependence" (Mackinnon et al. 2007; Storper et al. 2011). Until these underlying factors are addressed then innovation policies and programmes may struggle to achieve success.

9.1.3 Challenges

Let us now consider why the systems approach may not be appropriate for the weaker region context. The two main issues identified are the lack of a framework for places that fit neither the "region" nor "nation" categories, and the fuzziness of the concept rendering it difficult to practically implement. The first problem encountered when applying the SI lens to the Wales

case is whether a national or regional framework is more appropriate, due to Wales' interesting position sitting somewhere in between these two categories. Edquist (2005) considers that the decision of geographical framework should be made on a case-by-case basis, and this thesis aimed to investigate which is more appropriate for Wales. Empirical observations found a shift over the study period from a RIS based approach in the early years (Asheim and Gertler, 2005; Cooke, 2007, p.199; Cooke et al. 1997; Morgan, 1997; Nauwelaers and Wintjes, 2003; Paasi, 2009, etc.) towards a more NSI discourse emergent in the recent policy (Edquist, 1997; Furman, Porter and Stern, 2002; Isaksen, 2003; Lundvall, 1988 etc.). When the RIS framework was developed and employed in Wales by Cooke and Morgan (Cooke 1998, 2003; Morgan, 1997) it was the pre-devolution period when the WDA governed innovation policy and programmes. This thesis suggests that the term "regional" becomes increasingly untenable as Welsh civil society and politics is oriented towards a national discourse over the course of the study period, as seen through the increasing use of "country" in policy and a visible nation building agenda (WAG 2001, 2009c; WG, 2013b). However, the SI theory does not account for places evolving and shifting between these different geo-political categories.

Although the RIS approach has been found to be problematic in the Welsh context, the NSI is not ideal either if it is taken in its broad conceptualisation, which is posited as the most effective use of the concept by its key proponents (Freeman, 2002; Lundvall, 2007). In the broad conceptualisation of the NSI the role for government is wider than the other theories, there is an assumption that government is capable of addressing the various elements of the system. However, this is not necessarily the case if the government's powers are restricted, as in Wales. The issue of the restrictions to the Welsh Government's capabilities and powers and how this limits its ability to affect economic change emerged as important. If we take this insight and apply it to the SI framework, a broad and systemic approach to innovation policy

could be problematic for regions with limited power and governance. When many of the key organisations and institutions that compromise the innovation system are located and governed outside of Wales it is difficult to see how an NSI approach could be practically tenable for policymakers at the current time. Neither the regional nor national approaches are appropriate; the systems theory lacks a framework for places that sit in-between the two categories.

9.1.4 Summary & Suggestions

There are both positive and negative aspects to the SI approach when applied to the study of Wales; in some ways it is an appropriate framework for the study and advancement of innovation policy in this context, but in other areas it is deficient. In terms of the latter, some suggestions are provided as to how the SI theory can be advanced to make it more applicable to a weaker region case study. The strengths of the SI theory are the same factors that make it difficult to disseminate and translate from theory to policy: its evolutionary and context dependent nature, and focus on institutions and culture that vary from place to place. Furthermore, the literature is quite contested and contradictory, for example the debate about how theoretically rigorous or normative the approach should be (Edquist, 2005; Fischer, 2001; Lundvall, 1992, 2002, 2003; Nelson and Rosenberg, 1993, p.5-6), and the disagreements between the national and regional proponents (Asheim and Gertler, 2005; Cooke, 2007, p.199; Cooke et al. 1997; Edquist, 1997; Lundvall, 1988; Morgan, 1997; Nauwelaers and Wintjes, 2003; Ronde and Hussler, 2005, etc.).

Whereas the triple helix and cluster theories are premised on a "check-list" approach of transplanting a model developed in leading regions (e.g. Boston-Cambridge, Silicon Valley) to others, the systems approach is much more context dependent (Edquist, 2005). The specific context of a place should be taken into account – cultural, historical, political, and geographical – in studying and designing innovation policy, and these wider factors emerged

as vitally important for understanding the present situation. The systems approach may be more appropriate than approaches that are context "blind", such as clusters and the triple helix (Etzkowitz and Leydesdorff, 1997; Porter, 1998).

There have been relatively few attempts to implement SI approaches in Wales, but those that do exist received generally positive reviews. Herein lies the paradox: the most intellectually and theoretically rigorous approaches are potentially inaccessible to policymakers because of their complexity and confusing presentation. For example, the SI approach, because of its broad and evolutionary nature, is quite "fuzzy" to grasp (Edquist, 2005; Markusen, 2003). The more simple theoretical approaches, namely triple helix and cluster theory, have been more popular in terms of the programmes implemented; these both provide quite simple and clear guidelines for policymakers to follow (Etzkowitz, 2007; Porter, 1990, 1998, 2002). The systems theory provides a much more nuanced and context dependent approach but perhaps requires a less complicated packaging and presentation to make it more policy friendly and thus more likely to be implemented by policymakers.

A suggestion to advance the SI theory is that it should account for territories such as Wales, that sit somewhere in between a regional and national approach, or that are transitioning from a region to a nation as they gain further independence. This insight has a relevance beyond Wales, for example the "autonomous communities" in Spain (Garcia-Álvarez and Trillo-Santamaria, 2013),[17] or other regions with a strong national identity where the idea of an RIS may be untenable or unpalatable. Perhaps an Autonomous-Community Innovation System could be developed, which can select elements of the regional and national approaches to fit the specific context being studied.

[17] Also see Cooke & Morgan (1993, 1999) for studies of regional innovation systems in autonomous regions in Europe, including Wales and the Basque country.

Another suggestion is to incorporate a multi-level approach that does not try to select one geographical level to analyse, but rather examines the case study from multiple perspectives. However, there are few attempts in the SI literature to do this. Edquist (2005, p.11/12) asserts that an innovation system can be supranational, national, regional and even sectoral within a country at the same time, but provides little insight as to how this can practically be studied. Combining the systems theory with the concept of multi-level governance (Bache and Flinders, 2004; Hooghe and Marks, 2001) could provide a framework which better accounts for the complexity of the governance of innovation in regions such as Wales. This would allow for flows and interactions between the different levels to be taken into account, and opens up the potential to study a territory such as Wales as an innovation system in its own right, but also as part of a wider UK system.

9.2 Clusters

9.2.1 Overview

As Chapter 8 has illustrated, the cluster approach has become dominant in the recent period with the introduction of sector-based economic development. Several recent actions implemented follow this rationale: enterprise zones, city regions, and the "grand challenge" sectors are all encouraging the growth of certain sectors in particular geographical areas. The European smart specialisation agenda, currently driving the Welsh approach, is especially prominent in the most recent innovation policy (EC, 2013; Foray et al. 2009, 2011; WG, 2013b). Over the study period there is a trend of the Welsh agenda being influenced by developments at the European level; in the early period this materialised as an RIS based approach to innovation policy (Cooke, 2003; Morgan, 1997), and in recent years has steered the Welsh approach towards cluster development.

As such, cluster theory is relevant to the conceptual study of innovation and economic development in Wales, but whether it is the most appropriate model for a weaker region to follow is not clear, reflecting disagreement in the literature over whether or not clusters actually work (Isaksen, 2006; Martin & Sunley, 2003; Noteboom, 2006). Another issue with the Welsh approach is the selection of sectors, it is unclear whether the right ones have been chosen based on Wales' actual strengths rather than a wish-list of fashionable sectors, echoing Uyarra's (2007) findings in English regions. It is too early to provide definitive or complete evaluation of the cluster approach in Wales; it remains to be seen how successful the current programmes, and smart specialisation specifically, prove to be.

The earlier and smaller scale cluster-based interventions (the sector fora and Accelerate) received stongly positive reviews, succesfully building networks in quite narrow and focussed sectors. The more recent approaches are much broader in their understanding of sectors, and encompass whole sub-regions of Wales. It remains to be seen whether they achieve the same degree of success in building and strengethning the networks between actors on a larger scale.

9.2.2 Benefits

The cluster concept has proved well understood by Welsh policymakers and a popular approach in terms of policies and programmes implemented. Welsh policymakers are not alone; Martin and Sunley (2003) found that by marrying the concepts of competitive advantage and clustering, Porter (1998) delivers a pre-packaged concept that is attractive to policymakers worldwide. The simplicity and checklist-style nature of cluster theory is both a strength and a weakness of the approach. The strength is its relevance in policy spheres and the fact that it has such an impact outside of academia, the weakness is that it reduces and simplifies innovation and economic development to a list of actions that aim to replicate the success of world leading regions; it leads to a proliferation of "silicon somewheres"

(Hospers, 2006). This leads us to some fundamental questions about the nature of innovation theory itself and to what extent it should be policy relevant versus theoretically rigorous. The answer is, of course, a balance between the two, but it is suggested here that the cluster approach has been pre-packaged in a way that reduces economic growth to the geographical agglomeration of sectors, and normatively assumes that clustering is a good thing.

9.2.3 Challenges

There are several problems found with cluster theory when applied to the Wales case, echoing critiques made in the clusters literature (Asheim et al. 2006 p.22; Benner, 2002; Hassink, 2004, p.1/2; Martin & Sunley, 2003; Swann, 2006). Cluster theory posits that governments should build on the strength of pre-existing clusters rather than trying to build them from scratch (Porter, 1990) and focus on upgrading their competitiveness (Ketels, 2013, p.276). However, this may not be appropriate for weaker regions, which lack strong economic sectors, or are suffering from the effects of over-specialisation in the past. An approach premised on building up existing strengths, such as the cluster approach or smart specialisation, is potentially problematic in this context.

Clustering has been found to have negative effects on localities and sectors outside of those chosen as the focus of policy efforts; Swann (2006, p.267) refers to this as the "shadow" effects of cluster policy on the hinterland, and that any policy which strengthens one cluster may do so at the expense of weaker areas. The Welsh Government's cluster-based approach could lead to certain geographical areas and sectors losing out. Those situated outside of the key sectors may no longer be able to access support and feed into the policymaking process.

The cluster concept is probably the most notorious example of taking an approach developed in a leading region and attempt to transplant it wholesale into completely different contexts, in particular weaker regions (Hospers, 2006; Martin and Sunley, 2003), and Wales has not

escaped Porter's influence. Indeed, in 2002 Porter made a series of recommendations to the Welsh Government, finding that Wales has few well developed clusters and limited interactions within clusters. Most of his suggestions revolve around the famous clusters in the USA, such as San Diego, Atlanta, the San Francisco Bay Area, and Boston, which are posited as models for Welsh policymakers to recreate the success of those American cities in the valleys of south Wales (Porter, 2002). He proclaims that "building strong regional economies takes decades" and "a coherent strategy is an important prerequisite for effective action" as his key recommendations (Porter, 2002, p.24), somewhat unhelpfully. Whilst it would be easy to dismiss this report based on its dubious quality and integrity, the cluster approach has certainly re-emerged in recent years, and is an important element of the current Welsh approach to innovation and economic development, suggesting that these ideas have made a lasting impact on Welsh policymakers. It is suggested that the smart specialisation agenda being pushed at the European level (EC 2011; Foray et al. 2009, 2011) is reinforcing the Welsh Government's sector-based approach and further embedding it as a direction going forwards.

A key problem with replicating cluster approaches developed in leading regions is the privileging of sectors that are largely inappropriate in a weaker, especially post-industrial, context. Uyarra (2007) found, in her study of English regions, that in taking the concept wholesale, rather than adapting it to their specific regional context, policymakers failed to consider the potential of more traditional industries. The cluster approach could be problematic in a weaker region with a more traditional industry base (Uyarra, 2007, p.254). This study supports her findings, suggesting that some of the sectors chosen by the Welsh Government represent fashionable but inappropriate sectors based on replicating leading examples (Hospers, 2006).

9.2.4 Summary & Suggestions

It is interesting to see cluster ideas becoming popular again; it was over twenty years ago that the theory became popularised by Porter (1990), although it was first introduced by Marshall around a hundred years ago (Baptista, 1998). The smart specialisation agenda is re-igniting interest in the agglomeration of sector specific activity at the regional level, and is acting to validate Welsh Government's pre-existing sector approach (WAG, 2010b; WG, 2012b, 2013b), this thesis argues. A key tenet of smart specialisation is the "entrepreneurial discovery process" to establish which are the pre-existing strengths and capabilities of the region (Foray et al., 2011). Analysis found little evidence of this process taking place, and suggests it may be difficult for governments in weaker regions to identify their regions' strengths. The idea that all regions have strengths that they can build on was challenged by Welsh stakeholders, and is a key problem with trying to apply cluster-based approaches in this context. Based on the Welsh experience, the smart specialisation agenda being driven from Europe should draw out the novel elements, such as the entrepreneurial discovery process, that distinguish it from cluster-theory (McCann & Ortega-Argiles, 2013). Otherwise, a continuation of approaches that have been tried and found wanting in the past may occur.

This study echoes Martin and Sunley's (2003, p.5/7) view that clusters should come with a "public health warning", but questions their assertion that the concept was a "world-wide fad" and an "academic and policy fashion item". They were writing over ten years ago, and the concept is still highly influential; which suggests that it is more than a passing fashion. Cluster theory has little to offer regional policies addressing the problems of failing clustering efforts (Hassink, 2004), due to its focus on developing and enhancing pre-existing clusters in a one-way dynamic. The Welsh Government should be aware the potential negative effects of clustering (Swann, 2006) and design its policies in a manner that spreads the benefits of cluster development to different locations and sectors. Perhaps nesting clusters within a wider

systems framework (Edquist, 2005; Lundvall, 2007) could encourage further examination of the effects of policies and activities outside of the narrow geographical sphere of the cluster, across the whole region.

In summary, whilst the cluster approach has proved prominent in the Welsh Government's approach to innovation, there are concerns over its applicability in the weaker region context. Also, the simplification of the complex and contextual nature of innovation to a simple checklist applicable to all locations is problematic. The mixed results of cluster-based policies have been well documented, and it will be interesting to observe the passage of the Welsh programmes.

9.3 Learning Region

9.3.1 Overview

Whilst there are a number of programmes implemented in Wales over the study period that follow the learning region approach, it was not the dominant approach in the policy mix at any time. There have been a number of programmes implemented that are not strictly innovation related but are focussed on developing the knowledge and learning infrastructure and human capital elements, which are key tents of a learning region (Florida, 1995; Rutten & Boekema, 2007). There is also a strong discourse present throughout the study period of creating a "learning country", underpinned by these ideas. The three main programmes that follow the learning region approach (*Sêr Cymru* and *NRNs, HPC Wales, Digital Wales*) focus on developing the physical and knowledge infrastructure, and knowledge networks across Wales. These actions received positive reviews, and the issues they deal with such as education, training, and learning, emerged as important priorities to be addressed.

9.3.2 Benefits

The learning region theory is quite similar to the SI approach in that it is underpinned by the understanding of innovation as a socially and territorially embedded process, which is interactive and cannot be understood without considering the institutional and cultural contexts (Asheim, 2012; Lundvall and Johnson, 1994). The two approaches share many fundamental understandings and characteristics. As such, there are a number of similar benefits to applying the learning region to the Wales case, such as the importance placed on cultural, historical and geographical contexts as important innovation determinants. It is important that we have a conceptual framework that takes these wider issues into account if we are to understand innovation in weaker regions and provide recommendations to policymakers on how to overcome entrenched barriers to economic growth. The SI and learning region approaches both have a major benefit over the other two theories in this regard. There are two further elements of the learning region that make it appropriate for studying the Wales case; the emphasis on education and learning, and the focus on the human capital dimensions of innovation.

The learning region theory places high importance on learning and education aspects of innovation and economic development (Doloreux, 2002; Lundvall and Johnston, 1994), which emerged as central to this study. The poor education performance in Wales emerged time and again as a key barrier to innovation and economic growth, and a framework that incorporates these two elements could be highly useful. A criticism made of the Welsh approach is that education and innovation are not well connected at the policy level, and education is not given enough weight in terms of its impact on innovation and economic development; the learning region could provide a framework for addressing this.

Another key strength of the learning region concept is the emphasis on the human capital elements of economic development (Florida, 1995). This agenda is receiving increasing

attention in Wales, with recent programmes implemented to develop knowledge and learning networks, and attract or retain researchers, scientists and graduates. The theory tells us that a successful learning region relies on an educated and specialised human infrastructure and the coincidence of social, cultural, and spatial proximity to enhance interactive learning processes (Doloreux, 2002, pg.255); within a typical learning region we see "knowledge workers who can apply their intelligence in production" (Florida, 2007, p.65). There are certainly efforts to develop this in Wales, in particular through addressing the human capital infrastructure through training the existing workforce (apprenticeships, *Pro-Act* and *Re-Act*) and attracting knowledge workers (*Sêr Cymru* and *NRN*s). However, these programmes are quite small-scale and peripheral to the central economic and innovation agenda. Nauwealers and Wintjes (2003) studied similar approaches in Belgium and found them to be useful in attracting and retaining talent; continuing and expanding programmes in this vein could be a promising avenue for the Welsh Government to take. A strengthening of the learning region approach in Wales could help to integrate education and training based activities, which proved popular, with the innovation agenda.

9.3.3 Challenges

Conversely, the learning region theory's broad and contextual nature leads to the same problems of "fuzziness" and intangibility as the SI approach (Cooke and Boschma, 2011; Markusen, 2003; Martin, 2001). Actually combining education, learning, and innovation at a policy and programme level could be difficult for policymakers because they fall under different departments' and ministers' responsibilities. In order to implement a learning region approach, the innovation and learning agendas need to be integrated and joined-up, moving towards the joint goal of encouraging the production and sharing of knowledge and learning for economic growth. Implementing and embedding the type of government and governance required for the learning region, which is different from that of traditional manufacturing

regions (Florida, 1995, pg.67), could be challenging; especially in a region where the role and power of government is restricted, and it would require co-ordination between the different levels of government. Again, the concept of multi-level governance could be useful to conceptualise how the different levels need to co-operate and adapt towards becoming "learning governments" (Nauwealers & Wintjes, 2003, p.218).

Whilst the focus on learning and knowledge is a strength of the theory, it could also been seen as a problem when applied to a weaker region such as Wales. As Rutten and Boekema (2012) have noted, the learning region assumes a level of learning and innovation is necessarily taking place within the region, not appreciating the fact that in reality some regions may achieve economic growth through transfer and adaptations from elsewhere. For a weaker region without strong knowledge resources and capabilities, this may be a more realistic and viable strategy than developing them endogenously. The learning region theory only allows for a narrow range of successful regions, and is prescriptive because it assumes that certain institutions and characteristics are necessary for innovation (Rutten and Boekema, 2012). Along with Florida's (2006) ideas about the "creative class", the learning region theory is elite-focused, privileging knowledge intensive sectors and workers, which are typically lacking in post-industrial regions such as Wales. There is a danger that by following a learning region approach, regions will focus too much on attracting knowledge workers from outside at the expense of educating and training the indigenous population to partake in the knowledge economy.

9.3.4 Summary & Suggestions

The learning region approach is applicable to this study, but more as an aspirational "road-map" (Asheim, 2012, p.995) than as a conceptual framework to understand the case of Wales. It is not entirely clear how realistic it is as a framework for studying weaker regions but this thesis agrees with Hassink (2004) and Morgan (2007), who see it as a useful policy

framework for weaker regions to overcome and avoid lock-in, and to pursue an innovation and economic development agenda in the global knowledge economy. In particular, the emphasis on learning and education are useful for weaker regions that may be lagging in these areas and in need of linking-up their policy agendas. However, as with other ideas originating in strong regions, there are dangers in trying to apply a normative approach based on success stories with very different contexts and characteristics. A weakness of the learning region theory is the lack of guidance or advice as to how weaker regions should interpret and implement the approach.

Whilst it is a major strength of the learning region that it pays greater attention to the social and institutional dimensions of innovation (Morgan, 2007, p.110), without more concrete or useful guidelines for policymakers it may not achieve the impact and reach of the more simplistic theories. In Wales, the learning region has at no point developed the momentum and concentration that the other theoretical approaches have. Many of the ideas contained within the approach have been addressed in Wales, but in quite a dispersed manner lacking a framework to co-ordinate both the innovation and education elements. The learning region could provide this but it could be better presented as a policy-relevant concept that is more accessible to policymakers and easier to implement. The perceived success and usefulness of the Welsh interventions taking this approach suggests it could be a useful and promising avenue for the Welsh Government to pursue further. As with the RIS, discussed above, the use of the term "region" could be problematic, and Welsh policymakers have favoured the phrase "Learning Country" (WAG, 2001); perhaps the theory requires some adjustment to account for the potentially problematic connotations of the discourse of the region.

9.4 Triple Helix

9.4.1 Overview

The triple helix enjoys a prominent position within the Welsh Government's approach to innovation over the study period. At the policy level there is a strong triple helix rationale visible, whereby universities are ascribed a key role as drivers of the Welsh innovation system, and several important programmes implemented during this period take this approach. This agrees with the analysis of Jones-Evans and Bristow (2010) and Thomas and Henderson (2011), who find universities to be important actors in the Welsh innovation approach. The triple helix provides a useful framework because it has been a key tenet of the approach followed by the Welsh Government, and so is important when attempting to analyse and understand the interventions that have been undertaken. Triple helix interventions became especially prominent during the middle period, with large-scale programmes implemented and rolled out across Wales aiming to drive knowledge out of universities to businesses: the *Technium, A4B* and *KTP* being the most significant of these. The *Technium* is widely considered not to have been a success, leading to some fundamental questions about the applicability of the triple helix as a model for weaker regions.

9.4.2 Benefits

The triple helix theory has been found to be highly relevant when analysing Welsh innovation policy and programmes; it has been a dominant approach throughout the study period. The Welsh Government places a strong emphasis on universities as sources of wealth creation, innovation, and competitiveness; we can see the expansion of their purpose and activities to encompass increasingly entrepreneurial roles (Godin and Gingras, 2000; Nelles and Vorley, 2010; Olssen and Peters, 2005). It is important to have a conceptual framework that appreciates this role and provides recommendations as to how it can be enhanced. However,

there has been an over-reliance on universities as innovation drivers in Wales, and programmes implemented in this domain have been numerous but of mixed success.

The triple helix literature accounts for variations of the model, with "statist" and "laissez-faire" variants proposed, depending on the control government exerts on the system (Etzkowtiz, 2008). The "statist" model provides interesting insights for the Wales case, where government plays a central role in driving the innovation agenda. This can be seen as problematic; the Welsh Government is perceived as overly controlling, leading to innovation being stifled. The more ideal model is the "laissez-faire", where government acts more as an enabler and facilitator of the other spheres' activities (Etkowitz, 2008; Inzelt, 2004). The triple helix provides a framework whereby government can move more towards the ideal type (laissez-faire), and also within which we can understand the current situation (statist) (Etzkowitz, 2008). However, in a weaker region where the public sector plays such an important role as an employer, and the political tendencies lean more to the left, a framework that normatively asserts that government should become more "hands-off" and "laissez-faire" may not be particularly attractive or tenable. On the other hand, the triple helix model could provide a useful framework to improve the communication and collaboration between the three spheres in Wales. The simplicity of the idea and the fact it is presented in quite a clear checklist-style manner (e.g. Etzkowitz, 2008) is a benefit in terms of its policy relevance and influence.

9.4.3 Challenges

Whilst triple helix approaches have been prominent and popular from a policy perspective, this study has found their success and impact on the wider business sphere to be somewhat questionable. As such, it may not be the most appropriate policy framework for weaker regions. Whilst the universities are benefitting from triple helix programmes, through increased funding opportunities, it is not clear that the business sphere in Wales is engaging

and benefitting. There may be little demand for these services, considering the low knowledge intensity of much of the Welsh business sphere. As Cooke (2004, p.4) explains, a problem with the triple helix is that it assumes that government and industry would be willing to pay for privileged access to university-based knowledge and innovation; but this may not be the case if it is not particularly desirable or demanded.

Perhaps the triple helix model is not the most appropriate in a weaker region context where university originated knowledge and innovation is incompatible or irrelevant to a majority of the businesses in the region. In regions without leading entrepreneurial universities, such as MIT, upon which the theory was largely based (Cooke, 2004), the model may not be particularly valid (Gunasekara, 2004). Rather than attempting to push innovation and knowledge out of universities, a first stage could be to increase the absorptive capacity and innovation capability of the business sphere. Other organisations may be better placed to carry out successful knowledge transfer such as intermediaries, further education institutions, or government research centres (OECD, 2001; Sotaruta, 2004). In Wales, the model of driving innovation through universities has not proved particularly successful thus far; future actions could look beyond the universities as the source of innovation and growth.

It is not clear from the triple helix literature to what extent the three spheres should be interconnected and overlapping. According to Etzkowtiz and Ranga (2010), the ideal model is where the three come together in shared spaces and take on each other's roles. This overlap and interconnection between the university and business spheres does not seem to be occurring through the main programmes being implemented by the Welsh Government. However, this is not necessarily problematic because Leydesdorff (2012) believes that the triple helix can still function effectively without the three spheres being co-ordinated in a central overlapping zone. A criticism of the theory is that there is a lack of consensus over how important this is, and whether governments should be aiming for it.

The triple helix model is too limited in its conception of three helices; there have been several calls for widening the model to incorporate more actors such as intermediaries, not-for-profits, and end users (Arnhal et al., 2010; Bunders et. al, 1999; Marcovich and Shinn, 2010) and this could be an interesting avenue for increasing the applicability of the triple helix model to weaker regions such as Wales. Analysis found two main avenues through which intermediary (often not-for-profit) organisations play important roles: they participate in engagement activities between the different spheres; they also function as actors in the innovation system by carrying out innovation activities or providing funding. Examples of intermediary actors in Wales not accounted for by the triple helix are credit unions and social enterprises. Overall, the findings of this study support the calls for broadening out the model in order to increase the relevance and success of triple helix style programmes and policies, and to shift the focus away from universities as the primary innovation drivers.

9.4.4 Summary & Suggestions

As a conceptual framework for studying innovation policy and programmes in Wales the triple helix has proved relevant and useful. Indeed, it has been the dominant approach over the study period in terms of the actions implemented. The triple helix theory has certainly bridged the gap between academic theory and policy practice but the programmes implemented following this logic have enjoyed mixed success. This leads to questions about how useful the triple helix is as a policy blueprint for governments in weaker regions. Whilst it is attractive to policymakers due to its simple presentation and packaging, the triple helix is premised on replicating approaches that have been successful in exceptional regions in diverse contexts (Cooke, 2004; Gunasekara, 2004). Driving innovation through universities is not necessarily the best approach for a weaker region that is lacking a strong business sphere with high absorptive capacity. The triple helix assumes a strong business sphere capable of absorbing university held knowledge and having the means to utilise it in an economically

useful manner. Typically, we would expect these businesses to be in the knowledge intensive sectors, which have a certain demand for the knowledge and people within universities. However, in weaker regions, especially those that are post-industrial, these businesses do not necessarily exist in large numbers.

The number and scale of programmes implemented in Wales are out of line with the demand and capacity of the business sphere to utilise them. The result is to invest heavily in the university sphere; this does not necessarily or automatically translate into innovation or economic growth. The triple helix should be combined with a broader reaching approach, such as SI or learning region, so that its benefits can be enjoyed without leading to an over-dependence on universities in weaker regions.

There have been several calls in the literature to expand the triple helix beyond the three core actors to include intermediaries, NGOs, end users, and others to an "n-tuple" of helices (Arnhal et al., 2010; Bunders et al., 1999; Marcovich and Shinn, 2010; Leydesdorff, 2012). This study has found other actors beyond the three helices to be important in the Welsh innovation system, and supports these calls to expand the theory. However, once the triple helix is expanded it is difficult to see it as a theoretical framework in its own right, distinct from the broader systems and learning region approaches.

9.5 Conclusion

The table below summarises the analysis regarding each of the theories in terms of the benefits and challenges encountered through this study.

Table 9.1 Applicability of innovation theories in the weaker region context.

Theory	*Benefits*	*Challenges*
Systems of Innovation	• Incorporates a wide range of actors beyond firms, government and university, better reflecting the situation in Wales. • Builds culture into the framework, which emerged as a key barrier to innovation and economic development through interviews. • Path-dependence/historical context taken into account, which emerged as important issue to overcome in Wales (as in other post-industrial regions?). • The (few) programmes that took this approach are well regarded by stakeholders and had degree of success, but were not continued.	• Doesn't account for multiple geographical levels interacting – no framework for analysing a territory as both an RIS and NSI simultaneously. Also, doesn't account for territories that sit in between the two. • Because of its broad and evolutionary nature can be "fuzzy" and difficult for policymakers to grasp and operate compared to the more simple "checklist" approaches of clusters and triple helix. • This is not helped by the conflicts in the literature between the various approaches and over how theorised it should be.
Cluster Theory	• The cluster approach has proved popular with policymakers in Wales, and has become the dominant approach to innovation in recent years. • It is well known by policymakers and relatively easy to follow because of the checklist or plan provided by Porter. • This is both a strength and a weakness of the approach. A weakness because it simplifies the complexity of innovation and economic development to a few simple factors, but a major strength because it is accessible and understandable to policymakers.	• Not clear from academic literature or stakeholders questioned that a cluster-based approach is the most appropriate, or indeed whether clustering works. • Rather than trying to build clusters from scratch, governments should build on pre-existing strengths, but this may not be realistic or feasible in weaker regions that are lacking these. • The choice of sectors to support in Wales is contested, and it is not clear whether or not appropriate sectors have been selected. • There are concerns over the negative effects of clustering on areas and sectors that have not been selected- will they still receive support or will activity remain concentrated in the already (relatively) strong areas?

Theory	*Benefits*	*Challenges*
		• An approach developed in exceptional leading regions may not work when transplanted to a weaker region context.
Learning Region	• Learning and education emerged as key issues through interviews and the poor education performance in Wales is seen as a key barrier to innovation and economic growth, so the learning region approach could be an important framework to address the joint education and innovation agendas. • Appreciates the historical and geographical context and its impact on innovation; does not attempt to reduce it to a simple checklist. • Human capital elements are taken into account more than in other theories, and these emerged as important though interviews; also programmes addressing this were popular amongst the stakeholders.	• Broad and contextual nature makes it "fuzzy" and difficult for policymakers to grasp and implement. • Another example of an approach formulated in stronger regions, and it is not clear how relevant it is for weaker regions that do not have a pre-existing strong knowledge base. • Learning regions need "learning governments" but in reality this could be difficult to achieve and there are few insights as to how a transition should be made towards this. Also, in a region with different levels of government it could be more complicated because it is not clear which governments need to transform and how.
Triple Helix	• As with clusters, is an influential approach in the Welsh policy and programmes; high level of awareness of the ideas amongst policymakers and several programmes implemented that follow the approach. • Where government is not delivering and managing the programme (Cardiff Innovation Network) the triple helix approach has proved popular amongst businesses, supporting the literature which says that government should step back rather than control the situation.	• Reviews of triple helix programmes were on the whole fairly negative, suggesting it may not be the best approach for a weaker region. • Driving innovation through universities rather than building up the business sphere may not be appropriate. • The focus on three stakeholders is too narrow in Wales, where there are other important actors involved in both the governance and undertaking of innovation activities. • Again, because it was developed in stronger regions the triple helix assumes that there is a strong university sphere producing innovations and knowledge that the business sphere demands; this is not necessarily the case.

10 Conclusions

This final chapter presents the contributions of the study to academic theory and policy practice, and draws together the analysis of the preceding chapters. The first section is a brief overview of the work conducted. The second presents the theoretical contribution by feeding the findings from the Wales case back into advancing the theory. Following the theoretical discussion, the policy recommendations are provided under the contributions to practice section. This is followed by a consideration of the limitations of the study, and suggestions for future research that arise from these; the final conclusion re-iterates the core contribution of the work.

10.1 Thesis Summary

Nine chapters are presented, following a chronological logic according to the manner in which the research was conducted; this short section provides a brief overview to remind the reader of the various chapters and the contribution each makes. The first chapter introduced the study and the research questions. The second presented the literature review, setting the scene for the study and identifying the research gaps to which it contributes. It also proposed a conceptual framework, derived from the key theories presented in the literature, to be applied in the case study of Welsh innovation policy. Next is the context chapter (Chapter 3), which introduced the Wales case study with an overview of the economic and political background that is deemed important for understanding the remainder of the analysis. This is followed by the methodology chapter (Chapter 4), which explained the research design and the details of the methods employed in this study. Next are the three empirical chapters (5-7), which are structured chronologically and presented the combination of policy review and stakeholder

interviews to study the evolution of innovation policy and programmes from devolution to the present day. Chapter 8 employed the multi-theory framework developed to draw out further findings and conclusions about the case study, and to empirically test the framework as a tool for mapping and understanding regional innovation policy. Chapter 9 feeds back into the original literature and theories that have been employed in the analysis, presenting the benefits and challenges of applying the theories in the Wales context, and also making some recommendations as to how they can be made more applicable to the weaker region context. In this chapter the conclusions and contributions to theory and policy are presented as the final section of the thesis.

Two contributions to the fields of regional economic geography and innovation policy studies have been made by this piece of work. First, it has presented an in-depth case study of the evolution of Welsh innovation policy from devolution to the present day, considering the role of the Welsh Government as a driver of innovation and economic development. Second, it has developed a theoretical framework for analysing and "real-world" innovation policy using four prominent theories of innovation. It has expanded our knowledge and understanding of the dynamics, processes, and outcomes of regional innovation policy in a weaker region.

10.2 Contributions to Theory

This section presents the key contributions of this study to theory, and is then followed by the contributions to practice, or in other words the policy recommendations. The contributions are structured around the original research questions posed, in order to illustrate how these are answered by the study and to elucidate the key contributions it provides.

How has regional innovation policy in Wales evolved since the period following political devolution from the UK?

This thesis has provided an in depth case study of Welsh innovation policy and programmes since devolution. It has examined how the innovation agenda has evolved in Wales, and has identified three key stages according to which the analysis chapters have been structured. In each of these, the approach to innovation differs as does the extent to which innovation is prioritised relative to other agendas. To answer the first research question, the overall trend in the evolution of innovation policy that this study has identified is outlined. The headline trend is that the innovation approach has varied fairly considerably over the last fifteen years in a series of three visible stages, as illustrated in Chapter 8. In short, there has been relatively little stability.

In the early years, between 1999 and 2003, innovation was a high priority for the Welsh Government, with a number of important policies published during this time, including the Innovation and Entrepreneurship policies. The approach towards innovation was quite broad and systemic, incorporating ideas about creating a culture of innovation and taking a long term view. In the middle period defined in this study, through to 2009, innovation falls off the policy agenda somewhat, and is increasingly driven through the overlapping but distinct spheres of education and science policy. As such, a more university-based approach emerges, with a linear conceptualisation of innovation, different to that of the earlier period. In the most recent period, from 2009 to 2014 innovation again returns to the forefront of the wider policy agenda, with the publication of the most recent economic, science, and innovation policies. The approach to innovation is still fairly science and university premised, but we see the expansion of the cluster-based approach through the programmes and actions implemented.

What is the nature and the outcomes of innovation interventions implemented in Wales since devolution?

The perspectives of stakeholders from the different groups of university, business, and government were accessed in order to answer this question by building up a picture of which interventions are considered to have been more or less successful. The results of this analysis are mixed, but there is certainly an appreciation of the efforts that have been made by the Welsh Government. A handful of interventions received overwhelmingly negative reviews, most notably the Technium programme. The different stakeholder groups interviewed prioritised different interventions and types of approaches, for example the university stakeholders having more favourable opinions about the triple helix style programmes. An interesting insight is that the business stakeholders tended to prioritise efforts to address what falls outside the strict definition of innovation policy, for example skills and training programmes and efforts to improve infrastructure.

Certain types of programmes emerged more and less positively when the theoretical framework was applied: the more systems and learning region based approaches emerged most positively, the cluster approaches receive very mixed reviews, and some of the triple helix style programmes receive negative reviews. A Welsh innovation paradox emerges, whereby the more commonly implemented approaches (triple helix and clusters) have received the less positive reviews, and those that are considered in a positive light follow approaches that have been less common in Wales (learning region and systems). Popular approaches, such as the EAP, have been ended without replacement, leaving the innovation support infrastructure with gaps and inconsistencies, problematically. This leads to some important questions about the approaches that have been followed in Wales, and whether these represent what has been proven to work and

to be popular amongst stakeholders, and whether enough consultation and evaluation of programmes has taken place.

How can regional innovation theory be employed in the empirical study of regional innovation policy, and what insights can it provide us?

A multi-theoretical approach is presented as a useful way to study innovation policy, producing interesting and nuanced findings. It could be argued that taking a theory developed in an exceptional leading region and applying it normatively to a weaker region is inappropriate, judging the government of that region to have failed when the results do not fit the expectations of innovation and economic development posited by the theory is problematic. Instead, a combined approach is advocated, drawing on the strengths of the four theories and mitigating against their weaknesses. In this way, regional governments can better design policy using a framework that is applicable, and adjustable, to their contexts. This thesis has demonstrated how such as multi-theoretical framework can be employed in the study of "real world" innovation policy, and illustrates how this can elicit more nuanced and sophisticated insights about the case study under examination. The theoretical framework has enabled the trends in Welsh innovation policy to be uncovered, and also a better understanding of which types of policies and programmes have been more or less successful in this context. It has been found to be a useful tool in a study of this kind, and allows a two way process whereby theory can be used to help us understand the case study better, and the findings of the case study can be fed back into the theory to advance it further.

Which theoretical regional innovation models are most relevant and applicable to explaining and understanding policy and programmes in weaker regions?

The four key theories of regional innovation were identified as a result of the literature review, and incorporating into the multi-theoretical model which allows them to be used as "lenses" to examine the Welsh case study. As such, the benefits and challenges of applying these theories in the weaker region case study have been uncovered. In the previous chapter, these are discussed in reference to the prior work that has been conducted under each of the theories, and also some suggestions are made to render the theories more applicable in the weaker region case study. In short, no one theory emerges as perfectly applicable or relevant to the weaker region situation, each has its strengths and weaknesses. However, based on the Welsh innovation paradox identified, it is suggested that the more systemic approaches could be more useful in terms of securing better innovation policy outcomes.

10.3 Contributions to Practice

Having presented the theoretical contributions of this study, this chapter now addresses the policy recommendations that arise from the work. The recommendations provided here are a result of considering which insights could be most useful to policymakers in Wales, and potentially in other weaker regions too. This section focuses on the practical application of the case study findings, as opposed to the theoretical insights provided above; it has been the intention of the study from the outset to address both.

The education agenda has an important role driving innovation, especially during the middle period of the study when the Welsh approach was premised heavily on triple helix logic of driving innovation out of universities. Weaknesses in the Welsh education system emerged as an important barrier to innovation and growth. However, the innovation and education policy agendas have evolved quite separately. The Welsh Government could develop these two spheres conjunctively, and the policymaking process could be better linked-up between the departments. If we see the education and economic departments as two forces acting on the innovation agenda, they have previously been driving in different directions; it could lead to better innovation outcomes if they could push together. Whilst there have been a number of programmes and actions focussed on higher education, this has not been extended to the earlier years and further education. Considering the importance of education at all stages to innovation and economic growth, this could be an important gap for the Welsh Government to fill.

Another distinct but overlapping sphere that emerged as important is entrepreneurship. This has not been addressed by policy since the *EAP* during the early period, and few

entrepreneurship programmes have been implemented in Wales; this was a common criticism of the Welsh Government's approach to economic development. Furthermore, the lack of a culture of entrepreneurship and innovation was cited as a barrier to growth; other programmes may struggle to achieve impact unless this is addressed. Cultural change is recognised as being very difficult for governments to achieve, and entrepreneurial education could be one means through which the Welsh Government can instil a culture of entrepreneurship from an early age. There is little evidence that this has been addressed in Wales to date, and it could be an interesting avenue for the Welsh Government to pursue to embed entrepreneurship culturally.

As well as entrepreneurship and education, another overlapping policy area that has proved central to the innovation agenda in Wales is science policy. Indeed, the approach to innovation in Wales is found to be strongly science and technology focussed, and it is argued that the science agenda has had a disproportionately strong influence on innovation. A good example of the prominence of the science agenda in Wales is the recent establishment of the office and position of the Chief Scientific Advisor. Indeed, the two agendas have often been conflated in Wales, leading to an increasingly narrow interpretation of innovation that is premised on a linear understanding. This has contributed to the over-reliance on universities as a source of knowledge and driving innovation out of this sphere rather than, for example, building up innovation capacity and capabilities in the indigenous businesses and communities. It is suggested that a wider understanding of innovation could be useful in a weaker region such as Wales, where innovation does not necessarily correlate with the very high-tech, university based, and science oriented understanding.

A common theme that emerged from the study is that the underlying ideas behind programmes are often good, but the implementation is problematic. The different

programmes and actions experience unique problems and challenges, but issues with funding and bureaucracy were highlighted time and again. In particular, programmes with European structural funding were seen as overly onerous and bureaucratic, which could be stifling innovation activities, or preventing stakeholders from engaging in the programmes available. There is a wider insight about the role government plays in the innovation system, and ensuring that this is one that is enabling, rather than restricting or stifling innovation. This thesis raises questions over whether Wales has the governance competencies and capabilities found to be so important in regional economic development by Charron (2013) and Rodriguez-Pose (2013). Designing and implementing more innovation policies and programmes, and spending more funding on these activities may not produce positive change in the Welsh innovation system if the governance competencies and capabilities are not improved. Unless this is addressed, the situation in Wales may not improve going forwards, and it is suggested that a wider and more systemic approach to innovation allows more efforts to be devoted to issues of building capabilities in the governance of the innovation and creating stronger institutions upon which to build.

The relationship and communication between the Welsh Government and other actors in the innovation system, in particular business, is improving with the new structures put in place such as sector panels and the anchor companies approach. Future programmes might be more successful if there is more business (i.e. end-user) input in the design, and it seems that the Welsh Government is moving in this direction. Bristow et al.'s (2008) criticism about the lack of effective stakeholder engagement on behalf of the Welsh Government is showing signs of being addressed through the recent developments.

Whilst the Welsh approach to innovation has traditionally been quite linear, premised on R&D emerging from universities, network-based approaches emerge as positive from the analysis conducted here. In particular, those that create links between different actors (e.g. *Cardiff Innovation Network, KTP*) have proved more successful and relevant, especially to the business sphere, than programmes premised on driving innovation out of universities in quite a one-way process (e.g. *Technium*). Government taking a step-back and allowing the other actors to design and deliver programmes, functioning as more of an enabler could be a positive direction. More research into triple helix programmes that are not government-centred is needed to explore whether these tend to produce better results, or whether the *Cardiff Innovation Network* is unique.

Despite their perceived success, more interactive approaches to innovation are relatively rare, and the Welsh Government's understanding of innovation is science and high-tech focussed. Many of the sectors and perceived strengths in the Welsh economy are in other areas, such as creative and digital, but this is not well reflected in the innovation policy and programmes. Furthermore, the Welsh Government's approach is seen as being strongly premised on jobs and employment. These are primary concerns for governments in weaker regions; however, innovation is not necessarily compatible with job growth and may involve more risk taking on behalf of the government. There are inherent tensions within the role of government in driving innovation, and involving a wider range of actors in the governance of innovation could potentially help mitigate the risks involved. The Welsh innovation system features a broad range of actors and stakeholders, including intermediary and third sector organisations, which could further assist the Welsh Government in its economic development objectives.

A mixed approach to innovation, drawing on different theories and concepts, is suggested to be more appropriate and useful in the weaker region context than applying

one approach exclusively. This would allow governments to "cherry-pick" (Laranja et al., 2008) the elements that are most useful or appropriate for their specific regional context, drawing on the strengths of the different approaches whilst mitigating against their weaknesses.

In Wales, the innovation agenda has been found to swing between different theoretical approaches across the three periods. This has resulted in programmes ending quite suddenly, often without replacement, meaning cumulative gains and experiences are lost, an example being the *EAP*. Another example of inconsistency in the Welsh Government's approach is the confusion over business support in recent years following the unpopular decision to make grants re-payable and its reversal soon after. More consistency in the Welsh Government's approach could allow knowledge and experience to accumulate from the programmes implemented and other actors in the innovation system will be better able to plan for and undertake activities in more stable innovation support environment. Rather than swinging between the different approaches, this thesis suggests a more consistent but mixed approach that implements a range of programmes along the lines of the different theories in the framework presented.

10.4 Limitations of the Study

Firstly, the methodological limitations will be explained, and in the following section, on avenues for future research, some possible solutions are provided in order to mitigate against these. As explained in Chapter 4, it is impossible to conduct a "perfect" study due to the practicalities and realities of conducting research. The first potential limitation is the over-reliance on qualitative data. The case for taking a qualitative approach has been convincingly made (Bryman, 1988; Corbin and Strauss, 2008; Gbrich, 2007; May, 2002; Silverman, 2006), and it is a perfectly valid approach to take. However, as

Richards (2005) explains: qualitative and quantitative data do not belong in different worlds, and this thesis is in danger of excluding quantitative elements to its detriment. The decision to take a qualitative approach was due to the research questions being asked, and the types of data most likely to adequately answer them. The quantity of qualitative data collected in order to do this was necessarily large, but the analysis could be enhanced in the future by adding a quantitative dimension to the study, and this could enrich the analysis of innovation programmes.

A potential limitation with the case study methodology as it has been followed here is the selection of only one case, which means the findings and results of the study are not necessarily transferable to other contexts (Stake, 1995; Yin, 2009). Wales is given as an example of a weaker region, and the findings are broadened into a wider discussion about such regions generally. However, it is recognised that such an assumption is dangerous because each place is different, and having emphasised the importance of historical, geographical, political, and cultural contexts when studying innovation it would be deficient of this thesis not to appreciate this when making assumptions about the representativeness of the single case study. As such an in-depth case study was conducted, with a large amount of data from different sources, it was not possible to conduct a comparative case-study. It was decided that a deep case study of Wales would be more enlightening and interesting, and provide more sophisticated findings than a shallow case study of two or more regions. There are potential limitations in the two methods selected – the policy review and semi-structured interviews with key stakeholders. To deal with the policy review first, this is subject to the researcher's interpretation and understanding of the documents, which could differ from person to person. The subjectivity of the policy review could be mitigated by triangulating the analysis across different researchers, but this is not possible within the PhD framework.

Similarly, the coding and analysis of the interview transcripts is subject to the individual researcher's understanding and interpretation. Regarding the second method, semi-structured interviews were deemed the best method for exploring the issues surrounding innovation policy and programmes further, but this method is subject to problems. For example, elite interviewees can push their own agendas during interview, and because of the power imbalance between researcher and participant it can be difficult to challenge this. Also, the interview transcript does not present a truth, merely one person's perception and what they chose to present. To account for these issues a multi-method approach was chosen, to allow for triangulation to take place across the data and also the sources (Bryman, 1988; Cochrane, 1998; Denzin and Lincoln, 2005; Richards, 2005; Silverman, 2006; Yin, 2009). If the study were to be repeated it would be ideal to add observation of the policymaking process to the two existing approaches to provide another source of data triangulation and deeper insights.

There are also potential limitations in the theoretical policy mapping process because it depends on the researcher's understanding of both theory and policy, and the categorisation process is certainly open to debate. Another researcher might understand and categorise the programmes differently, thus producing a different map and set of results. This is a problem that cannot be entirely mitigated in a single researcher study, but attempts have been made to make the process transparent by explaining the methodology clearly and drawing heavily on past studies of the same nature. Whilst readers may disagree about some of the programme categorisations, the logic and rationale should be clear; it is intended as an interesting approach to studying regional innovation policy that has added another dimension to the case study.

10.5 Avenues for Future Research

Through consideration of the study's weaknesses or shortcomings ideas for future research have emerged. The methodological limitations of the study provide an obvious avenue for future research, in order to incorporate more mixed methods and data to strengthen the case study and its findings. The primary avenue for doing this would be to include quantitative data and analysis, in order to support the qualitative analysis of the various programmes and interventions. This would help to build up a more detailed picture of how successful or otherwise the various interventions have been in Wales. Also fruitful could be to combine more qualitative data into the analysis. In particular, the addition of observational methods could enrich the data and help expand the research to look in more detail at governance issues and the policymaking process as it is conducted, as opposed to how it is reported by stakeholders. This would require some careful consideration of access issues, but it not out of the question.

Another important direction for future research is to conduct similar studies in other regional contexts, both weaker and stronger, and to compare the findings with the Wales case to explore how representative and transferable they are. This thesis has proposed a multi-theoretical framework that can be employed in the study of "real world" innovation interventions, and has tested this approach through the Wales case study, finding it to be a useful tool to illicit more nuanced findings about the Wales case and to feed the findings of the case study back into theory. This framework requires testing in other regional contexts to explore how useful it is outside of the particular Wales case, and whether the findings from Wales are anomalous, or representative of other weaker regions. A first stage could be to explore other weaker regions within the EU, that are of a similar size and nature to Wales, for directly comparable studies. The second stage

could be to expand the analysis beyond weaker regions to explore how specific to the weaker region context is the framework itself and the findings it elicits.

The focus of this work has been the Welsh level of policy and programmes, with less reference to the European, UK and local levels. This was due to the discussion by interviewees of Welsh supports dominating (a notable exception being the KTP programme), and the policy review being focussed on the Welsh level. A fruitful avenue for future research would be to study the other levels of policymaking, perhaps using the multi-level governance framework to explore how the different levels of policy interact and impact upon the Welsh innovation system. This would provide a richer picture of how the different levels of policymaking interact and co-evolve, further explaining the evolution of the Welsh approach and reasons behind this. Also, with the next round of structural funds arriving in Wales in 2014 there will be another round of programmes and actions to study and it will be interesting to continue to track the evolution of the Welsh approach in the next stage.

The research questions formulated for this study asked how innovation policies and programmes have evolved in Wales, and how successful these have been from the perspectives of key stakeholders in the innovation system. An important further research question that arises from answering these questions is why the innovation agenda evolved as it did in Wales. This has begun to be addressed, with insights provided from interviews especially providing some explanation of why certain agendas were pursued and others were sidelined. However, a fruitful route for further study would be to address this question of why in greater depth. This would probably require further interviews with more politicians and decision makers at the Welsh, and also UK, European, and local levels, to find out why certain decisions were made and by whom. Access to such decision makers proved a challenge, in particular elected political

representatives, but it would certainly prove an interesting route to follow in future to supplement and deepen the broader overview provided here.

10.6 Key Findings & Contribution

This thesis has contributed to the fields of regional and innovation studies: it has presented a history of Welsh innovation policy and programmes since devolution; it also proposes and empirically tests a multi-theoretical framework for studying innovation policy in weaker regions. It builds directly on the prior work conducted by economic geographers in Wales (e.g. Bristow et al., 2008; Cooke 1998, 2003, 2005; Cooke and Morgan, 1998; Morgan, 1997, 2012; Pickernell, 2011), and also by the key theorists of innovation and economic development at the regional level (e.g. Asheim, 2012; Cooke, 1996; Etzkowitz and Leydesdorff, 1997; Lundvall, 1988; Martin and Sunley, 2003; Morgan, 1997, 2007, 2012; Porter, 1998; Rutten and Boekema, 2007). Insights have been gained both about the Wales case study, and about the applicability and usefulness of innovation theory itself. This final concluding section will reiterate the key contributions of the study firstly regarding the Wales case study, and secondly relating to innovation theory.

Regarding the Wales case study, the most pertinent contributions of the study are distilled into three main points: the "Welsh innovation paradox"; the instability of the policy approach to innovation over the last fifteen years; and the narrow conceptualisation of innovation as predominantly science and technology based. The concept of the Welsh innovation paradox is introduced, whereby the most commonly implemented approaches to innovation have been the least favourably reviewed. And those interventions that receive positive reviews and are seen to have been successful have been less commonly implemented, and several were ended without replacement. This finding suggests that the most appropriate and effective approaches have not been

followed in Wales, and the Welsh Government has not been implementing what "works". Furthermore, the innovation approach has been found to vary over time, according to the three time periods identified by this study, resulting in a lack of stability in the approach to supporting innovation. Some important questions are raised about the governance capabilities and capacities in Wales. A need for a broader conceptualisation of innovation is highlighted, as opposed to the narrow science and technology interpretation favoured by the Welsh Government, which has resulted in a very university driven approach to the innovation system.

In terms of the more theoretical contributions of the study, no one theoretical approach has been found to provide a perfect framework for studying and implementing innovation policy in a weaker region. A multi-theoretical framework is proposed as a means of mitigating against the weaknesses of taking one theoretical approach and applying it normatively. The process of transplanting approaches from leading to weaker regions in a wholesale manner is found to be problematic. However, a mechanism is needed whereby policymakers can incorporate best practice from elsewhere, whilst taking account of their individual regional contexts and needs. A multi-theoretical approach is proposed as a mechanism for better considering regional contexts and nuances, avoiding a one-size-fits-all approach to innovation policy and programmes.

The experience of Wales since devolution has provided two valuable opportunities. First, it enables us to make specific and practical recommendations regarding policy decisions on the basis of the perceived successes and failures of the past. Fifteen years on, the current situation, when viewed as the consequence of past decisions, can give useful pointers to the direction future policy should take. Second, we may regard Wales as an interesting case study in a much wider sense, teaching us more general lessons about the economic well-being of weaker regions. Some conclusions will clearly be

specific to the Welsh experience, but undoubtedly will have implications for other similar regions.

Perhaps the most telling conclusion we could draw is that a deep knowledge of the realities of the political, economic and cultural identity of each region really is essential in order to implement the most appropriate policies for their future. For a region to flourish economically and culturally, careful consideration of the unique characteristics of a place must always remain an essential element in the application of theory.

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Appendix 1 - Interview Schedules

Interview Questions for Businesses / Business Representatives

1) What are the key issues for business regarding innovation- are there constraints?
   - If so, what are the main constraints/ barriers to business innovation?

2) Do you think efforts have been made to alleviate these problems?
   - Efforts by government- policies/ programmes/ funds
   - Efforts by academia
   - Efforts by business sector

3) What have been the most important innovation programmes/ policies from the perspective of business?
   And why?

4) Which have been unsuccessful/ not useful?

5) How do you communicate with government about business opinions and needs in terms of innovation?
   - Can you take me through the process from policy conception to delivery?

6) How frequent is this communication?

7) In your opinion, how well taken into account are the views and opinions of the business sector by government?

8) What direction would the business sector like to see policy taking in the future?

   - And how well does this correspond with the direction it is currently heading?
   - E.g. sector based approach, smart specialisation, city regions....

9) Why do you think we have seen little improvement in the Welsh economy according to the major economic indicators, and what can be done to improve the situation?

Interview Questions for Academics

1) What is the role of academia in creating an innovative environment in Wales?
- How successful do you think academia is in doing this?

2) Is government policy supporting academia to do this?
- Which policies in particular
- E.gs A4B, Spin Out Wales, KTP etc?
- How effective are these programmes?
- What else do you think could be done to help academia contribute to raising innovation?

3) Have you been involved in providing advice to policymakers, or evaluating Welsh policy (since devolution)?
- If so, which policies / programmes in particular?

4) How do you present your views/ opinions to government?
- How often?
- Do you think your views are taken into account

5) Which policies/ programmes do you see as being successful and why? And how do you evaluate this?

6) And which do you see as unsuccessful and why?

7) How do you see the development of innovation/ economic policy in Wales following devolution?

8) Do you see academic ideas about innovation translating into policy?
- Can you give any examples?
- And if no, why do you think this is?
- What do you think academia/ government could do to remedy this?

9) Why do you think we have seen such little improvement in the Welsh economy according to economic indicators?
- What can academia do about this?
- What can government do about this?

10) Finally, how confident do you feel about the Welsh situation improving?

Interview Questions for Policy and Programme Implementers/Deliverers

1) How are you or your organisation involved in delivering innovation related programmes/ projects in Wales?

2) Which levels of government do you have the most interaction with? Which is the most important to your work?
   - Welsh Government
   - UK Government
   - EU/ European Commission
   - Local Government

3) What is your relationship with policymakers in the Welsh Government, and how do you communicate?
   - How often?
   - Is there two way dialogue?

4) Which programmes have proved successful in your opinion, and why?
   -How do you evaluate this?

5) And which have proved unsuccessful and why?

6) Where does the funding and direction for projects come from?
   - Government – which level?
   - EU programmes
   - Private

7) What are the main problems you face when delivering innovation related programmes?

8) Why do you think despite the number of programmes and resources does Wales continue to lag behind economically?

Appendix 2 - Examples of Interview Letters

Letter to Politician

Dear (Name Removed),

My name is Rhiannon Pugh, and I am a PhD student at Cardiff University. My PhD research is looking at innovation and economic policy in Wales, for which I am currently undertaking the fieldwork.

I am especially interested in gaining a wide range of different perspectives on Welsh innovation and economic policy, including those of politicians with responsibilities for this topic in Wales. I would very much like to gain your opinions and perspectives on this subject based on your role as the (position removed). I am interested in finding out your views on what has happened in terms of innovation and economic policy and programmes in Wales following devolution, where it is heading in future, and what is your stance on innovation as a driver of economic growth.

Currently, I am undertaking interviews with different stakeholders, including those from the business, academic, government spheres, and also the third sector and civil society; I aim to achieve a balanced and unbiased study which presents the perspectives of the main actors in an equal light. I think that the perspective of all of the main political parties should be represented in order to present a balanced view.

I wonder whether you would be willing to be interviewed as part of my research? I am flexible as to when and where, and can also send some questions in advance if you would like. The interview would take no more than an hour; I expect you are very busy but if you could find some time in your schedule I would be extremely grateful and delighted to speak to you about such an important topic for the future of Wales.

In case you have some concerns about participating in this research please be assured that this study follows the university's ethical guidelines; participants can each decide how they wish to be represented (i.e. named or anonymised), and all interview content being used will be sent to the participant first to be reviewed.

I would very much appreciate any input you can give to this project. Please feel free to contact me on the details provided via email, phone, or in writing. I look forward to hearing from you.

Yours sincerely,

Rhiannon Pugh

Letter to University Tech Transfer Professional

Dear (Name Removed),

My name is Rhiannon Pugh, and I am a PhD student at Cardiff University. My PhD research is looking at innovation and economic policy in Wales, for which I am currently undertaking the fieldwork.

I am especially interested in gaining a wide range of different perspectives on Welsh innovation and economic policy, and build up a detailed picture of innovation activities taking place across Wales and how these have developed over the last decade. I would very much like to gain your opinions and perspectives on this subject based on your role as Director of Commercialisation and Consultancy Services at (Institution Removed). I am interested in finding out your views on what has happened in terms of innovation and economic policy and programmes in Wales relating to universities' innovation related activities, and also about the role universities in Wales have to play in the innovation system.

Currently, I am undertaking interviews with different stakeholders, including those from the business, academic, government spheres, and also the third sector and civil society; I aim to achieve a balanced and unbiased study which presents the perspectives of the main actors in an equal light. I think that your perspective is important to this study, because of the key role universities in Wales play as drivers of innovation and economic growth. It is also important to me that the perspectives of actors from across Wales are represented, not just those based in the South of Wales.

I wonder whether you would be willing to be interviewed as part of my research? I am flexible as to when and where, and can also send some questions in advance if you would like. The interview would take no more than an hour; I expect you are very busy but if you could find some time in your schedule I would be extremely grateful and delighted to speak to you about such an important topic for the future of Wales.

In case you have some concerns about participating in this research please be assured that this study follows the university's ethical guidelines; participants can each decide how they wish to be represented (i.e. named or anonymised), and all interview content being used will be sent to the participant first to be reviewed.

I would very much appreciate any input you can give to this project. Please feel free to contact me on the details provided via email, phone, or in writing. I look forward to hearing from you.

Yours sincerely,

Rhiannon Pugh

Letter to Policymaker

Dear (Name Removed),

My name is Rhiannon Pugh, and I am a PhD student at Cardiff University. My PhD research is looking at innovation and economic policy in Wales, for which I am currently undertaking the fieldwork. I hope you don't mind me writing to you about my work.

I am interested in gaining a wide range of different perspectives on Welsh innovation and economic policy, including those within the Welsh Government. I would very much like to gain your opinions and perspectives on this subject based on your role heading the (Department Name Removed) at the Welsh Government. I am especially interested in finding out about the direction innovation and economic development is heading in Wales, and would very much like to speak to you about the current sectoral approach. Alastair Davies suggested I get in touch with you, because he thought that it would be very interesting for me to speak to you, and that you might be willing to contribute to my research.

I wonder whether you would be willing to be interviewed as part of my research? I am flexible as to when and where, and can also send some questions in advance if you would like. The interview would take no more than an hour; I expect you are very busy but if you could find some time in your schedule I would be extremely grateful and delighted to speak to you.

In case you have some concerns about participating in this research please be assured that this study follows the university's ethical guidelines; participants can each decide

how they wish to be represented (i.e. named or anonymised), and all interview content being used will be sent to the participant first to be reviewed.

I would very much appreciate any input you can give to this project, and it would be great to speak to somebody such as yourself who is at the heart of innovation and economic development policy in Wales. Please feel free to contact me on the details provided via email, phone, or in writing. I look forward to hearing from you.

Yours sincerely,

Rhiannon Pugh