The evolution of innovation policy in Styria – the impact of the regional innovation system concept

Stefan Kah

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Abstract

This study explores the concept of regional innovation systems (RIS) and its impact in practice. Taking a governance perspective at RIS, it describes how Styrian innovation policy has developed over time, how this has been shaped by the RIS concept and what challenges remain for innovation policy. Styrian policy-makers were amongst the early adopters of the RIS concept in the 1990s, explicitly referring to its terminology and assumptions. The region then went through a series of policy reforms, both in terms of strategies and innovation instruments, which allow observing how the region adjusted itself to new trends and ideas. The study shows that the RIS concept had a measurable impact on current Styrian innovation policy-making, but that the visibility of this impact changed over time. It also shows that the Styrian system of innovation policy governance is complex: many actors, many strategies and even more instruments. This complexity is partly a result of RIS-based innovation policy-making itself and brings a set of challenges discussed in the paper.

This study has been carried as part of a Masters degree of Research in Business and Management at the University of Strathclyde's Business School.[1]

[1] Research for this study has been carried out until the end of 2014. Any later changes to Styrian or Austrian policies have not been considered.

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Abbreviations

BMVIT	Federal Ministry for Transport, Innovation and Technology (Bundesministerium für Verkehr, Innovation und Technologie)
BMWFW	Federal Ministry of Science, Research and Economics (Bundesministerium für Wissenschaft, Forschung und Wirtschaft)
FFG	Austrian Research Promotion Agency (Österreichische Forschungsförderungsgesellschaft)
LCU	Leading Competence Units
NIS	National innovation system
RIS	Regional innovation system
RTDI	Research, technological development and innovation
SFG	Styrian Business Promotion Agency (Steirische Wirtschaftsförderungsgesellschaft mbH)

1. INTRODUCTION

This study takes a look at the concept of regional innovation systems (RIS) and its impact in practice. RIS have not only become increasingly popular concepts used to describe innovation processes in a spatial context, but also to act as rationale for policy interventions. Taking the example of the Austrian federal state of Styria, the author looks at how the concept has shaped innovation policy and how this changed over time. Styria lends itself well as case study. Policy-makers in the region were amongst the early adopters of the regional innovation system concept in the 1990s, explicitly referring to its terminology and assumptions. Styria also went through a series of policy reforms, both in terms of strategies and innovation instruments, which allow observing how the region adjusted itself to new trends and ideas.

This paper takes a governance perspective at regional innovation systems. It examines how innovation policy evolved in Styria and to what extent the regional innovation system concept influenced innovation policy-making. It is also a stock-take of the varied innovation-related activities in Styria.

After an introduction to the theoretical background of research around regional innovation systems (Section 2), the research approach and research questions are presented (Section 3). Section 4 explains the Styrian innovation system, including the complex governance arrangements. This leads to the main empirical part, which looks at the regional innovation system impact on Styria's strategic approach (Section 5.2) and on policy instruments (Section 5.3). This allows some reflections on Styria's innovation system (Section 6), including how the RIS concept contributed to shaping it and some policy reflections. Section 7 concludes this paper.

2. THEORETICAL BACKGROUND

2.1 Introduction

This section explains the theoretical foundations of innovation systems, focusing on the concept of regional of regional innovation system (RIS). A RIS is one of many attempts that try to describe and explain the economic performance of regions. It is similar to other concepts such as, for instance, innovative milieux (Camagni 1991), industrial districts (Becattini 1992) and learning regions (Morgan 1997), which all look at the conditions for innovation as part of regional development processes. It is also close to the triple helix model of innovation (Leydesdorff and Etzkowitz 1998), which distinguishes between the dimensions of government, industry and higher education. Yet, RIS have a stronger emphasis on spaces in which innovation occurs. RIS are aimed at describing the relationships between innovation, learning and economic performance within a region (Doloreux and Parto 2005).

After a brief look into evolution of the concept from a national-level perspective to a subnational or regional one (Section 2.2), various definitions of RIS are presented and discussed, including the main RIS characteristics (Section 2.3). Section 2.4 presents the systematic aspect of RIS, while Section 2.5 provides an introduction into its relevance as a policy concept. Section 2.6 draws together the main messages of Section 2.

2.2 Evolution from national to regional innovation system

The concept of RIS is closely related to and stems from the concept of national innovation system (NIS). Freeman (1987; 1995), Lundvall (1992) and Nelson (1993) developed the concept of NIS with the aim of assessing innovativeness by examining interactions between actors. This was in part because the alternative approach of measuring innovation inputs and outputs has proved to have its limitations when assessing the innovativeness of a country, as such indicators do not explain how inputs are better translated into outputs in some cases than in others. The concept of NIS stresses the importance of relations between public and private actors. A ‘web of interaction’ (OECD 1997) is the focus of such thinking and processes rather than static indicators are the object of investigation: ‘The national innovation systems approach stresses that the flows of technology and information among people, enterprises and institutions are key to the innovative process’ (OECD 1997). NIS are not only descriptive tools, but the understanding of how a NIS works provides policy makers with potential leverage points for interventions aimed at an increased innovation performance (OECD 1997).

Building on the concept of national systems of innovation, the idea of sub-national or regional innovation systems (RIS) has been developed. Several authors (Cooke, Gomez Uranga et al. 1997) argued that innovation systems are not limited to the level of national states. Freeman (1995), for instance, noted that the importance of regional systems is implicit to NIS. He pointed out that already Marshall (1890) recognised the role of regional systems such as industrial districts. Cooke (1992; 1998) argues for the use of RIS instead of NIS as frameworks for studying economic and innovative performance, since, due to their size, national systems entail distance and time effects. Similarly, Malmberg and Maskell (2002)

perceive innovation as a locally embedded process that needs to be investigated at a sub-national scale.

The importance and positive role of proximity has been stressed by several authors (Maskell 2001; Kitson 2011; Presutti, Boari et al. 2011). Yet, proximity is not necessarily geographical. Boschma (2005) defined five main types: cognitive, organisational, social, institutional and geographical. Cognitive proximity is related to the way in which firms gather knowledge, i.e. there must be some cognitive overlap between firms to allow learning through interaction. Organisational proximity is defined as the extent to which relations are shared in organisational arrangements. Social proximity instead looks at social relations between individuals at the micro-level, while institutional proximity is based on both formal institutions such as laws and rules and informal institutions, e.g. cultural norms and habits. Finally, geographical proximity is seen purely looking at spatial distance. Boschma acknowledges that the different forms of proximity are closely related and therefore delimitation is not always clear-cut. He argues that geographical proximity is merely strengthening other forms of proximity, and it is neither a necessity nor a sufficient condition for interactive learning.

The transfer of the concept to the regional level is also part of the reassessment of the regional scale as economic operating level amongst academics in the late 1990s. The main arguments in favour of a more regional focus of innovation systems include physical proximity but go beyond it (Grasenick 2006):

- Many conditions and factors for innovation are not very mobile, e.g. human capital und non-codified knowledge;
- physical proximity facilitates closer and more frequent face-to-face interaction;
- spatial concentration of R&D leads to local and regional knowledge spillovers;
- networks of firms are facilitated by physical proximity; and
- firms based in the same region are more likely to possess the same ‘regional culture’ of business-making.

Related to the aspect of ‘regional culture’ is the importance of trust amongst actors. On the one hand, it can be an important precondition for the creation of networks, but on the other hand it can also be the result of networking. Tödtling and Trippl (2004) argue that trust can be built up over time, a fact that is especially important in old industrial regions which tend to suffer from a lack of trust. This is where policy or governance can play an important role by encouraging increased interaction between regional actors.

More recent studies do not necessarily differentiate explicitly between NIS and RIS, and one can argue that their essential difference can be reduced to their spatial scale. Their distinction is often constructed anyway, and this is exemplified in federal countries with strong regions, e.g. Austria, Germany and especially Belgium. Confusingly, RIS terminology is sometimes used also in case studies on smaller countries e.g. (Asheim, Coenen et al. 2003; Koschatzky 2004). Some authors (Oinas and Malecki 2002) use the term spatial innovation system (SIS). The SIS concept acknowledges that innovations are created via technological paths among various locations through time and emphasises the importance of external relations of actors.

The following sections look at definitions and main characteristics of RIS (Section 2.3), their systemic composition (Section 2.4) and their role in policy (Section 2.5).

2.3 Definitions and main characteristics

In order to find a suitable working definition of RIS, it is worth taking a look at a number of definitions of RIS and NIS and to look at their commonalities and differences (see Table 1). Although there is no common definition of a RIS, authors widely agree on some key elements. Early definitions, still looking only at the national dimension, highlight especially the role of institutions (Freeman 1987; Nelson 1993; Metcalfe 1995), which interact with each other in order to 'initiate, import, modify and diffuse new technologies' (Freeman 1987) or to contribute to 'technological learning' (Patel and Pavitt 1994). Later definitions, then oriented rather towards the regional dimension, speak of systems and sub-systems (e.g. (Autio 1998; Cooke, Braczyk et al. 2004) or systemic processes (OECD 2011). Another key assumption of RIS is that innovation processes are highly interactive, therefore the creation of networks is essential (Tödtling and Trippl 2004). The governance dimension of RIS, which is of special interest in the context of this study, has been explicitly added by Tödtling and Trippl (2004), although already Freeman (1987) had mentioned the public sector. However, key terms and concepts in the research on RIS have often been defined insufficiently in existing studies (Doloreux and Parto 2005). Especially the systemic aspect has not been explored sufficiently (Cooke 2003; Tödtling and Trippl 2004).

Table 1: Definitions of regional and national innovation systems

Definition	RIS/ NIS	Source
"…the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies."	NIS	Freeman (1987)
"…the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge … and are either located within or rooted inside the borders of a nation state."	NIS	Lundvall (1992)
"…a set of institutions whose interactions determine the innovative performance … of national firms."	NIS	Nelson (1993)
"…the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country."	NIS	Patel and Pavitt (1994)
"…that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies."	NIS	Metcalfe (1995)
"…two sub-systems … constitute the main building blocks of RSIs. These are the knowledge application and exploitation sub-system and the knowledge generation and diffusion sub-system." "…social systems, composed of interacting sub-systems."	RIS	Autio (1998) Autio (1998)
"…a regional innovation system consists of interacting knowledge generation and exploitation sub-systems linked to global, national and other regional systems for commercialising new knowledge."	RIS	Cooke et al. (2004)
"A RIS is made up by two sub-systems embedded in a common regional socioeconomic and cultural setting: The knowledge application and exploitation sub-system … [and] the knowledge generation and diffusion sub-system […]. Additionally, we include the regional policy dimension neglected in Autio's model."	RIS	Tödtling and Trippl (2005)
"…the set of economic, political and institutional relationships within a given geographical area that generates a collective learning process, leading to the rapid diffusion of knowledge and best practice."	RIS	ONRIS[2] (2006)
"[In a RIS, innovation is] … a cumulative and non-linear systemic process. It results from the formal and informal, voluntary and involuntary interactions between different agents operating in the innovation system. Firms are the main repositories of technical knowledge and know-how and the primary agents in the search for innovation."	RIS	OECD (2011)

Source: Compiled by the author, adapted from (OECD 1997).

[2] Ontario Network on the Regional Innovation System, http://www.utoronto.ca/onris (accessed 15 December 2015).

For the scope of this report, the definition of RIS is closely following the definitions of Autio (1998), Cooke et al. (2004) and Tödtling and Trippl (2005): *A RIS consists of interacting knowledge generation and exploitation sub-systems embedded in a regional socioeconomic and cultural setting and influenced by regional and innovation policy*.

Although RIS and NIS provide usual frameworks to illustrate processes of innovation, there are a series of weaknesses and unresolved issues. Examples include:

- Proximity is a facilitator for innovation, but it can also be an inhibitor. While many supporters of RIS perceive proximity only as a positive factor, geographical and other forms of proximity may have detrimental effects to learning and innovation. An example is the lock-in effect, i.e. a lack of openness and flexibility, which has been often diagnosed in old industrial regions (Boschma and Lambooy 1999).
- RIS lack clear spatial delimitation. Since regions do not have fixed borders it is unlikely that interactions will take place primarily within regional administrative boundaries. For instance, Tödtling and Trippl (2005) emphasise the role of extra-regional actors. RIS are no self-sustaining units but are in continuous exchange with other RIS and knowledge generators and applicators from outside the region. In fact, the openness of a RIS might even be part of its strengths. Some decisions and resources related to innovation are based outside the region, often at higher spatial level, i.e. national or international (e.g. EU).
- RIS are only an insufficient basis for policy prescription. They might provide useful ways to describe certain economically successful regions, but their suitability to prescribe policy intervention has not been explored sufficiently. According to Doloreux and Parto (2004), the validity of policy recommendations generated from research on RIS is dubious. Since context specificity and regional embeddedness are characteristics of RIS (Autio 1998), good practices from a successful RIS are difficult to transfer to a different regional setting.
- The innovation focus of economic and regional development policy cannot be generalised. Increasing regional competitiveness on the basis of innovation is not a goal applicable to all regional economies. For instance, some poor and underdeveloped regions may lack the potential for innovation-based policies, at least if innovation is understood in a traditional, technological way.
- Trust amongst actors is an important factor for a successful region. However, it is not necessarily a precondition for the creation of networks, but can also be a result of networking. Tödtling and Trippl (2004) argue that trust can be built up over time, a fact that is especially important in old industrial regions which tend to suffer from a lack of trust. This is where policy or governance can play an important role by encouraging increased interaction between regional actors.

Over the past 20 years or so, research on RIS has widely been based on case studies, and Table 2 gives a number of examples showing the wide range of spatial units to which a concept of RIS has been applied. It can be noted that the choice of cases is clearly skewed towards comparatively innovative and high-performing areas. Existing research tends to look for cases that allow for the use of the RIS concept to describe good practices. Although there are examples of old industrial areas with structural challenges, such as Tampere in Finland or Wales, also these can be seen as best practice studies, as these regions showed positive

development trends over time. Also Styria, which is a typical example for a sub-national administrative unit used as study unit, falls into this category. Tödtling and Trippl (2004) looked at the RIS of Styria and in order to explain the successful renewal of clusters in old industrial areas. As they pointed out, there has not been a lot of research on renewal processes in old industrial areas. Based on their analysis of the Styrian case, they concluded that critical factors of a successful cluster renewal are a well-developed RIS, newly established innovation networks and an innovation-related policy approach (Tödtling and Trippl 2004).

It can also be noted that spatially defined innovation systems such as NIS and RIS are popular concepts especially in smaller countries: Southeast Brabant in the Netherlands (Boekholt and van der Weele 1998), Wales (Cooke 1998), Slovenia (Koschatzky 2004), Denmark, Finland, Iceland, Norway and Sweden (Asheim, Coenen et al. 2003).

Looking more closely at the different scales of analysis for RIS, Doloreux and Parto (2004) distinguished five levels: local (e.g. districts within cities), cities, metropolitan regions, statistical regions (NUTS 2) and the supra-regional/sub-national scale. For Table 2, these categories have been reorganised and the national level, i.e. NIS, has been added. The table assesses the geographical proximity of actors, how self-contained the studied areas are, their institutional capacity and the availability of statistical data. For each spatial level, the table also lists some examples of application of the RIS concept.

Table 2: Levels of analysis for RIS

Level of analysis	**National**	**Sub-national (regional)**	**City / Metropolitan areas**	**Sub-city**
Proximity of actors	Low	Medium	High	High
Self-containedness	High	Mixed-high	Mixed	Mixed
Institutional capacity	High	High-mixed	Low-mixed	Low
Availability of statistical data	High	Mixed	Low	Low
Examples	Japan (Freeman 1995) Denmark (Nelson 1993) Slovenia (Koschatzky 2004)	Ontario (Gertler and Wolfe 1998) Wallonia (Boekholt and van der Weele 1998) Styria (Tödtling et al. 1998) Swedish regions (Doloreux 2002)	Barcelona, Stockholm and Vienna (Diez 2002) Vienna (Trippl 2011)	Garment district, New York (Rantisi 2002) Software industry, Oslo (Isaksen 2004) Electronic cluster, Toronto (Britton 2003)

Source: Compiled by the author, partly based on Doloreux and Parto (2004).

Proximity of actors relates purely to geographical proximity, neglecting other forms of proximity (see Section 2.5). Smaller geographical units such as cities or metropolitan areas allow more interaction between innovation actors. Geographies that are self-contained allow

minimising the degree of interaction of the innovation system with factors from outside. While local systems are likely to be too small for a clear delineation, regions have a potentially high self-containedness, depending on their size, institutional endowment and relative independence in their national context. The highest degree of self-containedness is offered by entire countries, which gather all relevant institutions in their territory, albeit to different degrees. Nevertheless, also NIS are not insular and are embedded into the wider international context. Institutional capacity can range between low and high at all spatial levels, but is typically higher in nation states than in local units. At sub-national regional levels institutional capacity differs widely according to the centralisation present in a country. Finally, the availability of data is usually significantly better at national level, sometimes even allowing some comparison due to information provided by Eurostat for EU Member States.

2.4 RIS as systems

The notion of conceptualising innovation processes in a defined space as a 'system' proves beneficial, as it provides a tool for analysis and a guide for policy formulation. It looks at interactions and interfaces between actors rather than at the performance of its individual components (Heydebreck and Gabrielsson 2013).

The complexity of RIS and NIS led to several attempts to visualise the complex interactions between the variety of actors. This section presents the approaches of Autio (1998), OECD (1999) and Tödtling and Trippl (2005) (later updated by Trippl and Otto (2009)), as these form the basis for the present research on Styria.

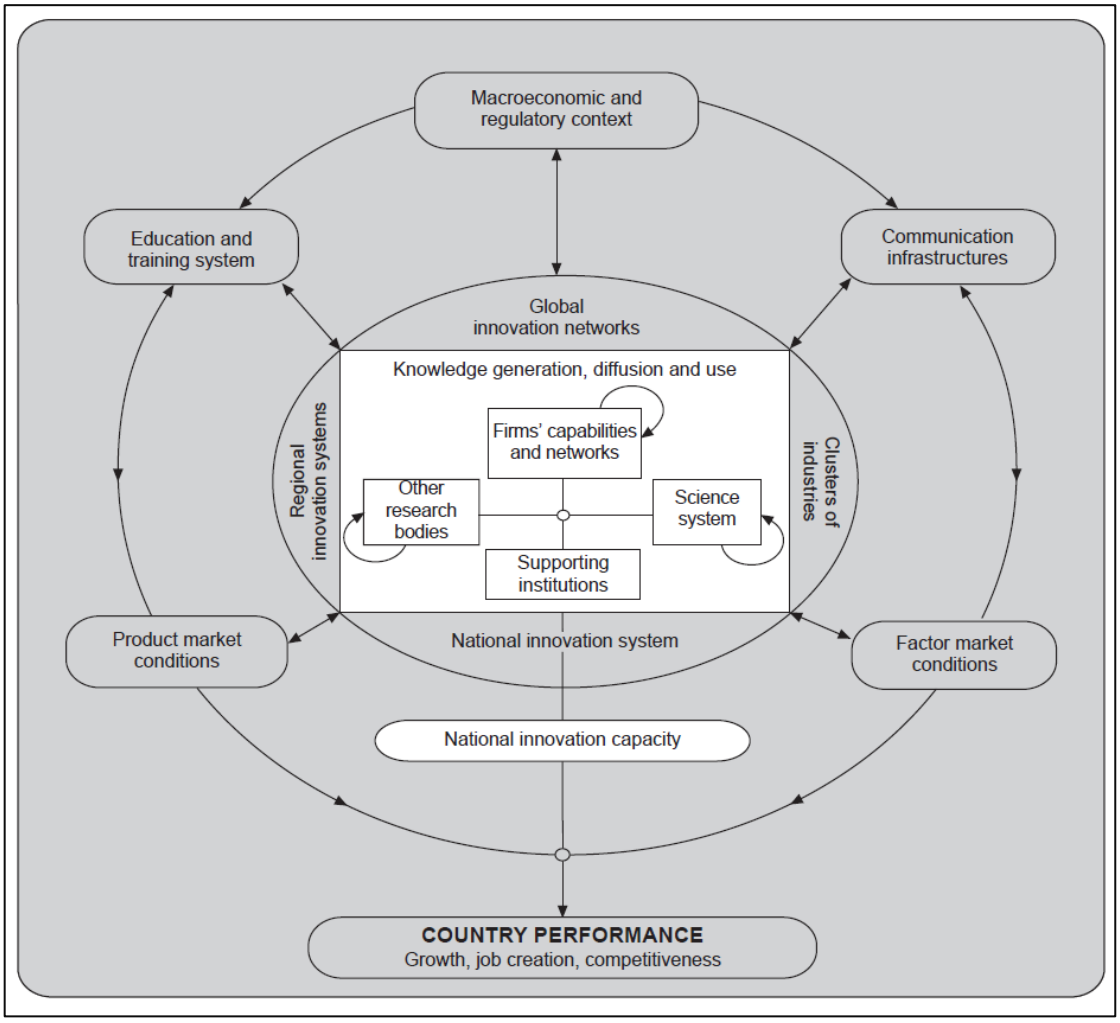
Autio (1998) was the first to provide a model that distinguishes explicitly between two main dimensions of RIS. In both of his two sub-systems knowledge stands at the centre. In the first sub-system, knowledge is generated and diffused, while in the second sub-system knowledge is applied and exploited. The two sub-systems interact with each other and exchange knowledge, but also human capital and other resources. The knowledge generation and diffusion sub-system consists of four different groups of institutions covering public research, technology mediation, education and workforce mediation. Public research institutions generate knowledge, which is disseminated directly or through technology mediating institutions. Educational and workforce mediating institutions diffuse knowledge and by this shape the regional skill base. The knowledge application and exploitation sub-system instead is located in the businesses realm and 'uses' the knowledge provided by the other sub-system. It consists of industrial companies interacting with the 'Four Cs' (Autio 1998) of customers, contractors, collaborators and competitors. Both SMEs and larger companies form networks with the four Cs. These can be vertical, e.g. with customers, or horizontal, e.g. with competitors.

Autio's approach to RIS is very much focussed on actors and processes. In his guidelines on how to evaluate RIS, one key message is that 'the main emphasis of the evaluation should focus on the processes' (Autio 1998). Measuring innovation inputs or outputs instead will not only suffer from validity problems but these will also not always be suitable indicators for successful innovation. Hence, he suggests looking at the relation between the constituent elements of RIS and how these interact with each other. These interactions can be facilitated by policy conditions and interventions and therefore should lie at the centre of innovation

policy-making. However, it is more challenging to study processes and relations rather than measuring inputs or outputs.

In 1999, the OECD presented a paper on managing national innovation systems. In this, it included a model of how actors are connected to each other (Figure 1).

Figure 1: Actors and linkages in a NIS according to OECD (1999)



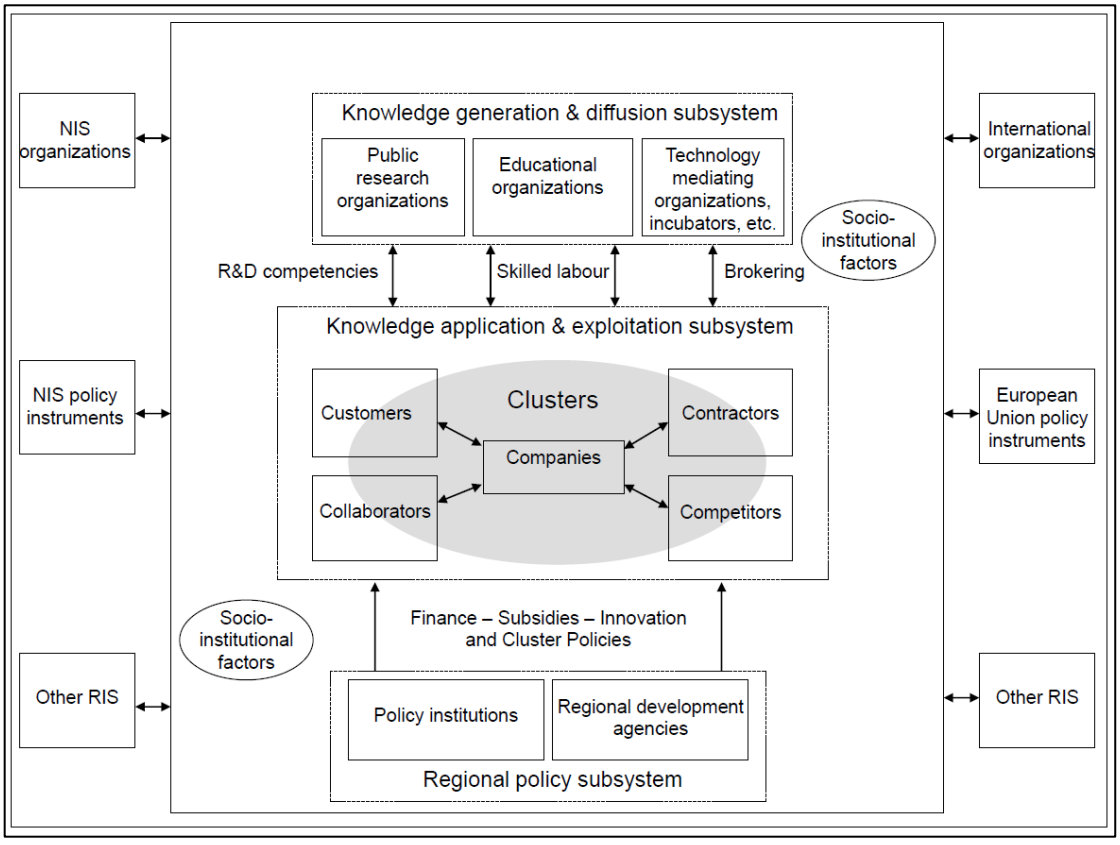
Source: OECD (1999).

The OECD's model has a 'knowledge generation, diffusion and use' sub-system at its centre. Within it, it distinguishes between the generators (science system and other research bodies) and users (firms). It also includes supporting institutions, which can be understood as both governance actors and institutions facilitating the 'diffusion' aspect of knowledge. Although the OECD focusses on NIS, the model also acknowledges the existence of RIS.

Autio's model from 1998 is relatively closed and considers policy aspects only as part of external influences, Tödtling and Trippl (2005) went a step further. They extended Autio's model by adding a policy element as the third dimension next to the knowledge generation/diffusion and knowledge application and exploitation sub-systems (Tödtling and Trippl 2005). Already Autio's main interest was the interface between the two sub-systems,

but since this is where policy can play an active role, Tödtling and Trippl upgraded this external factor to the third dimension of a RIS. Yet, in the version of this model revised by Trippl and Otto (2009; 2012) (see Figure 2), the regional policy sub-system has a direct impact only on the knowledge application and exploitation sub-system, not on the knowledge generation and diffusion sub-system. In practice though, regional policy is likely to also affect elements of the latter, e.g. technology mediating institutions. Nevertheless, the model according to Trippl and Otto provides a comprehensive overview of actors and processes in a RIS. Regional innovation takes place mainly via interaction of three actor groups, or sub-systems, mentioned above, but it is not isolated from external influences. These influences can be national, i.e. actors and policies of national innovation systems, or international, i.e. European or other international innovation actors, EU policy instruments and multinational companies. Finally, also other RIS actors in other regions play a role, be it as competitor or partner.

Figure 2: RIS with three sub-systems according to Trippl and Otto (2009)

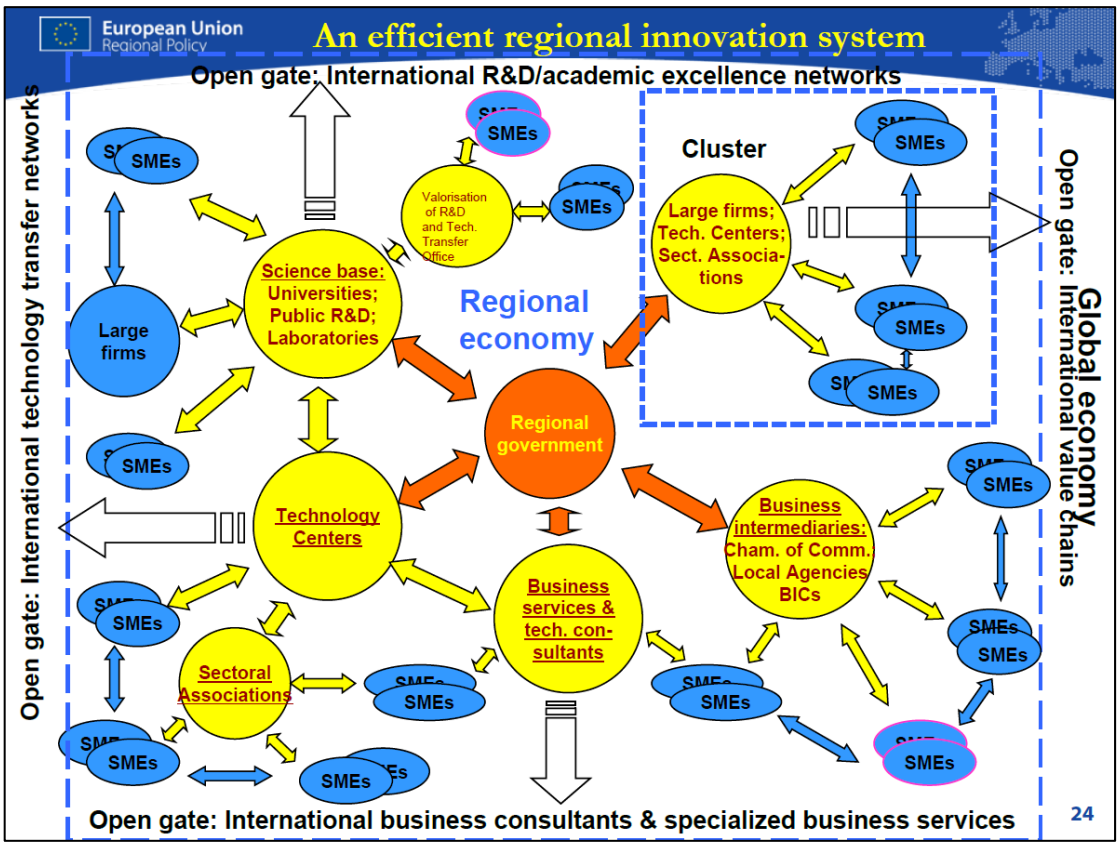


Source: Trippl and Otto (2009).

Several other models of RIS have been developed over time and many share the division of the relevant actors into three groups. Fritsch (2003), for instance, distinguishes between industrial enterprises, service providers and research institutions. Landabaso (2010) developed a highly complex model of RIS, that shares Tödtling and Trippl's assumptions of three different actor groups: businesses (knowledge application), RTDI institutions (knowledge generation) and regional development (policy). A graphical representation of his model illustrates the complexity of a RIS (see Figure 3). A main difference to Tödtling and Trippl is that Landabaso puts the regional government at the centre of his model, while a

series of knowledge generators and diffusers interact with firms and with each other. A key feature of Landabaso's model of a region is its openness to the outside world. It contains four open gates that allow interaction with international R&D, technology transfer networks, value chains and business consultants and services.

Figure 3: RIS according to Landabaso (2010)



Source: Landabaso (2010), http://wire.fecyt.es/Resources/documentos/ppt/Mikel-Landabaso.pdf (accessed 1 March 2013).

2.5 RIS and policy

In the mid to late 1990s, thinking of innovation processes as systems increasingly entered policy-making, for instance via the support of regional innovation strategies with ERDF funding (Landabaso, Oughton et al. 1999) and this left its mark also in an increased number of publications looking at governance and policy of RIS (e.g. Cooke (1998), Tödtling, Kaufmann et al. (1998)). A number of publications addressed rather at policy-makers than at academics facilitated the diffusion of the concept into policy, e.g. by the OECD (1997, 1999), Cooke (2003) for UNIDO and Doloreux and Parto (2004).

In order to grasp the variation amongst different RIS governance models, Cooke (1998) developed a typology in the shape of a two-dimensional matrix. The first dimension is the business innovation dimension, which describes the degree of integration of a RIS into the global economy. It can be localist or globalised, or take an interactive form. The second dimension is the governance of support to RIS, which includes public policy, institutions and knowledge infrastructure. The governance mode can take three different forms with

increasing degree of policy intervention: grassroots, network or dirigiste. The application of these dimension results in a grid with nine different possible forms of RIS (see Table 3).

Table 3: Taxonomy of RIS and examples

	Grassroots	**Network**	**Dirigiste**	
Localist	Tuscany	Tampere Denmark	Tohoku (Japan)	Business innovation
Interactive	Catalonia	Baden-Württemberg	Québec Gyeonggi (South Korea)	
Globalised	Ontario California Brabant	North Rhine-Westphalia	Midi-Pyrénées Singapore Wales	
	Governance of enterprise / innovation support			

Sources: Adapted from Cooke (1998; 2006).

A localist RIS is characterised by only a few public innovation and R&D resources. Its businesses tend to be small and the few bigger ones tend not to be indigenous. Interactive RIS instead typically show a balanced mix of indigenous businesses and branch operations from outside the region. Finally, globalised RIS are dominated by global corporations and research largely occurs within these. Although the classification is very simplistic, it provides a framework to highlight differences between successful RIS.

With regard to the governance of RIS, Cooke (1998) identified three different modes, which distinguish themselves in five characteristics: initiation of innovation, funding, research, coordination and specialisation (see Table 4). Grassroots RIS are usually initiated locally and rely on a mix of funding sources. Research is rather applied and there is no strong coordination. Grassroots RIS tend not to be much specialised. Network RIS instead are characterised by their multilevel initiation. Funding comes in a guided form from a mix of institutions in order to support research ranging from basic to applied types. There is a high degree of coordination, not least because of the number of stakeholders. Network RIS are unlikely to be too specialised, since they need to respond to a wide range of needs of different firms. Finally, dirigiste RIS are initiated by central government, which also provides determined funding. Research is basic and strongly specialised. Like network RIS, dirigiste RIS require a high degree of coordination.

Table 4: Typology of RIS and key action impulses

RIS characteristics	Grassroots	Network	Dirigiste
Initiation	Local	Multilevel	Central
Funding	Diffused	Guided	Determined
Research	Applied	Mixed	Basic
Coordination	Low	High	High
Specialisation	Weak	Flexible	Strong

Sources: Cooke (2006).

Innovation policy can also be understood as an evolutionary process. Kitson (2011) distinguishes three modes of innovation policy, which mark three evolutionary steps. In the traditional Mode 1, policies encourage R&D relevant to manufacturing, particularly in the context of high technology. Universities and other research institutions should develop new or improved technologies, which then are transferred into businesses. Mode 2 corresponds broadly to the idea of RIS. It is based on a more holistic approach and recognises that innovation takes place in a system with multiple actors. Typical frameworks and approaches in Mode 2 would be clusters (Porter 1990), open innovation (Chesbrough 2003) and the triple helix (Leydesdorff and Etzkowitz 1998). Mode 3 goes a further step by including social capital, the creative environment and the public and voluntary sector. The role of government in driving innovation through public procurement has also been highlighted (Uyarra and Flanagan 2010).

There is a vast variety of instruments applied in regional innovation policy. In order to categorise these instruments, they have been grouped into instruments targeting specific RIS sub-system or steps in the knowledge lifecycle (see Table 5). The OECD (2011) suggests a taxonomy with instruments operating in three dimensions of RIS: knowledge generation, diffusion and exploitation. The taxonomy does not only take into account the different purposes of innovation policy instruments, but also their degree of maturity. The examples in Table 6 include many instruments that are not exclusive to innovation policy. The reason is that the distinction of innovation policy from other policies is often unclear. Innovation policies often overlap with wider education and research policies on the one hand and economic development policies on the other. For instance, some traditional measures supporting the knowledge generation side of RIS can be perceived as research policy measures (e.g. support for technology centres), while some measures supporting knowledge exploitation (e.g. support to start-ups) can fall under economic development policies. It can be asserted that those instruments that address shortcomings in the interaction between RIS elements tend to be ‘unique’ to innovation policy. This is mainly the case for instruments falling into the ‘emerging instruments’ category in Table 6 (e.g. centres of excellence).

Table 5: Taxonomy of regional innovation policy instruments

<table>
<tr><th></th><th>Knowledge generation</th><th>Knowledge diffusion</th><th>Knowledge exploitation</th></tr>
<tr><td>Traditional instruments</td><td>Technology funds, R&D incentives/grants
Support for scientific research & technology centres
Support for infrastructure development
Human capital for science and technology</td><td>Science parks
Technology transfer offices and programmes
Mobility and talent attraction schemes
Innovation awards</td><td>Incubators
Start-up support
Innovation services
Training & raising awareness for innovation</td></tr>
<tr><td rowspan="2">Emerging instruments</td><td>PPP for innovation
Research networks/poles</td><td>Innovation vouchers
Certifications/ accreditations</td><td>Industrial PhDs
Support for creativity and design
Innovation benchmarking</td></tr>
<tr><td colspan="3">Competitiveness poles
Centres of excellence
New generation of scientific technology parks and clusters
Venture & seed capital</td></tr>
<tr><td>Experimental instruments</td><td>Cross-border research centres</td><td>Open source – open science markets for knowledge</td><td>Regional industrial policy
Innovation-oriented public procurement</td></tr>
</table>

Source: adapted from OECD (2011).

Amongst the more inventive instruments aimed at 'closing gaps' between knowledge generation, diffusion and application are dedicated innovation brokers which would identify possible collaboration opportunities between universities and firms (Roper, Love et al. 2007). But gaps can also exist between the policies aimed at supporting RIS, both between innovation-relevant actors within the same spatial unit and especially between different spatial levels (Lyall 2007). Edler and Kuhlmann identified a 'governance gap of poor integration and coordination' (2003) that occurs because the innovation policy multi-level process is taking place at different spatial levels ranging from local and regional to national and international.

The understanding of the type of challenges a specific regional innovation system faces should be the starting point to develop a suitable policy response (Heydebreck and Gabrielsson 2013). The bases for a targeted innovation policy can be so-called system failures (Tödtling and Trippl 2005). There are three types of system failures resulting from the specificities of regions: organisational thinness, lock-in and fragmentation. Although these failures are typical for specific regional categories, there can be overlaps. Organisational thinness, i.e. low levels of clustering and insufficient endowment with key organisations, is usually encountered in under-developed and poorer regions. A situation of lock-in, i.e. over-embeddedness and over-specialisation, can be problematic especially in old industrial regions (Grabher 1994). Finally, fragmentation and the over-proliferation of actors can be problematic

especially in metropolitan regions, where there can be a lack of interaction and networks between the RIS actors. In order to respond to these diverse challenges for regional innovation, innovation policy must apply tools targeted at the specific regional challenge (see Table 6).

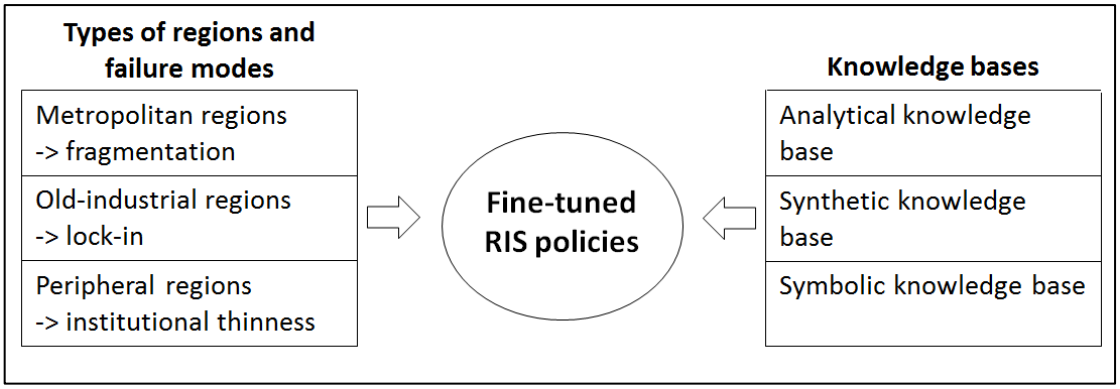
Table 6: Regional innovation policy approaches in different regional categories

Policy approach	Peripheral regions	Old industrial regions	Metropolitan regions
Strategic orientation	Upgrading of regional economy Catching up learning	Renewal of regional economy Transition to new trajectories	Improve position of the region in the global knowledge economy
Firms & clusters	Strengthen potential clusters Attraction of innovative firms	Support clusters in new/related sectors New firms formation Attraction of cluster-related FDI	Support emerging clusters related to region's knowledge base Support start-ups in knowledge-based services
Knowledge providers & education	Attract branches of national research organisations Build up medium-level skills (technical colleges, management schools)	Set up research organisations in new but related fields Build up & attract new skills (technical, schools, universities)	Expand and set up high quality research organisations Set up universities/ schools for highly specialised qualification
Networks	Link firms to knowledge providers (inside the region and beyond)	Stimulate networking with respect to new industries/technologies	Promote university-industry links

Source: Trippl (2012).

To take the example of peripheral regions, or rather poor and underdeveloped regions, the strategic orientation should be steered towards an upgrading of the regional economy and to catching up. In terms of knowledge application, i.e. firms and clusters, the attraction of innovative firms is suggested, which though will be challenging in a poor underdeveloped region. In order to improve the provision of knowledge and educational offers, the attraction of branches of national research organisations and a focus on medium-level skills appear to be the most suitable actions. Finally, in terms of networks, peripheral regions should start building up regional and interregional networks by linking firms and knowledge providers.

Figure 4: Fine-tuned RIS policies



Source: Adapted from Trippl (2012).

The heterogeneity of regions requires a differentiated or 'no size fits all approach' (Asheim, Moodysson et al. 2011) to regional innovation policy. Some argue that regions should concentrate their efforts on industries that they are traditionally strong in (Asheim, Moodysson et al. 2011), in spite of the risks associated to a lock-in situation (see below). In any case, the specific regional characteristics need to be taken into account when developing innovation policies. Along these lines, some suggest a knowledge base approach (Asheim, Boschma et al. 2011), which distinguishes between three types of knowledge base: analytical (science-based), synthetic (engineering-based) and symbolic (arts-based). They argue that the most suitable innovation policy approach depends on the knowledge base present in the region. Accordingly, the European Union has increasingly been supporting an approach in which development policies should be tailored to the potential present in the region. The European Commission encouraged the development of regional innovation strategies (Landabaso and Reid 2003). A series of initiatives followed each other, mainly the STRIDE Community initiative in 1990, the Regional Technology Plan initiative in 1994 and RITTS (Regional Innovation and Technology Transfer Strategies) until 2000. More recently, the European Commission has been asking for all regions to have so-called 'Smart Specialisation Strategies' in place if they want to receive Cohesion policy funding in 2014-20 (Charles, Gross et al. 2012; McCann and Ortega-Argilés 2013).

According to Trippl (2012), regional innovation policy requires fine-tuned approaches that take into account both the challenges faces by different types of regions (peripheral, old industrial or metropolitan) and the specific knowledge base(s) existing in the region. Figure 4 combines these two dimensions.

2.6 Conclusions

It has been shown that RIS have evolved from NIS, with their main difference being the geographical scale. Definitions of RIS vary, but they often distinguish between two separate dimensions of knowledge generation and exploitation that interact more or less actively. This systematic aspect of RIS is their key characteristic. Not only the different sub-systems provide areas for policy to intervene, but also and especially the formats in which these interact. The next chapter will present the research approach and define a research question that follows from these considerations.

3. RESEARCH APPROACH

3.1 Introduction

These sections formulate a research question with related subquestions (Section 3.2) and provide an explanation for the selection of case study (Section 3.3). Section 3.4 then explains the adopted methodology, before the conclusions in Section 3.5 lead to the next main chapter.

3.2 Research question

This study concentrates on the governance dimension of the RIS model.[3] It follows the above definition of RIS: a RIS consists of interacting knowledge generation and exploitation sub-systems embedded in a regional socioeconomic and cultural setting and influenced by regional and innovation policy.

The research question is:

- How has Styrian innovation policy developed over time?

Subquestions are

- How has the RIS concept shaped innovation policy in Styria?
- What are the challenges that innovation policy currently faces in Styria?

3.3 Case study selection: the Austrian Land of Styria

Styria is a successful example of regional innovation policy. For instance, the Regional Innovation Monitor (RIM) ranks Styria amongst 'world-class performers', a category that applies only to about ten percent of regions covered in the RIM repository (Technopolis, UNU-MERIT et al. 2012). In Austria, Styria can be considered the innovation leader, both in terms of innovation output (e.g. knowledge-intensive firms, number of R&D outputs) and innovation input, i.e. innovative approaches to innovation policy (Hartmann and Berger 2007). Styria is also amongst the leading European regions in terms of their innovation performance. Styrian innovation efforts have also repeatedly received international recognition, such as the European Commission's RegioStars award in the category 'smart growth' in 2012 for the ERDF-cofunded cluster 'ECO World Styria' (ÖROK 2013).[4]

The Austrian *Land* is sometimes seen as an example of good practice for a relatively peripheral, old industrial region that managed to redefine itself. A lot of this is due to its early policy focus on R&D on the basis of existing regional knowledge, e.g. through its tradition in

[3] Although there are differences between NIS and RIS, these concepts will be treated synonymously in the empirical part of this paper. The term RIS will be used for both, unless a distinction is necessary.

[4] RegioStars 2012 - ECO WORLD STYRIA - Boosting employment through a world-beating network of green-tech companies, http://ec.europa.eu/regional_policy/videos/video-details.cfm?LAN=EN&longversion=1&vid=962. For more information on ECO World Styria see http://www.eco.at/cms/223/English/

steel and manufacturing. Styria has recognised the importance of a coherent approach to innovation policy relatively early. Major policy elements are clusters and centres of excellence, leading to a well-established network of research-oriented firms, and the creation of a number of decentralised impulse centres, taking into consideration the region's rather decentralised economic infrastructure (Leo and Philipp 2011). In addition to that, Styria has a well-developed industrial firm basis, which is also rooted in the Styrian economic history of mining and steel.

Also the fact that Styria had an early policy focus on R&D and was the first Austrian *Land* to formulate a RTDI policy in the mid-1990s, allows to use the case study of Styria as a suitable case to test to what extent the RIS ideas have been put into practice and how this changed over time. The *Land* has continuously revised its strategies and instruments, allowing charting the evolution of its innovation system. Its innovation policy has been the object of several academic and policy-oriented studies, for instance by Tödtling, Kaufmann et al. (1998), Hartmann and Berger (2007) or Pöchhacker-Tröscher (2009). Styria had also been selected for an in-depth case study in the context of the European Commission's Regional Innovation Monitor platform, which drew widely positive conclusions (Leo and Philipp 2011). In summary, Styria is a recognised international player with regard to innovation policy and lends itself as a suitable case to study how the concept of regional innovation system (RIS) has been realised in practice. To look into an Austrian region is also interesting because Austria was in the past characterised by a 'structure-performance paradox' (Peneder 1999), which means that the country's GDP was high even when it still had a comparatively low R&D expenditure.

3.4 Methodology

This study is an embedded single case study. In order to select the most appropriate research method, Yin (2009) suggests looking at three conditions: a) the type of research question posed, b) the extent of control an investigator has over actual events, and c) the degree of focus on contemporary as opposed to historical events. According to Yin, research questions starting with 'how' or 'why', such as the one used for this study, are explanatory and lend themselves to the use of experiments, histories or case studies. The use of experiments would not be possible. As it is not possible to have control over actual events in the case region, this leaves the options of histories and case studies. Yin argues that the main difference between histories and case studies is that the only the latter can include contemporary events in addition to events from the past. The Styrian RIS is clearly shaped more by contemporary events than historical ones, which leaves case study research as the obvious choice.

There are different types of case studies, which can be broadly divided into single or multiple-case studies, and into holistic and embedded case studies. Since this study is only looking at one region, the research is based on a single case study. Also, it is an embedded case study, as it looks at a series of units of analysis within the wider case of Styria, for instance strategic documents and policy instruments (Yin 2009).

Looking at other comparable studies, case studies have been widely used in RIS research (see Section 2.5), for instance by Diez (2002) or Cumbers, Mackinnon et al. (2003). According to Doloreux and Parto (2004), there have mainly been two approaches to study

RIS: via comparative studies to gather information on criteria of RIS, i.e. multiple-case studies, and via single case studies ('snapshots') to 'determine the extent to which they correspond to a truly regional innovation system' (Doloreux and Parto 2004). Following the second approach, this study looks at how the RIS concept has influenced policy-making in Styria.

In case study research it is possible to use a variety of methods; it is a strength of the case study approach that it is able to deal with a broad variety of evidence (Yin 2009). The application of different methods and the use of different empirical sources allows for a triangulation of results. The set of methods most suitable in the present case includes document analysis and semi-structured interviews. A similar set has also been applied in other, comparable case study research on RIS (e.g. Diez (2002) on Barcelona, Stockholm, and Vienna and Skogseid (2007) on rural areas). Document analysis covers academic literature, policy documents and statistical data. For the interviews, some of the most informed actors in the field have been selected; this includes Styrian policy-makers as well as consultants and researchers who have been involved in studies about the Styrian RIS.

Sources used include mainly documents such as strategies, guidelines and legal bases for instruments. This information gathered through documentary analysis has been complemented by interviews with policy-makers, consultants and academics. Documentary analysis provided evidence for the impact of the RIS concept, i.e. by looking, on the one hand, for the use of the term 'regional innovation system' or 'innovation system' (for explicit impact) and, on the other hand, for RIS-related terminology use of policy instruments that allows to assume an implicit or indirect impact of the RIS concept.

Regarding the potential value of the results of this study, a disadvantage of case study research is that its results can only be generalised to a limited extent. Since the research is not based on a scientific sample, it does not allow generalisation to populations, i.e. to other RIS. Instead, it is possible to generalise to theory. Through analytical generalisation, case studies contribute to the expansion and generalisation of theories (Yin 2009).

There have been a number of practical constraints to this research, some of which are:

- Selection of units of analysis. The selection is not randomised, not least due to a limited number of units (e.g. interviewees). This might, for instance, potentially lead to a bias towards more active and open actors in the RIS.
- Confidentiality. Information from internal documents and 'off the record' comments gathered during interviews have to be treated with care. This is not least because some units of analysis potentially have conflicting interests. Some information was even retained.
- Language barriers. While the thesis is written in English, fieldwork interviews have been conducted in German. Also, most of the case study-related documents are in German. Translating from the original language into English carries the risk of changing the meaning, even if only to a small extent.

3.5 Conclusions

The previous sections formulated suitable research questions that will be answered in the subsequent text as far as possible. It has also been shown how the *Land* of Styria provides a suitable case study to analyse regional innovation policy making over time and in the light of an evolving policy concept of RIS. Finally, the methodology has been described, discussing also the potential values of the study's results.

After an introduction into Styria's innovation system (Section 4), the subsequent sections will attempt to answer the research question by looking at the evolution of Styrian innovation policy and the extent to which the theoretical concept RIS has been realised in Styria, looking at its impacts on the strategic approach and policy instruments (Section 4.6.1). For both innovation strategies and instruments, the study will gather explicit and implicit references to the RIS concept.

4. STYRIA'S INNOVATION SYSTEM

4.1 Introduction

Section 4 describes the Styrian innovation system, starting from the economic and innovation-related performance (Section 4.2). It then describes the key characteristics and actors of the two sub-system of RIS: knowledge generation and diffusion (Section 4.3) and knowledge application and exploitation (Section 4.4). Finally, Section 4.5 provides descriptions of the relevant domestic innovation policy actors, starting from the national Austrian level and moving on the Styrian government, the Land's business agency SFG and the largest research and technology organisation Joanneum Research, before briefly introducing a number of other key actors.

4.2 Economic and innovation-related performance

Styria is the fourth-largest Austrian *Land* by territory, but the second-largest by number of inhabitants. Its 1.21 million people correspond to 14 percent of the Austrian population. Styria's GDP per capita stood at €34,300 in 2013, which was below the Austrian average of €38,540.

Table 7: GDP per capita in Austrian Länder, €

	2011	2012	2013
Vienna	47,000	47,300	47,200
Salzburg	43,000	44,500	45,000
Tyrol	37,900	39,400	40,000
Vorarlberg	38,200	38,900	39,800
Austria	**37,650**	**38,050**	**38,540**
Upper Austria	37,100	38,000	38,500
Styria	**32,600**	**33,600**	**34,300**
Carinthia	31,300	31,700	31,800
Lower Austria	30,000	30,800	31,100
Burgenland	24,300	25,600	26,100

Source: Statistik Austria.

While the *Land* covers large parts of the Eastern Austrian Alps in the centre of the country, it also borders Slovenia in the south and is also located close to the eastern border with Hungary. This resulted in a historical dichotomy between the mountainous north and west on the one hand and the hilly south and east. Styria's capital Graz is located roughly at the transition point between the two.

The effectiveness of an innovation system is often measured by the R&D expenditure in relation to GDP. However, it has to be kept in mind that R&D expenditure and rate focus solely onto the input side and some experts argue that real innovative performance should be

measured by its outputs, such as the number of knowledge-intensive firms created or the number of R&D outputs translated into a marketable product.[5] However, there are issues with data availability. Nevertheless, this section will put Styria's innovation-related expenditure into both an Austrian and international context, both in terms of inputs and, to some extent, of outputs.

Austria has been improving its innovation performance continuously over the last years and in comparison with other EU and OECD countries, Austria performs above average. The European Union's Regional Innovation Scoreboard 2012 puts Austria into the category of innovation follower with above average performance. According to the Innovation Union Scoreboard 2011, the Austrian innovation system is considered to be excellent due to its openness, attractive research systems and intellectual assets. Yet, compared to other European countries there are also some relative weaknesses, e.g. in supporting innovation and developing economic impact from research (UNU-MERIT 2012). Styria appears to be the notable exception in Austria, with an above average investment into innovation and a wide range of innovation-related policy instruments.

In 2010, Austria's R&D expenditure stood at 2.76 percent of GDP. In European comparison, this is well above the EU average of two percent, but yet still behind the three percent Lisbon-goal and the leading EU Member States Finland (3.87 percent), Sweden (3.42 percent), Denmark (3.06 percent) and Germany (2.82 percent).[6]

Within Austria, Styria plays the role of an innovation leader (see Table 8). Looking at R&D expenditure as a share of GDP, Styria (4.32 percent) reported the highest share of all *Länder* in 2009. Even the capital Vienna, where many leading universities and R&D institutions are based, remained below Styria's relative expenditure. However, it should be noted that In fact, differences in the R&D rate also reflect the higher presence of major research institutions in some parts of Austria, and therefore especially large *Länder* and smaller ones such as Burgenland and Vorarlberg cannot be compared (Kah 2012).

Table 8: R&D expenditure in Austrian Länder, % of GDP

	2002	2004	2006	2007	2009
Austria	**2.1**	**2.3**	**2.5**	**2.5**	**2.7**
Styria	**3.7**	**3.7**	**3.9**	**4.2**	**4.3**
Burgenland	0.5	0.5	0.5	0.6	0.7
Carinthia	1.8	2.2	2.5	2.5	2.5
Lower Austria	0.9	1.0	1.3	1.3	1.5
Upper Austria	1.8	2.0	2.3	2.3	2.6
Salzburg	1.0	1.1	1.3	1.2	1.4
Tyrol	1.7	2.1	2.4	2.3	2.8
Vorarlberg	1.3	1.3	1.3	1.4	1.6
Vienna	3.0	3.2	3.2	3.3	3.5

Source: Statistik Austria.

[5] Interview with Markus Gruber, convelop, 5 September 2012.

[6] EUROSTAT.

Styrian R&D input has experienced strong growth over the past years. Although availability of up-to-date data is limited, the development of absolute R&D expenditure in Styria in recent years is more dynamic than in most other Austrian *Länder*. For instance, spending increased significantly by 31 percent from €40.8 million in 2002 to €53.5 million in 2006. Also in terms of expenditure per capita Styria (€45) has shown stable growth, which allowed it to overtake the traditional innovation leader Vienna (€42 per capita) in 2006.[7]

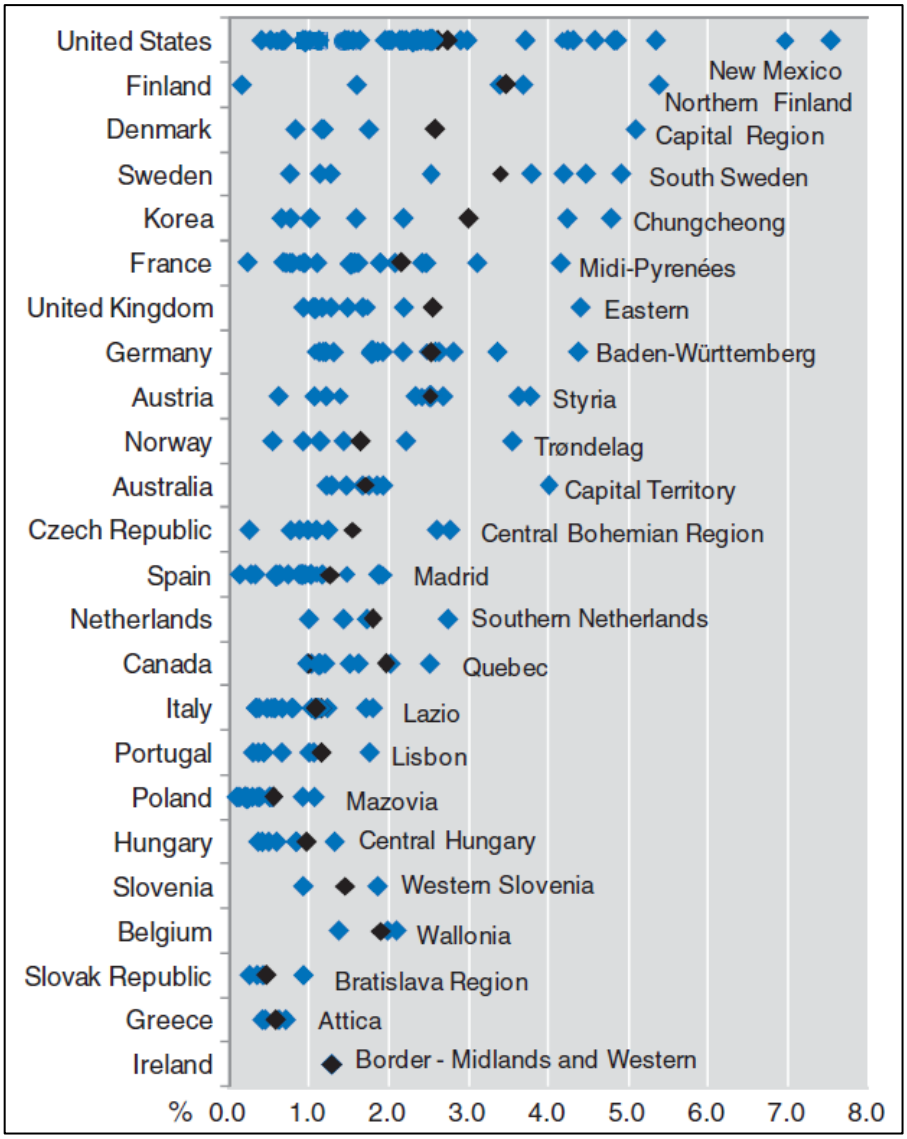
Yet, according to more recent data, Styrian R&D expenditure increased only by 1.9 percent in 2009, compared to 8.9 percent increase of total Austrian R&D expenditure. This is the lowest growth of all *Länder* and can be attributed to the effects of the economic crisis, which hit the Styrian economy more than other parts of Austria. However, the total Styrian spending of €1.49 billion for R&D still corresponds to about a fifth of the Austrian total of €7.48 billion (Kurzmann 2011) and the R&D sector provides about 10,000 jobs (FTE) in Styria alone.[8]

Styria's leading role in Austria is also illustrated by Figure 5, which shows the heterogeneity of R&D expenditure both between and within OECD countries. Styria was well ahead of most Austrian *Länder* and only Vienna managed to come close in 2007. Its relative expenditure is also higher than the national averages of the world's innovation leaders Finland, Sweden and South Korea. Styria's good performance is also acknowledged at the international level. The European Regional Innovation Monitor (RIM) classifies Styria as a 'world-class performer' (Technopolis, UNU-MERIT et al. 2013). RIM is an initiative launched by the European Commission in 2010 and provides comparative data on innovation performance of European regions.

[7] http://www.statistik.at/

[8] Innoregio Styria, http://www.innoregio.at/desktopdefault.aspx/tabid-1278/ (accessed 1 March 2013).

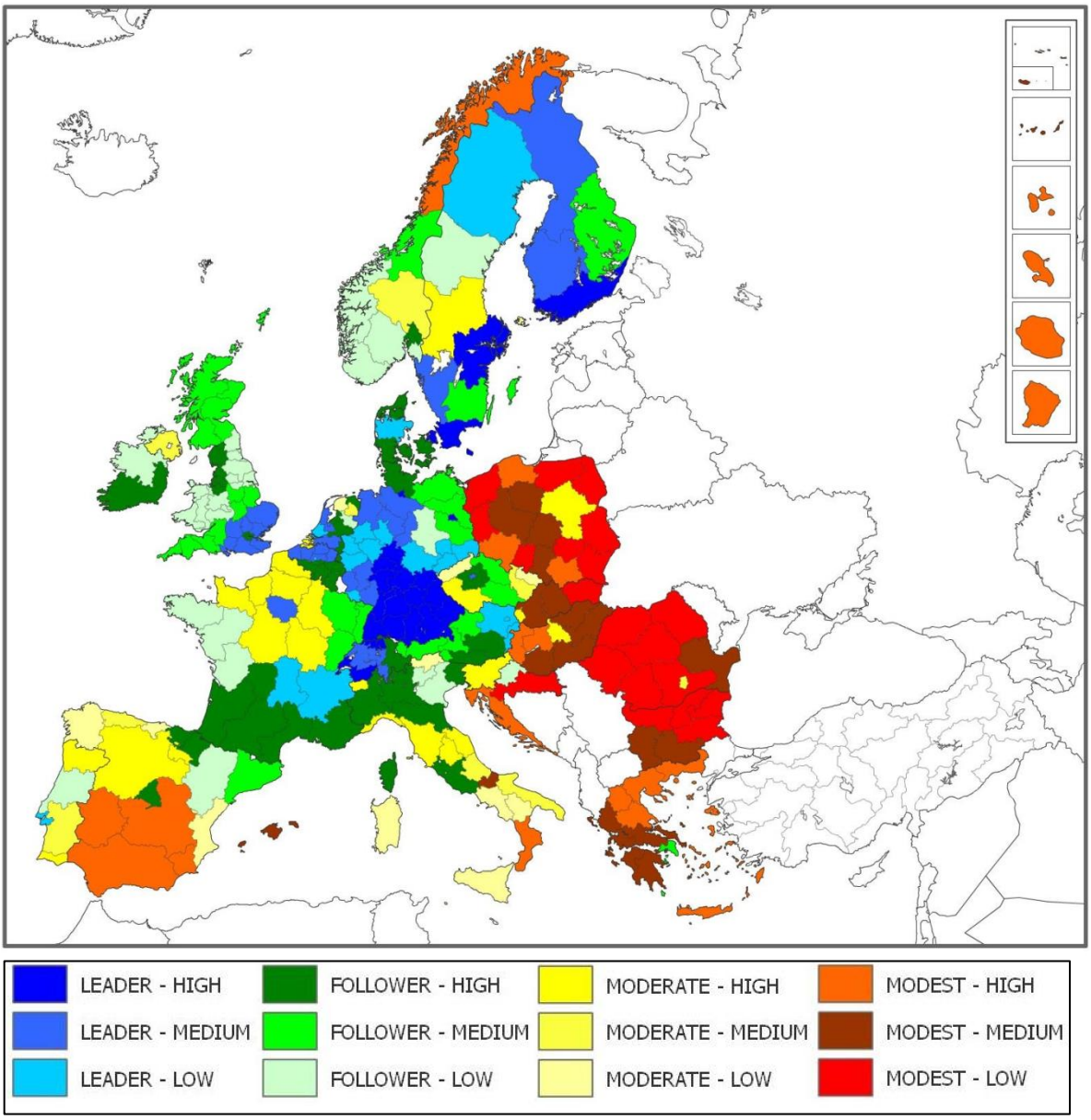
Figure 5: Heterogeneity in R&D intensity in OECD countries, 2007



Source: OECD (2011).

Although the R&D rate remains a common indicator to compare innovation performance, it focuses only on the input side. Some attempts have been made to look at the actual output of the innovation support system. For instance, the '*Innovationsindikator*' developed by the Federation of German Industry BDI lists Austria amongst the leading innovating countries worldwide. BDI uses 38 sub-indicators, including both input and output ones. Output indicators include, for instance, the number of patents per capita, the share of high-tech industries of the total GDP and the number of scientific publications per capita. Overall, Austria ranks eleventh and the country performs especially well in terms of its innovations system's productivity, i.e. the relation between innovation input and output. Austria ranks seventh and has been able to improve its position constantly since 1995 (BDI and Deutsche Telekom Stiftung 2012).

Figure 6: Regional Innovation Scoreboard 2012: innovation performance subgroups



Source: UNU-MERIT and Technopolis (2013).

4.3 Knowledge generation and diffusion in Styria

A study from 2009 identified 113 actors for Styria (see Table 9 and Table 10). However, the study focused on educational and non-university research institutions, and on innovation and technology transfer centres, which in this study are understood as instruments rather than actors. Nevertheless, Table 9 shows that the number of Styrian actors is far higher than in most other Austrian *Länder*, with the exception of Vienna. The 113 actors in Styria are listed in Table 10. Some actors that are listed in the 'knowledge diffusion' column are understood as instruments for this report and will be discussed in Section 5.3.

Table 9: Actors in knowledge generation and diffusion at Land-level, 2009

	Tertiary educational and research institutions	Non-university and cooperative research institutions	Innovation and technology transfer centres	**TOTAL**
Vienna	24	> 100	19	**> 143**
Styria	9	60	44	**113**
Upper Austria	3	32	36	**71**
Lower Austria	10	21	32	**63**
Tyrol	6	21	17	**44**
Salzburg	5	16	12	**33**
Burgenland	4	8	15	**27**
Carinthia	2	11	12	**25**
Vorarlberg	2	6	16	**24**
TOTAL	**65**	**> 275**	**203**	**> 543**

Source: Pöchhacker-Tröscher (2009).

The number and variety of actors is also a result of Styria's long tradition of exchange between industry and science. Today, the *Land* can build on a good research infrastructure, with the Technical University of Leoben being Austria's most important university for mining, metallurgy and materials. This and the technical universities in Graz represent some of the most important assets of Styria's innovation performance.

Table 10: Actors in knowledge generation and diffusion in Styria (2009)

Knowledge generation		Knowledge diffusion
Higher education and research institutions	**Non-university and cooperative research institutions**	**Innovation and technology transfer institutions**
5 universities: University of Graz Medical University of Graz Technical University of Leoben Graz University of Technology University of Music and Performing Arts Graz 2 universities of applied sciences: FH Joanneum (3 locations) FH CAMPUS 02 2 teacher training colleges	Joanneum Research Centres of excellence: 3 K2 Centres, 7 K1 Centres, 14 K Projects 20 Christian Doppler Laboratories 6 Ludwig Boltzmann Institutes + 1 research centre 7 other research institutes 3 ÖAW Institutes Austrian Foundry Research Institute (ÖGI) Inter-University Research Centre for Technology, Work and Culture (IFZ) Fraunhofer Centre for Visual Computing	10 clusters & networks 32 impulse centres 2 AplusB Centres: Science Park Graz ZAT Zentrum für angewandte Technologie Leoben Technology Transfer Centre Leoben (TTZ) NanoTecCenter Weiz Forschungsgesellschaft Technologie- und Entwicklungszentrum Georgsberg-Stainz-St. Stefan

Source: Adapted from Pöchhacker-Tröscher (2009).

4.4 Knowledge application and exploitation in Styria

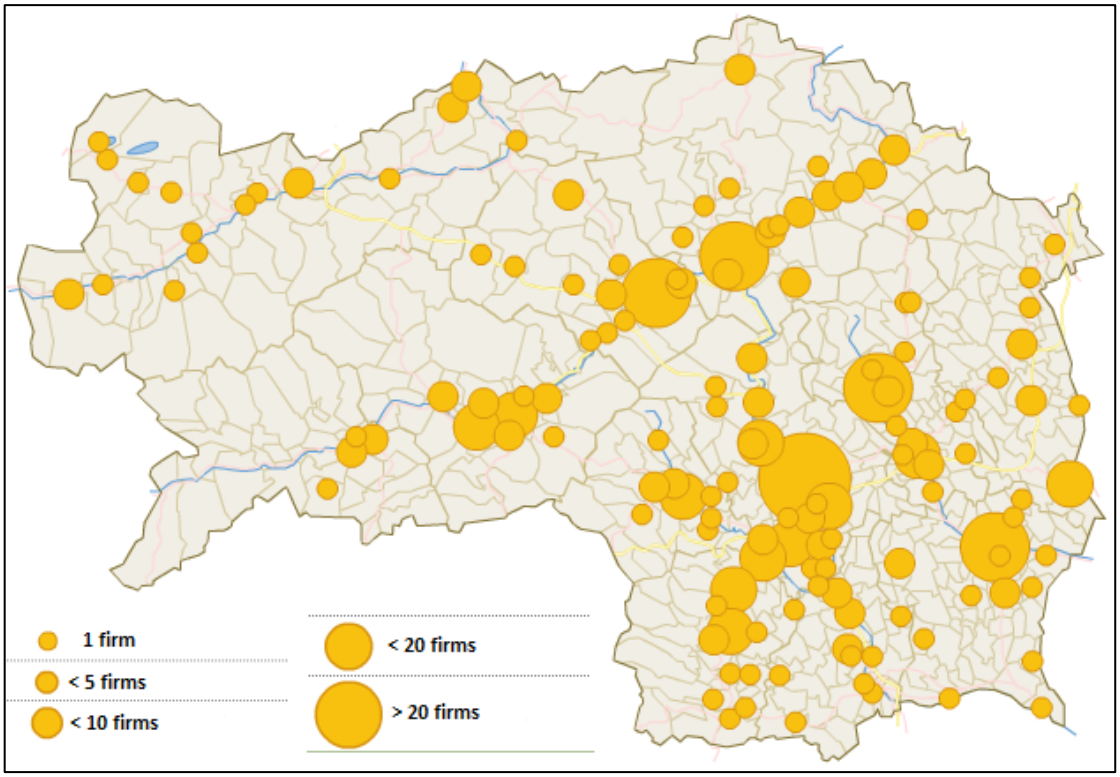
Industry has always been distributed unevenly in the *Land* and the concentration of economic activity in the agglomeration of Graz created an economic trichotomy in modern times:

- the mountainous and industrial north-west (Upper Styria);
- central Styria around Graz; and
- the rural borderlands of southern and eastern Styria.

This distinct trichotomy has largely disappeared, but industry continues to be distributed unevenly in the *Land* (see Figure 7). Upper Styria, mainly the so-called 'Mur-Mürz-Furche' running from the south-west to the north east and including the main industrial towns of Judenburg, Leoben and Kapfenberg, is the traditional centre of Styrian industry with historically strong mining and steel-producing industries. As in many other regions across Europe, those industries experienced a severe crisis in the 1970s and 1980s, from which the Styrian economy recovered only in the mid-1990s (Tödtling and Trippl 2004). The problems were an industrial mono structure, dominance of large firms mostly steered from outside, the lack of SMEs, little integration into regional supply networks, low number of industry-related services and relatively high wage levels; all largely characteristic issues of old industrial regions across Western Europe (Gerhardter and Gruber 2001). As part of the decline of the heavy industry, the dominance of Upper Styria was replaced by central Styria around Graz, where many of the most innovative companies are located. Southern and eastern Styria meanwhile continue to be largely rural parts of the *Land*, in which industrial firms are often only branch production sites. The uneven distribution of industry and its thematic

concentration in some regions of Styria have been picked up by Styria's cluster policy, one of the main features of Styria's economic structure (Section 5.3.2).

Figure 7: Distribution of industrial firms in Styria, 2013



Source: Adapted from Federation of Styrian Industries (*Industriellenvereinigung Steiermark*), http://industrie.signon.at/karte.html (accessed 1 March 2013).

Styria is one of the industrial heartlands of the Austrian economy and the *Land* looks back at a long-standing industrial heritage, at least in Upper Styria. The main industrial sectors are machinery and vehicle manufacturing, metals, electronics, paper and wood, iron and steel. The annual production value of Styrian industry is about €25 billion, which corresponds to over 36 percent of the total added value created. 32 percent of the Styrian workforce – about 100,000 people – is employed in the manufacturing sector. Taking into account also indirect effects, 285,000 jobs or more than half of all Styrian jobs depend on its industry. The Styrian industry is highly integrated into international production system and more than three quarters of the goods are exported.[9]

In the Austrian context, Styria is amongst the most industrial *Länder*. 15 percent of all Austrian industrial companies are based in Styria, providing employment for over 17 percent of all Austrian industry workers (see Table 11). In relation to all employees in industry, construction and trade, the percentage of employees working in industry is second-highest

[9] Federation of Styrian Industries (*Industriellenvereinigung Steiermark*), http://www.dieindustrie.at/datenundfakten/steirischeindustrie/ (accessed 1 August 2013).

only after Vorarlberg. In 2009, about a third of the added value creation in Styria came from the secondary sector, compared to 28.3 for the whole of Austria (Wirtschaftskammer Österreich 2011).

Table 11: Regional distribution of firms and employees in industry, 2009

	Firms			
	Total industry, construction and trade	**Industry**	**% of total industry, construction and trade**	**% of Austria**
Burgenland	4,623	1,046	22.6	3.5
Carinthia	9,041	2,288	25.3	7.7
Lower A.	24,783	5,580	22.5	18.8
Upper A.	22,476	6,080	27.1	20.5
Salzburg	10,533	2,374	22.5	8.0
Styria	18,327	4,464	24.4	15.0
Tyrol	12,465	2,832	22.7	9.5
Vorarlberg	6,803	1,947	28.6	6.5
Vienna	23,871	3,116	13.1	10.5
Austria	**132,922**	**29,727**	**22.4**	**100.0**
	Employees			
	Total industry, construction and trade	**Industry**	**% of total industry, construction and trade**	**% of Austria**
Burgenland	56,295	18,185	32.3	2.7
Carinthia	110,847	41,417	37.4	6.2
Lower A.	322,573	124,026	38.4	18.7
Upper A.	339,530	149,915	44.2	22.6
Salzburg	108,054	40,511	37.5	6.1
Styria	248,717	113,308	45.6	17.1
Tyrol	145,378	56,942	39.2	8.6
Vorarlberg	92,870	48,742	52.5	7.3
Vienna	241,542	71,395	29.6	10.7
Austria	**1,665,806**	**664,441**	**39.9**	**100.0**

Source: Statistik Austria, Leistungs- und Strukturstatistik 2009, 10 October 2011.

4.5 The governance of Styria's innovation system

Styria's RIS is governed by a complex system of governmental and semi-governmental actors at both the *Land*- and the federal level. In Austria, responsibility for many policies in support of regional economic development lies with the *Länder*, notably the *Land* government departments for economic development and *Land* economic development agencies. These entities are responsible for implementing regional investment aid and also for the provision of business infrastructure, such as industrial parks, incubators and technology centres. In most Austrian *Länder*, including Styria, these tasks have been outsourced to a dedicated business development agency.

4.5.1 National-level actors

RTDI policy in Styria is to a high degree influenced by federal policies and there are various actors at the national level that are involved in innovation policy-making in Styria. The ministries responsible for innovation are the Federal Ministry of Science, Research and Economics (BMWFW) and the Federal Ministry for Transport, Innovation and Technology (BMVIT). For instance, they share ownership together of the FFG, the main national funding body for applied research and development.

FFG is the Austrian Research Promotion Agency (*Österreichische Forschungsförderungs-gesellschaft*). Created in 2004, FFG offers a range of services for enterprises, research institutions and researchers, including the management of public funding programmes, consulting services in all phases of technology development and innovation and support for integration into European research programmes and networks. It is an important intermediate body for the delivery of Cohesion policy funding. In Styria it was responsible for activity field 3 'R&D in firms' of the 2007-13 ERDF programme, in which it managed about 11 percent (€17.3 million) of the total funding. FFG is owned by the BMVIT and the BMWFW.[10] Between 2008 and 2011, FFG provided over €2 billion of funding. Of these, more than two thirds or €1.4 billion supported R&D in firms, which had to contribute match-funding of between 25 and 80 percent. Other beneficiaries have been research institutions (19 percent) and universities (11 percent). Important FFG instruments include the COMET for centres of excellence (see Section 5.3.4) and AplusB centres (see Section 5.3.4) (FFG 2012).

Another important actor in the Austrian national innovation system bringing together research, technology and innovation policy is the Austrian Council for Research and Technology Development (in short: Austrian Council, *Rat für Forschung und Technologieentwicklung*). The Austrian Council has been set up in 2000 and is independently consulting the Federal Government in all issues of research, technology and innovation policy. For instance, they drafted the various Austrian national-level RTI strategies presented in Section 5.2.4.

4.5.2 Styrian Government

Governmental responsibility for innovation is not unambiguous. The role of governmental innovation actor is instead shared between two Government Departments: Department 12 Economy, Tourism and Sport and Department 8 Science and Health.

Department 12 Economy, Tourism and Sport (*Abteilung 12 Wirtschaft, Tourismus, Sport*) is the main Government Department responsible for Styrian economic and innovation policy. It consists of four units, one of which is the Unit for Economy and Innovation (*Referat Wirtschaft und Innovation*), which used to be a separate Government Department until the reform of 2012. The Unit (or its predecessor Department 14) was responsible for the development of all economic strategies discussed below (Section 5.2.2). The Unit for Economy and Innovation has been Styria's managing authority for Structural Funds since Austria's EU accession in 1995. It was responsible for the Styrian Objective 2 programmes in 1995-99 and 2000-06 as

[10] https://www.ffg.at/en (accessed 3 December 2014).

well as for the ERDF programme in 2007-13. Although the Austrian ERDF managing authority will be transferred to the national level in 2014-20, the Unit for Economy and Innovation will continue to be responsible for programme delivery at the Styrian level. Amongst a variety of other tasks, the Unit is also responsible for the development of the Styrian economic strategies (Section 5.2.2) and the coordination of the Styrian centres of excellence (Section 5.3.5).

Styria is one of a few *Länder* with a separate Government Department for science and research. Department 8 Science and Health (*Abteilung 8 Wissenschaft und Gesundheit*) is tackling innovation from an RTDI perspective and is a central funding and service agency within the Styrian scientific community. It is also involved in the overall strategic agenda setting, e.g. through the Research Strategy 2005 plus (see Table 13). Department 8 manages Styria's research funding schemes, provides RTDI-related information and advisory services and engages in networking. It also acted as intermediate body for the 2007-13 ERDF programme's activity field 1.1 'Inter-firm R&D' (see Section 5.2.5) and is the central office for the Future Fund Styria (*Zukunftsfonds Steiermark*), which aims at the long-term and sustainable development of Styria. Between 2002 and 2010 the Future Fund Styria provided support not only in the area of economic development and RTDI, but also to cultural and youth projects. Still in place, but with reduced funding, the Future Fund published its sixth call in 2012 and in April 2013 decided to support 11 projects. Lastly, Department 8 also assumes the role of secretariat for the Styrian Research Council.

4.5.3 SFG

The Styrian Business Promotion Agency (*Steirische Wirtschaftsförderungsgesellschaft mbH*, SFG) is a 100 percent subsidiary of the Styrian Government and the operational arm of Department 12. It has been created in 1991, earlier than most similar institutions in other *Länder*. Other early examples of similar agencies are the Carinthian Economic Promotion Fund (*Kärntner Wirtschaftsförderungs Fonds*, KWF) from 1993 and the *Wirtschaftsservice Burgenland* (WiBAG) in Burgenland from 1994. Also the Business Agency of Lower Austria (*Wirtschaftsagentur des Landes Niederösterreich*, ecoplus) was created in the 1990s, although it had a precursor as the INDUSTRIEZENTRUM NÖ Süd Gesellschaft already since 1962.

SFG acts as a service provider for business support on the basis of the Styrian economic strategy, i.e. currently the 'WiSt 2020'. It does not only offer financial support in the form of loans and grants, but it also takes on a more strategic and coordinating role by managing networks, encouraging technology transfer and supporting clusters. The SFG provides a holistic support service that goes beyond financial contribution and includes awareness raising of innovation themes via organising events, giving awards and using different media.

The SFG's maximum annual budget is €100 million, although in 2011 only €62.1 million of funding has been spent. SFG targets mainly firms, but it also manages funding for network structures such as clusters (Section 5.3.2) and impulse centres (Section 5.3.3). At the same time it is the main *Land*-level actor in managing the federally initiated centres of excellence and AplusB centres.

Table 18 in Section 5.3.1 shows the importance of support to innovation and R&D in the portfolio of the SFG. 20 percent of all projects in 2011 fell under the core strategy innovation and R&D, amounting to €35.7 million or 58 percent of all SFG funding. The SFG runs several support schemes under its core strategy 'Innovation and R&D' (Section 5.3.1). Their number varies, as some are phased out and others introduced on a regular basis.

Table 12: SFG support by core strategies in 2011

Core strategy	N. of projects	Total project volume, € 1,000	SFG support (*Land* & EU sources), € 1,000	SFG contribution to total project volume, %	SFG support per project, € 1,000
Innovation and R&D	**411**	**391,468**	**35,746**	**9.1**	**87.0**
Location development and management	**28**	**34,049**	**9,362**	**27.5**	**334.3**
Entrepreneurs and SME growth	**779**	**54,849**	**13,195**	**24.1**	**16.9**
Qualification and human capital	**851**	**8,169**	**3,403**	**41.7**	**4.0**
Internationalisation	**31**	**2,812**	**251**	**8.9**	**8.1**
TOTAL	**2,100**	**488,348**	**62,058**	**12.7**	**29.6**
of which grants	2,083	458,163	59,465		
of which loans	17	30,184	2,592		

Source: SFG (2012) and own calculations.

The firm-related measures accounted for almost 73 percent of SFG funding provided in 2011. The remaining 27 percent went to network structures such as clusters, impulse centres and centres of excellence. The SFG is also the most important Styrian intermediate body in the delivery of Cohesion policy funding (see Section 5.2.5). SFG implemented over 62 percent of the Styrian ERDF funding in 2007-13. About two thirds of the SFG-budget are related to the regional ERDF programme, which is a high share in comparison with other Austrian *Land* business agencies (Resch 2010).

4.5.4 Joanneum Research

The cooperation between universities and firms has significant tradition in Styria. An important role in this was played by the Joanneum. In the 1950s and 1960s, the Graz universities needed costly investments such as mainframe computers, nuclear reactors or electron microscopes. Because the federal government was not able to provide this necessary but expensive equipment, the *Land* Styria made the necessary resources available under the condition that research is carried out under a separate legal entity cooperating with the Styrian universities. This led to the creation of four associations that would later merge into the current Joanneum Research: an association for the promotion of electron microscopy, a data processing centre, an institute for nuclear reactors and an institute for low temperature physics. At the end of the 1960s, the four bodies were merged into the umbrella organisation

Research Centre Graz (*Forschungszentrum Graz*), which was renamed Joanneum Research in 1984. The range of research areas covered was extended to other activities and the association was transformed into a limited company in 1987. Today, 90 percent of the company are owned by the *Land* and 10 percent are held by the Netherlands Organisation for Applied Scientific Research (TNO).[11] Over time, some of the Joanneum tasks have been assumed by the SFG. While similar but much smaller institutions have been created also in Salzburg and Upper Austria, Styria was for a long time the only *Land* with such an institution.[12]

Today, Joanneum Research is not only one of the largest research and technology organisation in Austria, but it acts also as a mediator between the science and business realms. The most recent fundamental change was its reorganisation into five institutes in 2010, each comprising four to six research groups:

- Institute for Surface Technologies and Photonics (MATERIALS)
- Institute for Biomedicine and Health Sciences (HEALTH)
- Institute for Information and Communication Technologies (DIGITAL)
- Institute for Water, Energy and Sustainability (RESOURCES)
- Centre for Economic and Innovation Research (POLICIES)

The role of Joanneum Research has been confirmed in the Styrian Research Strategy from 2013, which highlights its important function as the *Land*'s application-oriented research organisation (Amt der Steiermärkischen Landesregierung 2013). According to its most recent framework plan from 2008, Joanneum Research aims to act as an 'entrepreneurial provider of innovation and technology' (Amt der Steiermärkischen Landesregierung 2008).

4.5.5 Other key actors

Other actors with important supporting roles in the Styrian innovation system include:

- The **Styrian Research Council** (*Forschungsrat Steiermark*)[13] is an important advisory unit for research activities in Styria. The first Styrian Research Council has been set up for 2007-11 and a follow-up body has been established for 2012-16. Department 8 of the *Land* Government assumes the role of secretariat. The Council consists of ten members, coming from science and technology policy, businesses, education and social sciences. It operates under the following principles: Forward-looking and strategic orientation, regional economy and sustainability, promotion of an innovation culture, excellence and international competitiveness, implementation focus, networking, independence and transparency, and dialogue and open communication. The tasks of the Research Council are to monitor research activities in Styria and to make recommendations for action. These recommendations focus on

[11] http://www.joanneum.at/en/get-to-know-us/get-to-know-us/shareholders.html (accessed 3 December 2014).

[12] Interview with Markus Gruber, convelop, 5 September 2012.

[13] http://www.forschungsrat.steiermark.at/cms/ziel/33996410/DE/ (accessed 1 March 2013).

those resources that are crucial for an advanced knowledge society and included social innovation, biotechnology, mainstreaming a youth support programme, knowledge-intensive services and increasing innovative capacity. In total the Council prepared 37 recommendations between 2007 and 2011 (Forschungsrat Steiermark 2008).

- The **Federation of Styrian Industries** (*Industriellenvereinigung Steiermark*) represents 366 firms, which employ about 85 percent of Styria's industrial workers (Industriellenvereinigung Steiermark 2012). They do not provide any funding, but launched the initiative Innoregio Steiermark,[14] which is an innovation network involving firms, universities and other research institutions as well as key regional actors. The Federation of Styrian Industries also provides an online map-based database of industrial firms (see for instance Figure 7).[15]

- **Social partners** play an important role in Styria, as they do in the rest of Austria. The Austrian 'Social Partnership' model consists of organisations representing both the trade unions and the employers. It was established in the 1950s to enhance economic growth and social stability (Leo and Philipp 2011). The Styrian social partners are also involved in the policy-making process, although the degree of involvement depends on the particular issue. The partnership In Styria consists of *Land* branches of the Trade Union Federation (*Österreichischer Gewerkschaftsbund*, ÖGB), the Federal Economic Chamber (*Wirtschaftskammer Österreich*, WKÖ), the Chamber of Labour (*Arbeiterkammer*, AK) and the Chamber of Agriculture (*Landwirtschaftskammer*, LK).

4.6 Conclusions

Styria has a positive innovation performance, partly due to its historical roots as the industrial heartland of Austria. But compared to other Austrian *Länder*, and using the terminology by Tödtling and Trippl (2005), Styria has the advantage of having both a well-developed knowledge-generation and diffusion system and a well-developed knowledge application system. It can be argued that this is an important difference to other Austrian *Länder*, which tend to be strong in one of the RIS sub-systems, while they are weaker in the other. Upper Austria and Vorarlberg, for instance, have a strong industrial sector, but lack sufficient knowledge generators with strong application orientation. The otherwise economically strong Vorarlberg is one of the smallest *Länder* and does not have a university. The city-State of Vienna, in contrast, does not have a significant industrial firm basis, while it has many major knowledge generators such as the largest Austrian technical university, the Vienna University of Technology.

Styria's innovation system is complex, with many governmental and semi-governmental actors and influenced by the national level. What this means for Styrian innovation policies, namely for strategies and instruments, is discussed in the following sections.

[14] http://www.innoregio.at (accessed 9 December 2014).

[15] http://industrie.signon.at/karte.html (accessed 1 March 2013).

5. INNOVATION POLICIES IN STYRIA

5.1 Introduction

In order to respond to the research questions of how Styrian innovation policy has evolved and how the RIS concept has shaped this policy, this section looks at the innovation-related development strategies and instruments. In particular, it explores how policy has been shaped by key ideas, such as the innovation system concept and the view that innovation depends on effective knowledge generation, diffusion and exploitation.

The following sections look at evidence of the RIS concept, both in innovation-related development strategies and instruments. After taking stock of the sequence of Styrian innovation-related development strategies (Section 5.2), the most important innovation-related policy instruments are presented (Section 5.3). Some preliminary conclusions are drawn after this (Section 5.4).

5.2 Development strategies

Styria has come a long way from a mostly rural, old industrial region in decline to Austria's innovation leader. The *Land* Government started to look for development options in the 1980s with a series of influential studies on regional development in Styria. In 1982, the research institutes ÖIR (*Österreichisches Institut für Raumplanung*) and WIFO (Austrian Institute of Economic Research) together with the University of Graz produced a study analysing the difficult economic situation of Upper Styria (ÖIR, WIFO et al. 1982). They introduced the term 'endogenous renewal' (*Endogene Erneuerung*), which influenced the development of the first Austrian instrument to support endogenous regional development (*Förderungsaktion Eigenständige Regionalentwicklung*, FER) in 1986. Initially, the FER was targeted towards rural and underdeveloped regions, but subsequent studies changed the focus to also include old industrial parts of Styria. Crucially, Glatz and Moser (1988) suggested an innovation-oriented regional policy for old industrial areas, again looking at the case of Upper Styria. This, and an additional study in 1990 on the Styrian peripheral border regions (Tichy 1990), led to the creation of the first innovation-related strategies in Styria in 1995. Since then, there has been a succession of various strategic documents (see Table 13) along three broad themes: technology, economy and research. There are thematic overlaps and the relation between the different strategies has often not been made clear. At the same time, starting in 1995 when Austria joined the EU, there have been three generations of Structural Funds programmes and a fourth programme period is about to start. These strategic documents can be understood as secondary or second-tier strategies, as they have been derived from the other three strategic strands, mainly the economic development strategies. In addition to strategic documents developed at the Styrian level there has been a succession of RTI strategies also at the national level. However, at the time of writing (2014), the two most relevant innovation-related strategies for Styria are the Economic Strategy Styria 2020 and the Styrian Research Strategy 2013.

The following sections focus on the *Land*-level strategies, but also include the three successive national-level strategies for RTI, as well the innovation-oriented Styrian Structural Funds programmes. A closer look is taken at the evolution of the various Styrian strategic

documents and at the role that the RIS concept played in that. The impact of RIS can either be explicit, implicit or not observable. The results are summarised in Section 6.2.

Table 13: Strategies related to innovation and RIS impact

<table>
<tr><td></td><td colspan="3">Primary strategies</td><td>Secondary strategies</td></tr>
<tr><td></td><td colspan="2">Land-level</td><td>National level</td><td></td></tr>
<tr><td>Year</td><td>Technology strategies</td><td>Economic strategies</td><td>RTI strategies</td><td>Structural Funds</td></tr>
<tr><td>1994</td><td></td><td></td><td rowspan="5"></td><td></td></tr>
<tr><td>1995</td><td rowspan="9">Technology Policy Strategy (Technologie-politisches Konzept Steiermark I)</td><td rowspan="9">Economic Development Concept (Wirtschaftsleitbild)</td><td rowspan="3">Objective 2 and Objective 5b programmes 1995-99</td></tr>
<tr><td>1996</td></tr>
<tr><td>1997</td></tr>
<tr><td>1998</td><td rowspan="6"></td><td rowspan="8">Objective 2 programme 2000-06</td></tr>
<tr><td>1999</td></tr>
<tr><td>2000</td></tr>
<tr><td>2001</td></tr>
<tr><td>2002</td><td rowspan="2">National Research and Innovation Plan (NAFIP)</td></tr>
<tr><td>2003</td></tr>
<tr><td>2004</td><td rowspan="9">Research Strategy Styria 2005+ (Forschungsstrategie Steiermark 2005 plus)</td></tr>
<tr><td>2005</td><td rowspan="6">Technology Policy Strategy II (Technologie-politisches Konzept Steiermark II)</td><td rowspan="6">Economic Strategy Styria ‘Innovation serienmäßig’</td><td rowspan="3">Strategy 2010 - Perspectives for Research, Technology and Innovation in Austria</td></tr>
<tr><td>2006</td></tr>
<tr><td>2007</td><td rowspan="6">Regional Competitiveness Programme Styria 2007-13 ‘Zukunft Innovation Steiermark 2007-2013’ (ERDF)</td></tr>
<tr><td>2008</td></tr>
<tr><td>2009</td><td rowspan="4">Strategy 2020 – Research, Technology and Innovation for Austria</td></tr>
<tr><td>2010</td></tr>
<tr><td>2011</td><td colspan="2" rowspan="4">Economic Strategy Styria 2020 (Wirtschaftsstrategie Steiermark 2020, WiSt 2020)</td></tr>
<tr><td>2012</td></tr>
<tr><td>2013</td><td rowspan="2">Research Strategy Styria</td></tr>
<tr><td>2014</td><td>Styrian part of ERDF OP</td></tr>
</table>

Source: Author.

5.2.1 Technological strategies

There have been two technological strategies in Styria, one in 1995 and an update in in 2005. The 2005 version is the – so far – last edition of the technology strategy, as the strategy is understood to have been subsumed in 2011 under the Economic Strategy Styria 2020 (WiSt 2020) (see Section 5.2.2).

The Technology Policy Strategy (*Technologiepolitisches Konzept*) in 1995 was the first innovation-related strategy in Styria. Although there was EU funding available at the time as part of the ERDF innovative actions for the development of regional innovation strategies, the first strategy was set up between 1993 and 1995 on Styria's own initiative (Landabaso, Oughton et al. 1999). Different to more than 100 other regional innovation strategies across Europe, including the Austrian case of 'RIS NÖ' in Lower Austria, the Technology Policy Strategy was financed entirely domestically.

Reasons for the development of the strategy were structural problems and the weak innovation performance of Styria at the time. Economic growth remained behind the rest of Austria in the 1980s and early 1990s, R&D expenditure and innovation activities were below average, and the cooperative activity amongst firms was weak. The aim of the Technology Policy Strategy was thus increasing the competitiveness of Styria and to develop Styria from being mainly a 'technology consumer' into a 'technology provider'. The strategy suggested (1) strengthening of capacity for cooperation, in particular through cluster development, (2) increasing the capacity for absorption and diffusion of innovation, (3) strengthening of quality and qualification levels through cluster-specific campaigns and increased exchange of staff between universities and regional SMEs and (4) improving the regional and national organisation of technology policy, in particular the coordination of numerous technology policy initiatives and institutions (Steiner, Gruber et al. 2006). Although RISs as such are not mentioned, these four measures relate to features that are prominent in the RIS concept. Especially the aspects of cooperation (measure 1), diffusion of innovation (measure 2) and exchange between universities and SMEs (measure 3) can be found in the RIS concept. Lastly, also the policy governance element of RIS is reflected in measure 4.

The strategy recommends that Styria should build on a number of technological areas of strength, the *Land* being a research location with five universities and numerous non-university research institutions. These strengths include the automotive sector, metal and materials, wood and eco-technologies, as well as the cross-cutting areas of mechanical engineering and automation (Gerhardter, Gruber et al. 2009). Together with the Economic Development Strategy from the same year (see Section 5.2.2 below), the strategy introduced the cluster concept for the first time into not only Styrian but Austrian policy. Due to the lack of major companies of international importance, Austria, and especially Styria, should focus on clusters as an alternative competitiveness strategy (InTeReg 1995). The strategy was revised in 2005, when the economic and technological position of Styria had improved significantly and the wider policy context changed. The drafting of the Research Strategy Styria 2005 plus (Section 5.2.3) in 2004 provided another impulse for stock-taking and strategic reorientation. Finally, the redesign of the Styrian ERDF programme for the 2007-13 Structural Funds period offered an opportunity for a review of existing strategies (see also Economic Strategy, Section 5.2.2).

The revised Technology Policy Strategy II from 2005 (*Technologiepolitisches Konzept II*) defined nine action fields: (1) Renewal and differentiation of economic and technological strengths, (2) maintenance and support of top innovative areas, (3) broadening the innovation base, (4) development of new technology and service areas, (5) internationalisation and inter-regionalisation, (6) technology-oriented, knowledge-based start-ups (7) qualification and training, (8) regional knowledge infrastructure and (9) design and implementation of regional technology policy. The new strategy recognised the need for renewal and differentiation of the strengths formulated in the 1995 strategy. It identified ten themes on which Styria should focus on and distinguished between traditional strengths (automotive, metals/materials, timber-based technologies/paper, eco-technology), growth areas (human life science technology), still unlinked areas (IT, electronics), traditional cross-cutting themes (machinery and equipment, flexible automation), new cross-cutting technology (nanotechnology) and complementary scientific areas of strength (Computer simulation and mathematical modelling).

The self-conception of the 2005 strategy is as an innovation strategy, as it understands regional technology policy to be synonymous with regional innovation policy (Steiner, Gruber et al. 2006). Also, the Technology Policy Strategy II and the Research Strategy 2005 plus (*Forschungsstrategie Steiermark 2005 plus*), developed in parallel, need to be seen as integrated strategies. Most importantly, the Technology Policy Strategy II refers explicitly to the concept of RIS:

'[Another reason is] … the systemic understanding of interventions, interaction and feedback mechanisms, which is the basis of the regional innovation system (RIS) concept that constitutes the conceptual framework.'[16] *(Steiner, Gruber et al. 2006)*

The earlier version of the Technology Policy Strategy from 1995 instead does not make any direct reference to RIS. It was drafted at a time when the RIS concept had not yet entered mainstream policy-making. In 2005, however, thinking of innovation processes as systems was much more common and manifested itself in regional innovation strategies across Europe. Nevertheless, it has to be noted that already the 1995 strategy used RIS terminology and ideas, for instance by emphasising the importance of clusters, networking and diffusion of innovation.

5.2.2 Economic strategies

The first economic strategy has been developed in parallel to the technological strategy discussed above. Since then, Styria has prepared three economic strategies. The Economic Development Strategy (*Wirtschaftsleitbild*) from 1995 was followed by the Economic Strategy Styria '*Innovation serienmäßig*' in 2006 and in 2011 by the current Economic Strategy Styria 2020 (WiSt 2020). All documents were developed by the Styrian Government Department responsible for innovation (Department 14 for Economy and Innovation until 2012 and Department for Economy and Labour until 2006) and hence look at innovation from an

[16] Translated by the author. Original text: '*Ein anderer [Grund] ist das systemische Verständnis von Interventionen, von Interaktion und Rückkopplungsmechanismen, wie es dem Konzept regionaler Innovationssysteme (RIS) zugrunde liegt, das den konzeptionellen Handlungsrahmen bildet.*'

economic perspective, or, in RIS terminology, from a knowledge application and exploitation perspective.

The first version of the economic strategy was the Economic Development Strategy (*Wirtschaftsleitbild*), created in 1995 in parallel with the Technology Policy Strategy (see above). The study was commissioned by the Styrian Government and developed by the Institute for Industrial Research (*Industriewissenschaftliches Institut*, IWI). This first Economic Development Strategy defined 11 clusters based on an analysis of strengths and weaknesses. The authors identified three clusters of outstanding importance: metal/steel and materials, wood/paper and vehicles/transport. However, these results had to be interpreted more as potentials for clusters rather than as actual clusters (Tödtling, Kaufmann et al. 1998). The concept suggests six lines of action: internationalisation, support to create viable businesses, immaterial investments, efficient administration, acceleration and benchmarking. As part of 'acceleration', the authors identify the so-called 'innovation-span' as an important lever for successful economic development. The span between technological development and marketability should be shortened, as innovation is identified as a key competitiveness factor:

'For regions in industrialised countries, competition on the basis of labour costs will be replaced by competition on the basis of technologies. The decisive factor, however, is not only the innovation capacity of enterprises themselves, but also the economic policy is required to create the conditions under which companies can introduce new production methods and products quickly into the desired market. In the future, the economic viability of a company is not only influenced by its innovativeness, but also especially by how fast a certain idea can be implemented' (Fabris, Hohl et al. 1995).[17]

A number of ways to shorten the 'innovation-span' are suggested, including promotion of technology transfer between universities and industry, incentives for firms to cooperate (e.g. in clusters), easier access to business funding and simplification of administrative procedures. These measures can be related to features of the RIS concept, for instance the cooperative elements between knowledge generation and application, and between single entities of the knowledge application sub-system (Fabris, Hohl et al. 1995). Together with 1995's Technology Policy Strategy (see above), the Economic Development Strategy introduced the cluster concept into Austria and made Styria the pioneer region in this respect.[18] There is no explicit reference to RIS and the suggested measures are only marginally related to the RIS concept. Although the concept highlights the importance of a quick introduction of innovations into markets, it does not distinguish between knowledge generation and application systems nor does it recognise the flow of knowledge back from enterprises into research. Hence, no impact of the RIS concept on the Economic Development Strategy can be documented.

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[17] Translated by the author. Original text: '*Für Regionen in den Industrieländern wird daher künftig der Wettbewerb über die Arbeitskosten vom Wettbewerb der Technologien verdrängt werden. Entscheidend dabei ist aber nicht nur die Innovationsfähigkeit der Unternehmen selbst; auch die Wirtschaftspolitik ist gefordert, Rahmenbedingungen zu schaffen, unter denen Betriebe neue Herstellungsmethoden bzw. Produkte sehr rasch auf den gewünschten Markt bringen können. Denn die wirtschaftliche Lebensfähigkeit eines Unternehmens wird künftig nicht nur von seiner Innovationsfreudigkeit beeinflußt, sondern auch ganz besonders dadurch, wie schnell eine bestimmte Idee umgesetzt werden kann.*'

[18] Interview with Herwig Schneider, Industriewissenschaftliches Institut, 4 March 2013.

The follow-up strategy from 2006 instead refers explicitly to an innovation system. Following up on the 11 thematic strengths highlighted by the Economic Development Strategy from 1995, the Economic Strategy 'Innovation serienmäßig' from 2006 defined 11 themes or core competences (*Stärkefelder*), which should be the focus of economic and innovation policy: (1) Automotive/mobility, (2) Engineering (3) Timber, furniture, construction, (4) Telecommunication / IT / new media, (5) Energy, environment, (6) Human life science technology, (7) Food technology, (8) Creative industry, (9) Nano- and microtechnology, (10) Simulation and mathematic modelling and (11) Materials. These themes are not only based on what types of businesses are operating in Styria, but they also reflect the degree of cooperation between companies, research and educational institutions. The core competencies cover about 2,000 companies with 115,000 employees in Styria, which correspond to a fourth of all jobs in the *Land*. Yet, R&D activities of these 2,000 firms represent 95 percent of all private R&D expenditure in Styria (Amt der Steiermärkischen Landesregierung 2006). The 2006 strategy suggest seven lines of action, similar to the nine action fields of the technology strategy published just one year before: (1) innovation, (2) location strategy and internationalisation, (3) clusters, networks and areas of strength, (4) self-employment and entrepreneurial spirit, (5) qualification, (6) regions and infrastructure and (7) innovative financing. Under action field (1), the strategy explicitly mentions the Styrian innovation system when asking for

'strengthening the Styrian innovation system, including the university level, competence and innovation centres, quasi-public and private research and development institutions, and finally the actual implementation on the market of products, processes and services.'[19]

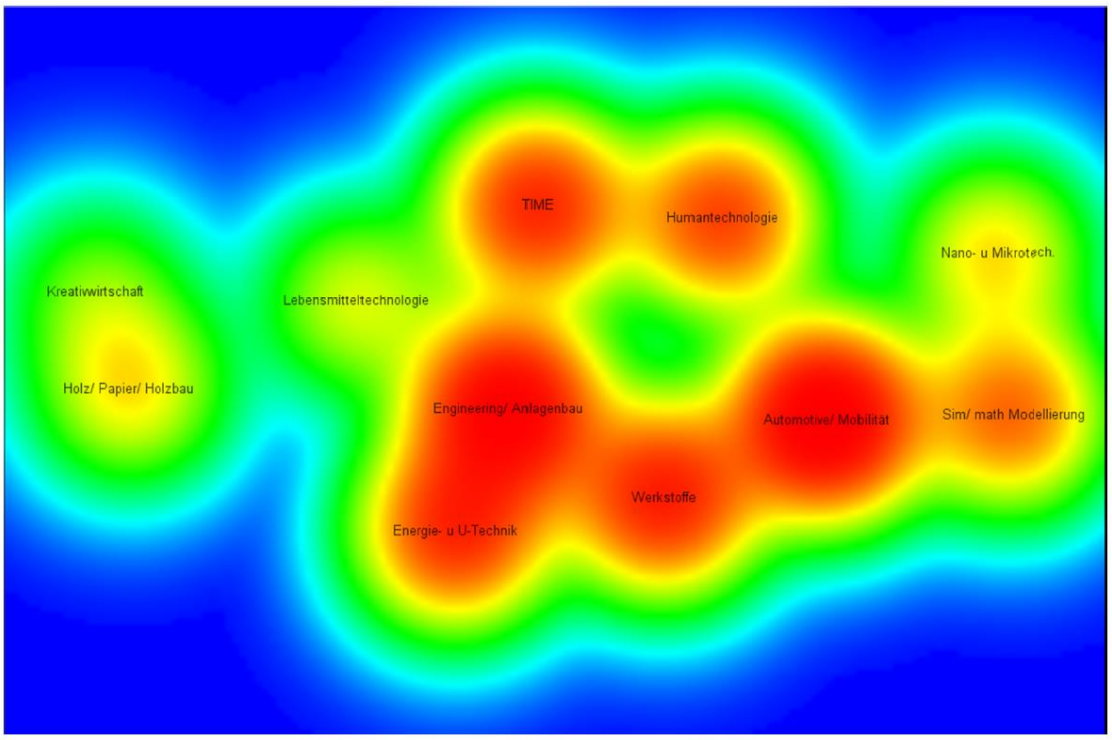
Also other action fields illustrate the substantial extent to which the RIS concept became one of the rationales for the strategy. For instance, action field 3 on clusters and networks argues for an increased technology transfer in Styrian cluster policy (Amt der Steiermärkischen Landesregierung 2006).

The third and current edition of the Styrian economic strategy, 'WiSt 2020' or 'Growth through Innovation' (*Wachstum durch Innovation*) has been presented in 2011 and replaced the previous strategy from 2006. Its guiding principle and motto is 'Growth through Innovation', which indicates the central role that is given to innovation. The main change from its 2006 precursor is the reduction from 11 core competencies (*Stärkefelder*) to three thematic foci (*Leitthemen*). These themes are considered to be of special importance for the region, as they reflect genuine strengths of Styria-based firms and research institutions. For the WiSt 2020, a study measured the strengths of the 11 themes formulated by its predecessor (see Figure 8). This so-called *Stärkefeldmessung* assessed the degree of proximity and overlaps between the different themes (Joanneum Research 2010). It allowed the visualisation of thematic proximity and led to the reduction of the number of themes to three:

[19] Translated by the author. Original text: '*Stärkung des steirischen Innovationssystems von der universitären Ebene über die Bereiche Kompetenzzentren und Impulszentren über öffentlichkeitsnahe und private Forschungs- und Entwicklungseinrichtungen hin zu tatsächlich am Markt umgesetzten Produkten, Verfahren und Dienstleistungen.*'

- Mobility: builds on traditional strengths in the automotive sector and aims to further develop the area of clean mobility, high-value niche products and aviation/rail.
- Eco-tech: uses natural resources in Styria, e.g. as part of the wood cluster (*Holzcluster*). Focus is on increased technological development and investments.
- Health-tech: Health and food technology.

Figure 8: Assessment of the thematic strengths of Styria



Source: Joanneum Research (2010), p. 5.

WiSt 2020 follows the principles of the 'Smart Specialisation' concept, which has gained importance in the context of the 2014-20 Cohesion policy programming period. Having a smart specialisation strategy in place is an ex-ante conditionality for regions to receive Structural Funds support. WiSt 2020 defines five core strategies: (1) Location development and management, (2) Innovation and R&D, (3) Entrepreneurship and growth of young companies, (4) Qualification and human resources potential, and (5) Internationalisation of companies and location. The new strategy also argues for policy to move away from aid to businesses and towards a proactive development of Styria as business location, providing holistic financial support instead of only grants (Amt der Steiermärkischen Landesregierung 2011).

Although innovation is the central motto of the strategy, it does not feature equally throughout the strategy but is instead mainly dealt with under core strategy 2 'Innovation and R&D'. Innovation-related aims are:

- to broaden innovation activities by including more firms into innovation processes;
- to improve commercial exploitation of research results via improved conditions for technology transfer;

- to strengthen innovation in the business-related service sector;
- to increase the number of firms using federal and EU-level innovation support schemes, and to combine these with *Land*-level programmes; and
- to improve knowledge of firms, especially SMEs, on how to establish and use intellectual property (Amt der Steiermärkischen Landesregierung 2011).

In spite of the strong innovation-orientation, the 2012 economic strategy does not make any explicit reference to RIS. Its implicit impact is nevertheless clearly recognisable, e.g. in its aim to improve commercial exploitation of research and technology transfer. The RIS impact is implicit, but strong.

5.2.3 Research strategies

In addition to technological and economic strategies, Styria had a research strategy since 2004. The Government Department responsible for Science and Research produced the Research Strategy Styria 2005+ (*Forschungsstrategie Steiermark 2005 plus*) in 2004. The document tackled innovation from an R&D perspective. At the time of drafting the strategy, there was already a technological strategy in place (Section 5.2.1), which was in the process of being updated.

The Research Strategy Styria 2005+ has been developed involving a wide range of public and private stakeholders including the political level, research institutions and the business sector. It was conceptualised as a continuously evolving strategy aimed at fostering Styria's research and innovation capacity via four fields of action:

- **Strategic priorities**: Policy should focus on the ten most important sectors. These are different albeit similar to the thematic foci of the economic strategy: material sciences; mechanical engineering/automotive and transport technologies; chemical and process engineering; human technology; information and communication technologies; environmental technologies; energy; building services engineering (including timber construction); nanotechnology; computer simulation; and mathematical modelling.
- **Governance of the regional RTDI system**: Institutionalisation of strategic priorities, coordination with federal actors and other *Länder*, policy learning, establishment of fora for exchange of experiences.
- **Horizontal measures:** Internationalisation, human resources and interface management.
- **Other supporting measures**: e.g. regional marketing, congress and scientific tourism (Amt der Steiermärkischen Landesregierung 2004).

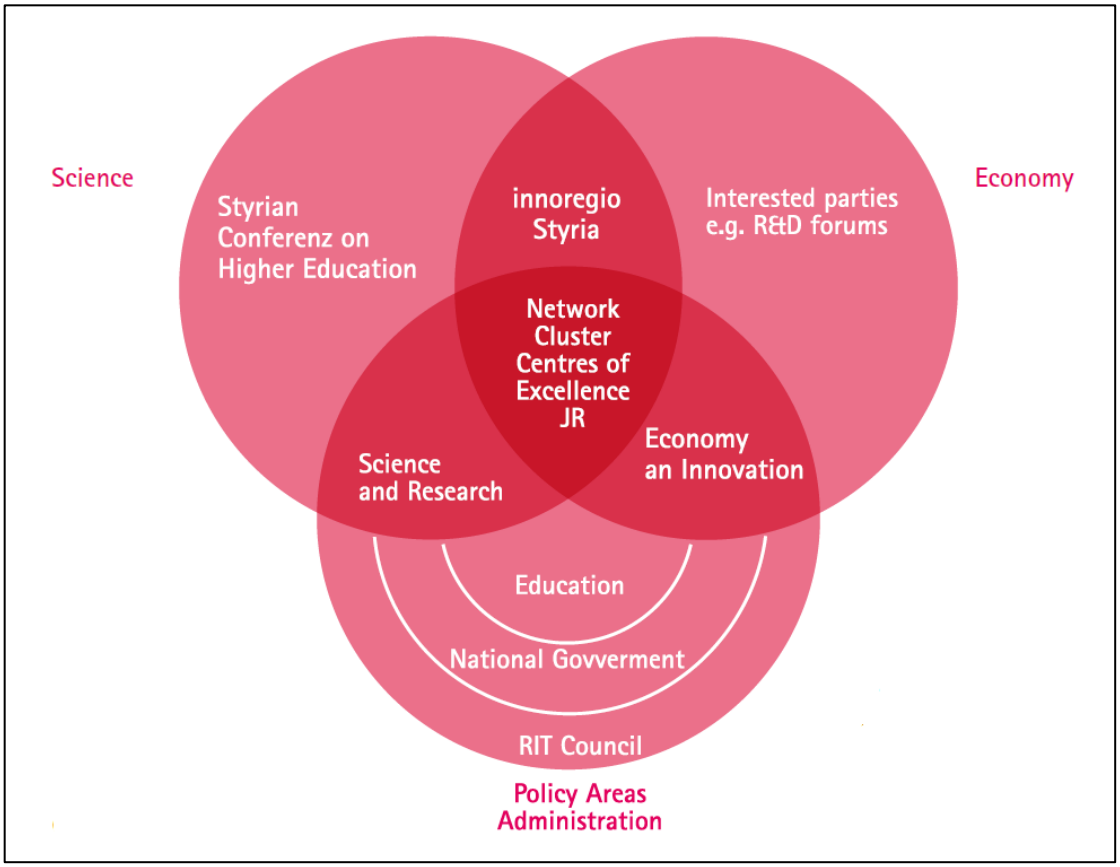
The strategy explicitly emphasises the existing good cooperation between actors in the knowledge generation and in the knowledge application sub-systems of the Styrian RIS:

'There is a well embedded interaction between the scientific and the economic sub-systems of the innovation system. Cooperation between science and industry are exceptionally strong in Styria (Amt der Steiermärkischen Landesregierung 2004).' [20]

There are four other explicit mentions of the term 'innovation system' or 'regional innovation system' in other parts of the document (pp. 16, 17, 35 and 53). The impact of the RIS concept on the Research Strategy Styria 2005+ is explicit.

The 2004 strategy has been evaluated in 2012 and a reviewed strategy has been published at the start of 2013. The Research Strategy 2013 continues the directions of its predecessor and follows the guiding principle of a 'shared space for science and innovation'. Although there is no explicit reference to the RIS concept, the strategy provides an illustration of the Styrian RIS (Figure 9) that is reminiscent of RIS diagrams (e.g. Figure 1 and Figure 2). It clearly derives from systemic thinking in three dimensions: science, economy and policy. Therefore the RIS impact on the Research Strategy 2013 can be described as implicit, but strong.

Figure 9: Governance architecture of research and innovation in Styria



Source: Amt der Steiermärkischen Landesregierung (2013), p. 25.

[20] Translated by the author. Original text: '*Hier zeigt sich eine sehr gute Einbettung und Interaktion zwischen dem wissenschaftlichen und dem wirtschaftlichen Teilsystem des Innovationssystems. Kooperationen zwischen Wissenschaft und Wirtschaft sind am Standort Steiermark überdurchschnittlich stark ausgeprägt.*'

Similar to its 2004 version, the strategy concentrates on the knowledge creation sub-system of RIS and speaks of 'scientific innovation systems' (Amt der Steiermärkischen Landesregierung 2013). However, it also emphasises the importance of knowledge transfer from the scientific into the business realm and argues for 'location management at the interface between science and industry' (Amt der Steiermärkischen Landesregierung 2013).

5.2.4 National RTI strategies

At the federal level, there are a number of sectoral strategies with some innovation element to them, for instance the Austrian Energy Strategy and the Austrian Strategy for Sustainable Development. However, the most important innovation-related strategy documents have been prepared by the Austrian Council for Research and Technology Development (*Rat für Forschung und Technologieentwicklung*). The Austrian Council has been set up in 2000 and gathers representatives from all relevant federal ministries.

In 2002, the Council published the National Research and Innovation Plan (NAFIP). NAFIP starts with a stock-taking of Austria's innovation system in an international context and continues by suggesting measures for improvement. In the NAFIP, reference to the concept 'national innovation system' is strong and direct reference is made to an OECD publication on managing national innovation systems from 1999 (OECD 1999). The strategy reproduces a diagram showing actors and linkages in the NIS, which mentions the key processes of knowledge generation, diffusion and use (Austrian Council 2002).

At the end of its first five-year term in 2005, the Austrian Council presented the follow-up 'Strategy 2010 - Perspectives for Research, Technology and Innovation in Austria'. It builds on the NAFIP from 2002 and contains recommendations in ten strategic fields of action. These fields range from knowledge generation ('Universities') and knowledge application ('Business Enterprises') to policy governance ('State as a Driving Force' and 'Funding Portfolio'). Improving the 'national innovation system' stands in the centre of the strategy and also the important role of regions is highlighted as one of the ten fields of action: 'Regionally anchored players transform new knowledge, turning it to use for local conditions. By providing co-ordinating support for cooperation between such players in innovation networks, a targeted regional development policy can initiate regional learning processes,…' (Austrian Council 2005).

The 2005 strategy was replaced in March 2009, when the federal Austrian Government published the new 'Strategy 2020 – Research, Technology and Innovation for Austria' (*Strategie 2020 - Forschung, Technologie und Innovation für Österreich*). The document is the result of a multiannual consultation process running between 2007 and 2008, the 'Austrian Research Dialogue' (*Österreichischer Forschungsdialog*), involving about 2,200 stakeholders across Austria. As part of this, a team of researchers provided a review of Austrian support for RTI (Aiginger, Falk et al. 2009). The new Austrian RTI strategy has a time horizon of 2020, aligning it with the EU strategy Europe 2020. It addresses measures to strengthen national research structures, foster the innovative capacity of firms, allow for thematic priority setting, increase the efficiency of governance, and linking research,

technology and innovation to the education system. Similar to its predecessor, the strategy for 2020 is strongly emphasising the importance of the 'national innovation system' Austria. It emphasises the interaction of science and businesses and repeatedly uses the concept of a 'knowledge triangle' between education, research and innovation (Austrian Council 2009).

5.2.5 Structural Funds programmes

Structural Funds programmes can be described as secondary strategies, as they were set up on the basis of existing regional priorities. The three programmes since 1995, when Styria started to benefit from European Structural Funds, translated Styrian strategies into the rigid framework imposed by EU Cohesion policy. The 1995-99 programmes came at a crucial phase in Styrian policy-making, as they played an important role in triggering the development of the first comprehensive Styrian strategies (technological and economic).

From 1995 to 1999, the *Land* received €38.77 million from the ERDF and €19.2 million from the ESF through its Objective 2 programme. Support was limited to the eligible areas in Upper Styria, i.e. the *Land*'s more industrial regions. Two Measures under Priority 2 'Support of technology and innovation transfer, advisory services and software applications' were explicitly innovation-orientated. Measure 2.1 'Technology and innovation transfer, advice and information, esp. for SMEs' had a total funding allocation of €9.3 million (2 percent of all costs), including domestic cofounding. To Measure 2.2 'Firm-based and collaborative R&D and business-related basic research' €40.1 million (8.6 percent) were allocated. Hence, in total, less than 11 percent of the programme funding was allocated to innovation. If one considers only the ERDF part of the programme in order to allow some comparison across programme periods possible, the innovation share increases slightly to 11.9 percent (Amt der Steiermärkischen Landesregierung 1995).

The emphasis of Structural Funds in Styria changed with the subsequent programme period. From 2000 to 2006, Styria received €200.3 million from the ERDF, resulting in a total of €523.5 million of public funds. In terms of effects, these helped directly creating over 5,500 new jobs and more than 100 start-ups. In terms of innovation, ERDF funding co-financed 14 research and technology centres and almost 2,700 technology-/innovation-related consulting services.[21]

In the 2007-13 programme period, Styria fell into the Regional Competitiveness and Employment category for Structural Funds support and unlike between 2000 and 2006, the whole of Styria was eligible. While ESF funding was administered centrally by the federal level, Austrian ERDF programmes were managed by the *Länder*.[22] In Styria, Division 12 is the managing authority, which is responsible for the implementation of the programme '*Regionale Wettbewerbsfähigkeit Steiermark* 2007-2013 (Regional Competitiveness Styria 2007-13). The programme had a total public budget of €310.1 million, of which €155.1 million came from the ERDF. The programme was the largest Austrian ERDF programme under Regional

[21] http://www.innovation-steiermark.at/de/programm/ziel2/pdf/Ziel2_Auswertung02092008.pdf (accessed 4 December 2014).

[22] In Burgenland, both the Convergence Phasing-Out ERDF and ESF programmes were managed by the Burgenland *Land* Government.

Competitiveness and Employment Objective and it corresponded to more than ten percent of all Austrian Cohesion policy funding. The cumulative value of generated investment was estimated at €950 million. The programme was divided into three Priorities: (1) Strengthening the innovation and knowledge-based economy, accounting for more than 85 percent of funds, (2) Strengthening the attractiveness of the regions and sites and (3) Governance and Technical Assistance (Amt der Steiermärkischen Landesregierung 2006). Amongst the expected impacts of the programme were 1,800 new jobs, of which 250 in R&D, an additional renewable energy capacity of 11 MW and the reduction of greenhouse gases by 110,000 tons/year.

Table 14: Funding allocations of the ERDF OP Styria 2007-13, €

Priority Axis	EU	National Public	Total Public
Strengthen the innovation- and knowledge-based economy	132,398,529	132,398,529	264,797,058
Strengthen the attractiveness of the regions and sites	19,909,285	19,909,285	39,818,570
Governance and Technical assistance	2,754,040	2,754,040	5,508,080
Total	**155,061,854**	**155,061,854**	**310,123,708**

Source: Amt der Steiermärkischen Landesregierung (2006).

The Styrian OP for 2007-13 had an even stronger innovation focus than the previous programmes. According to the European Commission's thematic codes under the heading 'R&TD, Innovation and Entrepreneurship', 79 percent of all funding was innovation-related (compared to Austrian average of 77 percent). Innovation-related measures were implemented under Priority 1, which consisted of six activity fields (see Table 15). The SFG (see Section 4.5.3) was the by far most important intermediate body in terms of funding. It was responsible intermediate body for activity fields 1, 4 (partly), 5 and 6 of Priority 1, which in total amounted to ERDF funding of €95.5 million or 61.6 percent of the total.

Table 15: Innovation-related funding in the Styrian ERDF OP 2007-13

Activity field	Responsible intermediate body	ERDF allocation, €
1: Inter-firm R&D	Dept. 8	6,590,129
2: Strengthening innovation system actors, including business-related infrastructure	SFG	19,056,804
3: R&D in firms	FFG	17,262,989
4: Promoting innovation in firms	SFG ERP & AWS*	62,178,987 13,056,527
5: Promoting entrepreneurial spirit	SFG	5,253,093
6: Knowledge acquisition and knowledge management for innovation	SFG	9,000,000
Total Priority 1		**132,398,529**

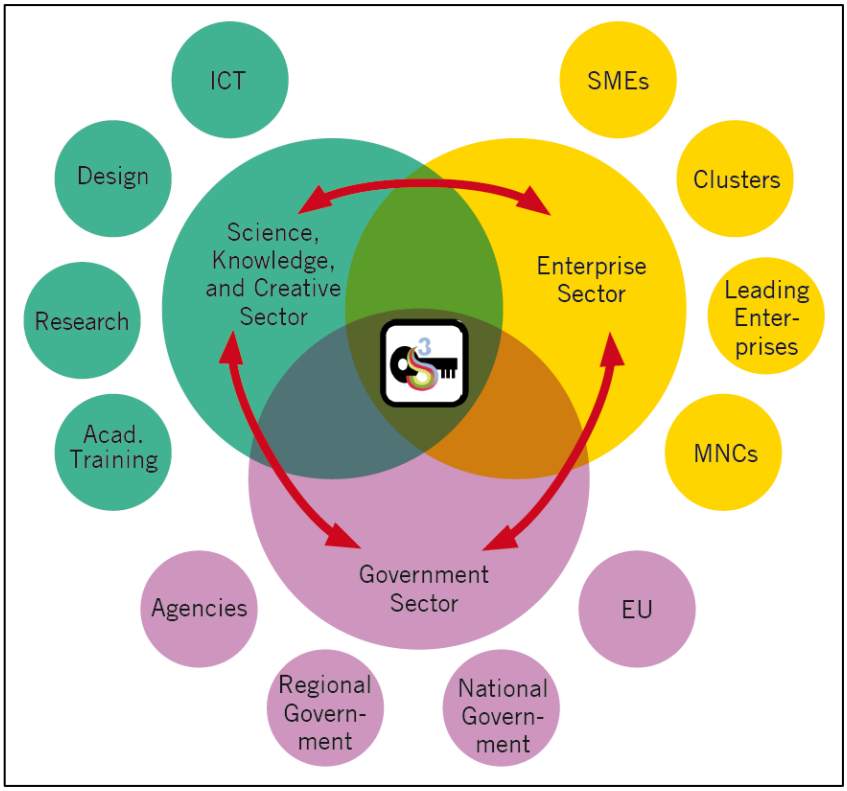
Source: Own calculations on the basis data provided by the Styrian Government Department 12 Economy, Tourism and Sport, Unit Economy and Innovation.

* **Note**: ERP (European Recovery Programme) Fund and AWS (Austria Wirtschaftsservice) are both federal intermediate bodies.

With the exception of SFG, the importance of Structural Funds is relatively limited for most Styrian intermediate bodies. However, in single interventions and regions, their share can be quite high. The ERDF contribution is approximately one third of the SFG budget (Resch 2010). However, compared to regions in other countries, the Styrian RIS has a comparative low dependence on Structural Funds (Leo and Philipp 2011).

In the 2014-20 programme period, Austria manages a single ERDF OP for all *Länder*. The importance of innovation-related activities increased, as the European Commission asks for the preparation of so-called Smart Specialisation Strategies. These have to be in place before funding will be paid out. Therefore, the federal Austrian level commissioned a guidance document in 2012 in which it suggests the RIS model shown in Figure 10. Some features of the RIS concept are clearly reflected in the diagram, including the thinking in three separate but partially overlapping dimensions: research, businesses and governance (Joanneum Research 2012). However, with its Economic Strategy Styria 2020 and the most recent Research Strategy 2013 in place, Styria does not envisage any challenges in fulfilling the new condition.

Figure 10: Smart specialisation – suggested RIS model



Source: Joanneum Research (2012).

5.3 Instruments

The following sections look at the most important innovation instruments in Styria and to what extent their creation has been influenced by the RIS concept. Many of these instruments can be found in Table 5 (Section 2.5), which provided a taxonomy of regional innovation policy instruments developed by OECD.

However, before presenting the most important innovation policy instruments, it is important to put the significance of public funding for innovation into context. Table 16 gives an overview of sources of innovation funding in Austria, separated by *Länder*. These figures have to be treated with care, as they also include funding that is not primarily aimed at innovation, e.g. basic funding for universities. Nevertheless, they provide some insights into the relative importance of the different actors by comparing the figures in an Austrian context.

The largest providers of funding in Styria are Austrian enterprises (38 percent) and the federal level (25 percent). The private share in Styria appears to be below the Austrian average (49 percent), but this does not include foreign private funding, which is subsumed under foreign funding. The non-EU category is particularly high in Styria (24 percent), which results from research centres based in Styria but run by multinationals based outside the EU. In Styria, one of the most important companies investing into research undertaken in Styria is Magna

Steyr, a producer of automotive parts and a subsidiary of Canadian-based Magna International.[23]

Table 16: Sources of innovation funding 2009, in %

	Austria						Foreign	
	Private		Public					
	Enter-prise	Non-profit	*Bund*	*Land*	Muni-cipa-lities	other	EU	non-EU
Austria	**48.7**	**0.5**	**24.0**	**3.8**	**0.1**	**4.9**	**1.5**	**16.4**
Burgenland	74.4	0.1	7.3	6.3	0.3	5.8	0.9	5.0
Carinthia	42.6	0.1	11.7	3.6	0.4	4.2	0.4	37.0
Lower Austria	73.3	0.8	14.2	4.8	0.1	2.7	0.8	3.3
Upper Austria	77.4	0.1	10.5	2.7	0.2	4.0	0.8	4.3
Salzburg	55.2	0.6	29.8	4.9	0.7	5.5	1.6	1.7
Styria	38.3	0.1	24.9	5.1	0.1	5.8	1.7	23.9
Tyrol	46.2	0.9	35.8	4.1	0.1	5.2	1.8	5.9
Vorarlberg	77.7	0.1	5.3	6.1	0.2	2.2	0.4	8.0
Vienna	36.2	0.7	31.3	3.2	0.0	5.5	1.9	21.2

Source: Statistik Austria and Leo and Philipp (2011).

Table 17 shows the key features of the five most important types of instruments supporting the Styrian RIS. **Overall responsibility and administration** is located either at the Styrian level, the federal level or it can be shared. Clusters and impulse centres are managed mainly by the *Land* Styria, while the responsibility for AplusB centres and centres of excellence lies mainly with the national level, i.e. the BMVIT and its funding body FFG. Although Styria is involved in the implementation of the latter two, it is important to note that they have been initiated by the national level.

- **Actual implementation tasks** are usually located in Styria, i.e. the SFG. Only AplusB centres are implemented directly by the federal level, but again the SFG has some role.
- The **time of launch** of the instrument varies between clusters and impulse centres in the 1990s and the more recent AplusB centres from 2001. Current SFG instruments are from 2007/2008, but similar instruments have been in place before that.
- The **annual budget** ranges between €3 million (AplusB centres) and €47.9 million (centres of excellence) (in 2011).
- The **target of support** can be either individual firms, as in the case of most SFG instruments, or networking and knowledge exchange structures (e.g. clusters).

[23] Interview with Markus Gruber, convelop, 5 September 2012.

- Related to the target of support is **which RIS sub-system is primarily targeted**, i.e. rather the knowledge generation and or the knowledge application sub-system. The various networking and knowledge exchange structures again have different emphases, ranging from predominantly business-oriented networks (clusters) to instruments with a balanced role of firms and R&D (impulse centres and AplusB centres) and finally to predominantly R&D driven structures (centres of excellence).

Table 17: Selected instruments supporting the Styrian RIS

	SFG business support*	Clusters	Impulse centres	AplusB centres	Centres of excellence
Responsibility / Administration	Styria	Styria	Styria	National level	National level & Styria
Implementing body in Styria	SFG	SFG	SFG**	Mainly federal, minor role of SFG	SFG
Launch year	2007/2008	1995	1990s***	2001	1998
Public funding volume in € million (2011)	31.8 (SFG incl. Structural Funds)	6.1 (SFG)	8.6 (SFG)	3.0 (FFG)	47.9 (FFG) 20 (Styria)
Targeted RIS actors		Directly to firms		Networking and knowledge exchange structures	
Targeted RIS dimension	Knowledge application	Mostly knowledge application	Balanced knowledge application & generation	Balanced knowledge application & generation	Mostly knowledge generation

Source: Author.
Notes: * Groß!Tat, Geistes!Blitz, Einfalls!Reich and Rat!Geber, see Section 5.3.1
** Only 17 of 32 Styria impulse centres are coordinated by the SFG.
*** The first centres were set up earlier (1986), but their development into impulse centres took place in the 1990s.

The following sections look at the five types of instruments listed in Table 17 more closely. These include three Styrian instruments (or group of instruments) as well as two mainly federally driven instruments. Section 5.3.1 starts by providing an overview of SFG measures directed at firms and the subsequent sections present the main structures for networking and knowledge exchange between research and business actors: clusters (Section 5.3.2), impulse centres (Section 5.3.3), AplusB centres (Section 5.3.4) and centres of excellence (Section 5.3.5).

5.3.1 SFG support for R&D in firms

The SFG is the key actor in the delivery of Styrian innovation policy instruments (see Section 4.5.3). This section focusses on SFG support for R&D in firms, but the SFG is involved in the delivery of all other instruments discussed here, albeit to a different extent. SFG offers support under five core strategies. With almost €36 million or 58 percent of all funding, the SFG core strategy 'Innovation and R&D', under which the instruments below fall, is the by far most important one in financial terms.

Table 18 lists the most important instruments supporting innovation. The number of instruments for firms fluctuates, as some are phased out and others are introduced on a regular basis. In total, R&D in firms was supported with €35.7 million in 2011. The relative importance of SFG support per project varies, but can reach about half of the total project volume. The four most important support schemes for firms are briefly presented below. However, SFG also supports the networking and knowledge exchange structures discussed in the subsequent sections. For these, SFG funding ranges between very high in the case of clusters, which are almost entirely funded by SFG (93 percent), significant in the case of impulse centres (39 percent) and modest in the case of centres of excellence (9 percent). The latter are mainly financed federally by the BMVIT.

Table 18: SFG innovation support in 2011

Instruments	N. of pro-jects	Total project volume, € 1,000	SFG support (*Land* & EU sources), € 1,000	SFG contri-bution to total project volume, %	SFG support per project, € 1,000
Support for firms					
Groß!Tat	54	215,474	22,302	10.4	413
Geistes!Blitz	147	139,460	6,806	4.9	46
Einfalls!Reich	59	2,675	1,202	44.9	20
Rat!Geber	103	3,699	1,480	40.0	14
Erlebniswelt Wirtschaft	36	5,277	1,679	31.8	47
Zukunfts!Sicher	7	1,184	120	10.1	17
Teil!Haben dynamisch	3	23,200	1,900	8.2	633
Teil!Haben innovativ	1	100	50	50.0	50
Other firm support	1	400	207	51.8	207
Total	**411**	**391,468**	**35,746**	**9.1**	**1,448**
Support for network structures					
Clusters	25	6,564	6,073	92.5	243
Impulse centres	7	21,877	8,563	39.1	1,223
Centres of excellence	2	25,650	2,214	8.6	1,107
Total	**34**	**54,091**	**16,850**	**31.2**	**2,573**
Grand total	**445**	**445,559**	**52,596**	**11.8**	**4,021**

Source: SFG (2012) and own calculations.

According to Leo and Philipp (2011), the most important innovation schemes offered by SFG are Geistes!Blitz and Einfalls!Reich, while policy-makers emphasise the importance of Groß!Tat,[24] which accounts for more than 62 percent of SFG investments into innovation and R&D. Finally, looking at the number of funding cases and relative SFG contribution, Rat!Geber is another important funding source for Styrian businesses. With the exception of Einfalls!Reich (2008), all these instruments have been launched in 2007. They have been revised in April 2012 and extended until the end of 2013:

- **Groß!Tat** provides support for innovative investments in existing companies as well for the creation of new innovative firms. The target group includes both industrial firms and industry-related service providers, with a focus on firms in future-oriented technology fields. Eligible investments must fall under the three thematic foci (mobility, eco-technology and health technology) or five core competencies set out in the Economic Strategy 2020. Costs are eligible for planning, construction, machines,

[24] Interview with Gerd Gratzer, Department 12 of the Styrian *Land* Government, 4 March 2013 (phone).

office equipment of capital assets and immaterial investments. Maximum awards depend on the eligibility status according to Regional Aid Guidelines, but usually range between five and 15 percent of the total costs, which must amount to at least €750,000. In 2011 alone, Groß!Tat supported 54 projects with a total investment volume of €215.5 million. The SFG contribution was €22.3 million, which corresponded to 10.4 percent.

- **Geistes!Blitz** is the second-most important SFG instrument in terms of funding. The scheme provides support for research, development and creative impulses and targets SMEs in industry, industry-related services and the creative economy. It is split into three Priorities: 'Innovation Impulse', 'Innovation Contact' and 'Innovation Performance'. 'Innovation Impulse' funds up to 40 percent or €4,000 for external consultancy services in preparatory phase of R&D projects. 'Innovation Contact' provides up to 40 percent or €2,000 for costs related to the creation of international R&D projects and partnership building. Finally, 'Innovation Performance' funds consulting, material, design and, in the case R&D in firms, also staff costs related to innovations close to market introduction. In 2011, Geistes!Blitz €6.8 million of funding to 147 projects, which corresponds to five percent of a total project volume of €139.5 million.
- **Einfalls!Reich** is split into a number of subthemes supporting the creative potential of the workforce, the drafting of creativity strategies, the realisation of creative ideas, their market introduction and the implementation of creative communication strategies. Up to 40 percent of costs are eligible with the maximum amount ranging between €8,000 and €50,000. All firm sizes are eligible and sectors include industry and industry-related services as well as creative industries. In 2011, the SFG supported 59 projects with a total €1.2 million. This corresponded to 45 percent of the total project costs of €2.7 million.
- **Rat!Geber** funds business-to-business advisory services with the aim of strengthening their innovative abilities and to encourage more SMEs to use external consultancy services. The target group includes SMEs in industry and industry-related services. Eligible advise can relate to business management (introduction of new organisational forms, quality management systems, controlling instruments), environment (optimisation of resources and reduction of emissions, optimisation of internal mass flows, introduction of environmental management systems), marketing (integrated marketing concepts, processes to integrate customer needs, new forms of communication) and to ways to increase the added value generated (regional added value, internal process optimisation, costs for external certification). Rat!Geber covers up to 40 percent of the total project costs or a maximum of €20,000. In 2011, this amounted to an SFG contribution of €1.5 million or 40 percent to the total project volume of €3.7 million spread across 103 projects.

In addition to these 'hard' instruments, which provide direct financial support to enterprises, the SFG also carries out 'soft' measures aimed at raising innovation awareness and include events, competitions and media relations. One of the most prominent activities is the 'Fast Forward Award', which has been awarded to innovative firms since 1995. There are five award categories, plus a special 'Public Forward Award'. Four of the five categories are determined by the size of the company based, i.e. the number of employees and turnover.

The fifth category is reserved for other institutions and research institutes. Each project submitted in one of these five categories will also take part in the separate 'Public Forward Award'. Here the winner is determined by the audience of the 'Fast Forward Award' ceremony. Winners receive a trophy and a grant of €10,000. Although the prize money is quite low and therefore negligible for most winners, the award can be used in corporate marketing. Prize winners of the past years include Magna Steyr Fahrzeugtechnik (2002), Saubermacher Dienstleistungs AG (2005), Siemens Transportation Systems (2008), Binder+Co AG (2009), ACC Austria GmbH (2010) and AT&S Austria Technologie & Systemtechnik AG (2011). Most of these firms fall into the category of *Leitbetriebe,* so-called Leading Competence Units (LCU) that play an important role in clusters.

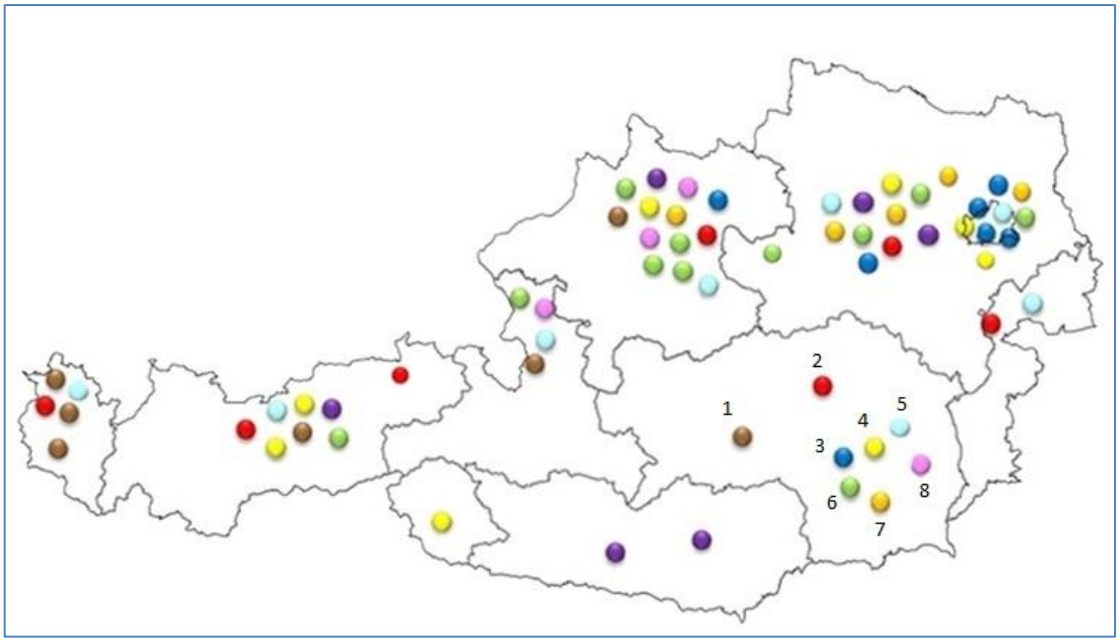
The four different SFG schemes supporting R&D in firms that have been described above are exclusively directed at the knowledge application side of RIS. Although they also support the generation of knowledge, this relates only to R&D in firms. The schemes do not foster any exchange with dedicated knowledge generators and the directives do not contain any explicit reference RIS or to innovation occurring in systems. Therefore, SFG support for R&D in firms falls into the category of 'no impact of RIS'.

5.3.2 Clusters

Clusters are one of the characteristic elements of Styrian policy and the *Land* is perceived to be the 'cradle' of clusters in Austria. The automotive cluster ACstyria was set up in 1995 as the first Austrian cluster, quickly followed by many similar initiatives across Austria. In 2012, there were more than 50 clusters distributed across all Austrian *Länder* (see Figure 11). These involve about 4,000 companies with more than 400,000 employees (TACTICS 2012). The importance given to the cluster tool by policy makers is also shown by the creation of the Austrian cluster platform[25] by the Federal Ministry of Economy, Family and Youth in 2008. Over time, clusters steadily developed from business-to-business structures to more science-to-business structures. This allows for a better coordination of research and business needs.

[25] http://www.clusterplattform.at/index.php?id=1&L=1 (accessed 4 December 2014).

Figure 11: Clusters in Austria



Source: Clusterplattform Österreich, http://www.clusterplattform.at/index.php?id=27&f=&c=&L=nwuakwns (accessed 5 May 2013).

Currently, there are eight clusters in Styria as well as two networks with similar characteristics, BioNanoNet and NANONET-Styria. The eight clusters are:

- (1) Holzcluster Steiermark GmbH (timber, furniture, construction): Founded in 2001, the cluster's aim is to position Styria as a location known for 'wood-high-tech'. About 150 partner firms are in the process of internationalising their activities, especially in Southern and Eastern Europe, and aim to intensify their R&D-activities in the forestry industry.
- (2) Materials cluster Styria (materials): The cluster was founded in 2001 and includes companies involved in both production and industry-related services, but also research in the area of materials at universities and in six centres of excellence.
- (3) ACstyria Autocluster GmbH (automotive, rail, transport and aerospace): It is the largest cluster in Styria with over 40'000 employees in 180 firms. The total annual turnover of the cluster amounts to about €10 billion. ACstyria has been created in 1995 and is directed by five shareholders (AVL, Krenhof, Magna Steyr, SFG and TCM International).
- (4) Human.technology.styria (health, life science, wellness): 76 members are aiming at international leadership in the development and implementation of integrated health care solutions. The cluster started in 2004 to become the hub for medical devices and repair medicine.
- (5) Verein Netzwerk Logistik SÜD (logistics): The Association for Network Logistics has three regional divisions, one of which covers southern Austria including Styria and is based in Kapfenberg. It offers a platform for knowledge exchange to logistics providers and consumers.

- (6) ECO WORLD STYRIA (sustainable energy, environment): The cluster was set up in 2005. Today, 173 firms are operating in the four areas biomass, solar energy, mass flows and fresh and waste water, making ECO WORLD STYRIA the worldwide leading environmental cluster. ECO World Styria won the 2012 Regiostars Awards as a good example for smart growth co-financed with Structural Funds.
- (7) TECHforTASTE.net (food): This cluster for modern food technology has been created in 2007. It looks at research and the development of new technologies and innovative processes.
- (8) Creative Industries Styria: Created in 2007, the aim of the cluster is to develop the potential of the Styrian creative economy. With Graz as its centre, Styria is supposed to develop into a hot spot for creative talent.

Depending on the sector, a cluster can consist of up to 200 partners. Many Styrian clusters also involve partners from other *Länder* as well as actors from abroad, especially from neighbouring countries to the south and east.

All clusters and networks operate as an own company. When they were set up, they were fully owned by SFG. After a first phase of establishment and following the strategic positioning process, the SFG transferred 49 percent of the shares to scientific and/or business members of the cluster. This leads to a broadening of the ownership and a first synchronisation of the stakeholder groups of business, science, education and the public sector. In well-developed cluster organisations, the SFG limits its involvement to a minimum of 26 percent of the total capital.

The tasks of Styrian clusters typically include ensuring maximum transparency in the respective field of strength; establishing databases about the most relevant actors (businesses, academic institutions, training providers, etc.); information and communication about future trends, their relevance their consequences; initiation of technology and knowledge transfer processes (e.g. workshops and other events); development of cooperation projects in the field of technology, innovation, organisation, marketing; identification of skill needs and development of cluster-specific training; location marketing; participation in internationalisation and export programmes; and participation in the development of key projects such as centres of excellence.

On average, each cluster organisation employs six people. Their budget sizes range between €600,000, €1.2 million a year. Each cluster member pays an annual contribution ranging between €1,500 and €7,500, depending on company size and turnover. Additional funding comes from sponsors (e.g. banks) and SFG funding (Clement, Pamminger et al. 2009). In 2011, the SFG supported the Styrian clusters with €6.1 million (SFG 2012).

In 2009, an evaluation of cluster development in Austria stated positive effects on the national economy and on regional innovation performance. One of the points of criticism was the lack of an Austrian cluster strategy (Clement, Pamminger et al. 2009).

The role of clusters changed over time. They evolved from purely networks of companies to research cooperation arrangements encouraging the creation of spin-offs. A major development step was the launch of the centres of excellence (see Section 5.3.4) from 1998

onwards and the AplusB programme (see Section 5.3.4) by the federal level in 2001.[26] These structures become part of clusters. Looking into the future, clusters are supposed to be further developed into 'knowledge-based production systems' (Schwaiger 2012) and to have an even higher profile in the Styrian RIS.

A feature of Styrian clusters is that many tend to be star-shaped, i.e. there is one major firm linked to many smaller firms surrounding it, typically suppliers.[27] The economic crisis in 2009 showed that this set-up makes them more vulnerable to external shocks. In the other Austrian *Land* with a strong cluster policy, Upper Austria, clusters are less reliant on single companies. Although also Styria's economy recovered well after a slowdown in 2008/2009, Upper Austria came slightly better through the crisis. In this context, the Austrian Federation of Industries commissioned a study in 2011, which looked at the role of the most important firms for the Austrian and *Land*-level economy. The study highlighted the importance of these *Leitbetriebe* or so-called Leading Competence Units (LCU), not only for the economy more widely but especially for innovation. The Institute for Industrial Research (*Industriewissenschaftliches Institut*, IWI) identified 103 LCUs in Austria, of which 11 still fall under the category of SMEs. 17 LCUs are located in Styria.[28] In 2006, the Styrian LCUs alone invested €380 million in R&D, which created an additional R&D investment of 25 percent by supplying companies and corresponded to about half of all Styrian R&D investment (Heidinger, Riemer et al. 2009).

In their initial configuration as networks of firms, clusters would be located entirely on the knowledge application side of RIS. With the inclusion over time of centres of excellence and AplusB centres, they assumed more of a role of intermediary between knowledge application and generation. A well-developed cluster can in practice become its own RIS at a small scale. However, Styrian policy documents setting out the strategic foundations for clusters do not make any explicit reference to innovation systems. Hence, clusters show only implicit impact of the RIS concept.

5.3.3 Impulse centres

Impulse centres (*Impulszentren*) are technology, start-up and business parks, which support technology-oriented new and growth-oriented firms. About 90 centres have been set up in the Austrian *Länder* from the early 1990s onwards. There are 32 impulse centres in Styria alone (see Figure 12), of which 17 are coordinated by the SFG.[29] They are owned fully or partly by Innofinanz GmbH, a 75 percent-owned subsidiary of SFG. Innofinanz advises and supports the Styrian impulse centres and its tenants. The aim of these centres is to create an

[26] Interview with Markus Gruber, convelop, 5 September 2012.

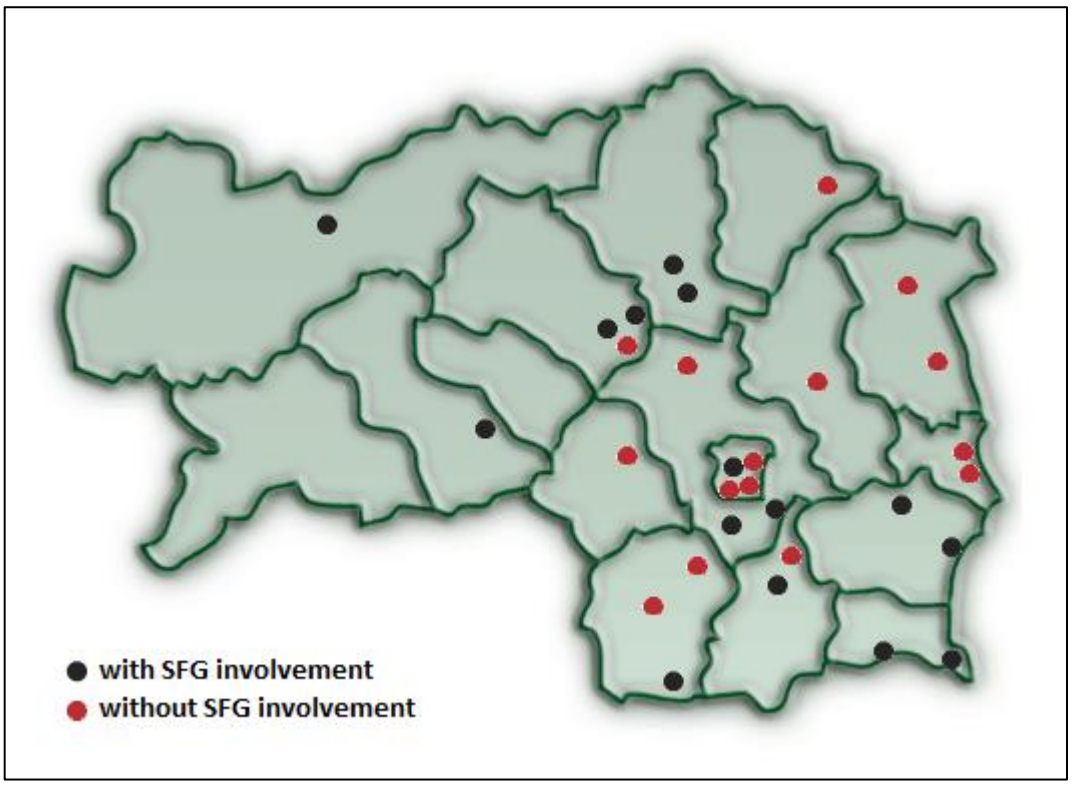
[27] Interview with Herwig Schneider, Industriewissenschaftliches Institut, 4 March 2013.

[28] LCU in Styria: ACC Austria GmbH, Andritz AG, AT & S AG, austriamicrosystems, AVL List GmbH, Binder + CO AG, Borckenstein AG, EPCOS OHG, Grazer Armaturen-Werk Pildner-Steinburg GmbH, Knauf GmbH, Knill Holding GmbH, Magna Steyr Fahrzeugtechnik AG & Co KG, Maschinenfabrik Liezen und Gießerei GmbH, Steirische Gas-Wärme GmbH, Vogel & Noot Verpackungstechnik GmbH, Zellstoff Pöls AG.

[29] The term impulse centre is not used consistently and different sources count different numbers of centres. According to the Association of Austrian Technology Centers there are 26 impulse centres in Styria. However, the Association itself has only 11 members (54 in the whole of Austria), see http://www.innovationszentren-austria.at (accessed 2 May 2014).

innovative business environment going beyond offering only real estate at low cost. The spatial concentration of many small innovative firms working within a specific thematic area leads to positive synergy effects. As a bridge between business and science, impulse centres contribute to technology transfer. Cooperation between companies in the centres themselves and with other companies, educational and R&D facilities in the region stimulates the development of new products, services and processes. A major focus is the development and management of high quality specialised properties (including laboratories) for technology-oriented companies in combination and coordination with research and educational institutions.[30]

Figure 12: Impulse centres in Styria



Source: Adapted from SFG, http://www.sfg.at/cms/982/Landkarte/ (accessed 5 May 2014).

As the first Austrian centre of its kind, the first impulse centre has been set up in Graz in 1986. It was followed the centres in Niklasdorf (1990) and Grambach (1994). However, a coherent strategic basis for impulse centres was provided by Technology Policy Strategy (*Technologiepolitisches Konzept*) from 1995. In the late 1990s and early 2000s, the development of impulse centres was accelerated, and in addition to expanding existing ones, many new centres were created, for instance Lebring (2000), Auersbach (2001), Radkersburg (2001), Mureck (2006), Leoben (2007) and Zeltweg (2007). In the case of Liezen, an existing structure has been further developed into an impulse centre. The start-up centre from 1994 became an impulse centre in 1996 and has since been expanded in 2000, 2003 and 2006.[31]

[30] http://www.sfg.at/cms/484/Leitbild/ (accessed 9 December 2014).

[31] Written reply by Sabine Proßnegg, SFG, 12 May 2014.

In 2014, the Styrian impulse centres accommodate about 450 firms employing over 2,000 people. In 2011 alone, SFG co-funded the Styrian impulse centres with €8.6 million.

Impulse centres perceive themselves as bridges between business and science. They play a central role in RIS by facilitating the flow of knowledge between the knowledge generation and application sides. The objective of impulse centres set out in a federal document from 2011 makes explicit reference to the innovation system, albeit without mentioning any spatial aspects:

'Development and strengthening of key innovation competencies and functions of the impulse centres in the innovation system with the focus on high-tech and innovative start-ups and young, growing and innovative companies.[32] *(Bundesministerium für Verkehr 2011)*

However, in spite of the explicit reference to innovation systems, impulse centres are classified as showing only an implicit impact of the RIS concept. The directive from which the above quote is taken has only been produced in 2011, i.e. long after the first impulse centres have been set up in the 1990s.

5.3.4 AplusB centres

After the introduction of clusters and impulse centres by Styrian policy-makers in the early to mid-1990s, the most important subsequent developments were driven by the national level. These include mainly the introduction of two instruments, the centres of excellence (see Section 5.3.5) and the AplusB Centres, which were initiated by the federal level and have been set up from the early 2000s onwards.

AplusB centres are incubator centres that support business start-ups from universities, colleges and other research institutions. AplusB has been launched in 2001 and stands for 'Academia plus Business'. All eight Austrian centres are linked to academic institutions. The incubators support, accompany and accelerate the development of promising start-up projects with advice, networking, funding and infrastructure. Their aim is to foster the commercial implementation of innovation via:

- stimulation of the establishment of companies;
- expertise to start-ups;
- advice and assistance in the start-up processes;
- integration of start-ups into networks;
- assistance to companies in early stages;
- follow-up financing for assisted start-ups;
- physical infrastructure;
- co-funding for pre-seed, seed and early business stages; and
- comprehensive patent consulting services.[33]

[32] Translated by the author. Original text: '*Entwicklung und Stärkung zentraler Innovations-kompetenzen und -funktionen der Impulszentren im Innovationssystem mit dem Fokus auf High-Tech- und innovative Unternehmensgründungen sowie junge innovative Unternehmen im Wachstum.*'

[33] AplusB - The Austrian Hightech Incubator Network, http://www.aplusb.biz/ (accessed 1 March 2013).

Table 19: AplusB Centres in Austria

Name	*Land*	Location	Year
CAST	Tyrol	Innsbruck	2001
build!	Carinthia	Klagenfurt	2002
INiTS	Vienna	Vienna	2002
Science Park Graz	Styria	Graz	2002
tech2b	Upper Austria	Linz	2002
ZAT	Styria	Leoben	2004*
Accent	Lower Austria	Wiener Neustadt	2005

Source: FFG, http://www.ffg.at/content/aplusb-zentren (accessed 4 December 2014). **Note**: The BCCS-Business Creation Center in Salzburg has been closed at the end of 2014. * The centre has been created in 1999, but it only received the status of an AplusB centre in 2004.

Currently, there are seven AplusB Centres in Austria (see

Table 19 and Figure 13), of which two are based in Styria:

- The Science Park Graz promotes entrepreneurial thinking in an academic environment, in order to encourage academics from all disciplines to set up innovative, knowledge-based and technology-oriented firms. Since its creation in 2002, it created 470 jobs; at the end of 2014 the centre has been home to 64 start-ups.[34]
- The ZAT (Center for Applied Technology) in Leoben was founded in 1999 as the first centre for university spin-offs in Austria. It is working closely with the University of Leoben, which is Austria's university for mining, metallurgy and materials, and created around 300 jobs in the region.[35]

They incubators are jointly administered by *Bund* and *Länder* and receive funding from the Federal Ministry for Transport, Innovation and Technology (*Bundesministerium für Verkehr, Innovation und Technologie*, BMVIT) via the FFG and from the *Länder*. In Styria, the SFG coordinates activities between the federal level and the two Styrian centres. The federal level assumes a maximum of 35 percent of the costs, while a minimum of 15 percent of own resources need to be provided. The remaining costs are covered by other actors, mainly the *Land*. In 2011, the FFG made more than €3 million of support available (FFG 2012). Overall, more than €262 million of capital has been invested in spin-off companies. Until the end of 2011, 349 firms were created through the AplusB programme. These represent 95 percent of all companies that have received AplusB support, which means that only five percent have ceased trading (AplusB 2012). By July 2012, these firms created about 1,900 jobs in total, of which 71 percent are university graduates.

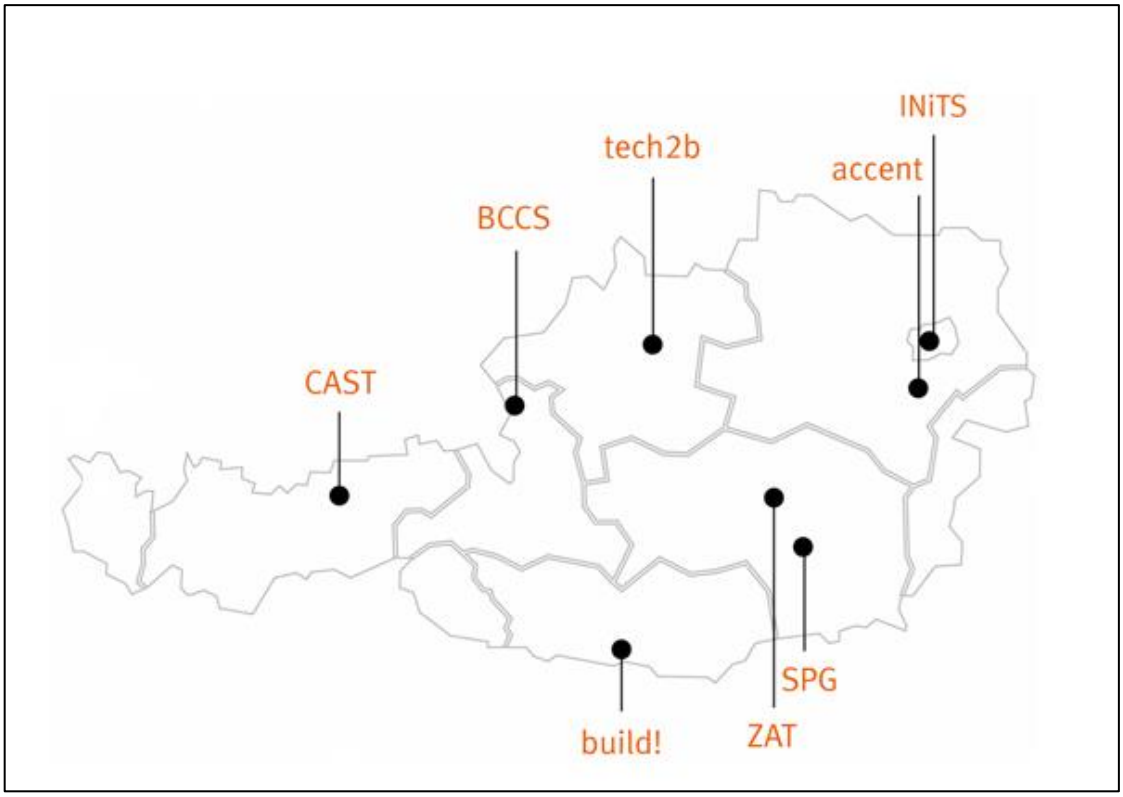
The work of the AplusB centres is supported by the Austrian AplusB network, which acts as national and international advocacy for their start-ups. It supports these in the areas of

[34] http://sciencepark.at/erfolge/wussten_sie/fakten.php (accessed 4 December 2014).

[35] http://www.zat.co.at/de/2667/ (accessed 4 December 2014).

growth, financing and internationalisation. In the eight incubators across Austria, more than 150 partners work together, including nearly all Austrian universities, many other research institutions and private businesses.

Figure 13: AplusB Centres in Austria



Source: http://sciencepark.at/ueber-uns/aplusb.php (accessed 15 December 2015).

Evaluations of the AplusB programme have so far been favourable (Heydebreck and Petersen 2008). However, there is also some friction between the centres, SFG and FFG. SFG is only responsible for co-financing the *Land* share of costs, while the programme is basically run by the BMVIT. Yet, Styria supports knowledge-intensive start-ups also as part of their impulse centres (Section 5.3.3), where the *Land* can place different emphases according to their strategic aims. This shows that federal and *Land*-level measures are not necessarily aligned with each other.[36]

The role of AplusB in the regional innovation process is to increase the number and performance of spin-off companies from academia (Bundesministerium für Verkehr 2001). The centres concentrate on transferring knowledge from the 'generators' in academia to the 'applicators' in the business world, which is also a key aspect of the RIS concept. Yet, the AplusB directive from 2001 does not make any reference to innovation systems, nor does the directive for the renewed support scheme from 2011 (Bundesministerium für Verkehr 2011).

[36] Interview with Markus Gruber, convelop, 5 August 2013.

Therefore, AplusB centres can be categorised as instruments with an implicit, albeit strong, impact of the RIS concept.

5.3.5 Centres of excellence

The Austrian centres of excellence are strategic alliances between universities and industrial firms. In 1998, Austria started targeted programmes (Kplus, K_ind and K_net) to support cooperation between research and industry. In 2007, these programme have been transformed into COMET (Competence Centres for Excellent Technologies), which is operated by the Austrian Research Promotion Agency (FFG) on behalf of the two federal Ministries BMVIT and BMWFW. COMET has three lines of funding, which differ according to the centres' international visibility, project volume and duration. So-called K2 Centres are centres with high quality international research, while K1 Centres focus on scientific and technological developments with relevance to future markets. Finally, 'K Projects' are smaller centres that allow for the support of research themes run by relatively small consortia that do not yet fulfil the criteria of K1 Centres. COMET funding is awarded for a period of three to five years for K Projects, seven years for K1 Centres and ten years for K2 Centres. Public funding ranges between a maximum of €450,000 (K Projects) and €5 million (K2 Centres) annually and must not exceed 35 or 55 percent respectively. Businesses need to provide at least 40 percent, while scientific partners are required to meet at least five percent of the costs. In 2011, for instance, the FFG provided €47.9 million of federal funding to centres of excellence, making it the FFG's second most important instrument in terms of funding size (FFG 2012). In Styria, €100 million (*Sonderbudget Kompetenzzentren*) will be invested into the *Land*'s centres of excellence between 2006 and 2016. This funding has been extended by an additional €40 million of Styrian funding for the ten-year-period 2013-22.[37] In total, the annual Styrian funding for centres of excellence averages to €20 million a year.

Centres of excellence (and AplusB centres, Section 5.3.4) are evidence of an increasing shift from a firm-centred approach to a system-centred one, i.e. the support of different kinds of clusters and networks. In Styria, like in many other countries and regions, there has been a withdrawal of the State as provider of industrial subsidies and its re-emergence as promoter of research-industry interfaces, thus facilitating networking and collective learning activities (Tödtling and Trippl 2012).

All centres of excellence are regularly evaluated. A compulsory ex-ante evaluation is followed by a review in the second (for K1 Centres) or third year (for K2 Centres). At half-time, an external mid-term evaluation determines whether funding is continued or not. Finally, after the end of the funding contract, an ex-post evaluation needs to be carried out.

24 of the 57 Austrian centres of excellence (over 40 percent) are located in Styria (see Table 20). These include three of only five K2 Centres in Austria, seven of a total of 16 K1 Centres

[37] Interview with Gerd Gratzer, Department 12 of the Styrian *Land* Government, 4 March 2013 (phone) and report by the Styrian *Land* Parliament, available at: http://www.landtag.steiermark.at/cms/dokumente/ltpdf.11406713/na/11406713.pdf (accessed 9 December 2014).

and 14 K Projects. COMET is aiming at the creation of further centres of excellence and has been running a number of calls for applications in 2014.

Table 20: Centres of excellence in Styria

K2 Centres	
ACIB	Centre for industrial biotechnology
K2-Mobility	Application-oriented vehicle development
MPPE	Material, process and product development
K1 Centres	
Bioenergy 2020+	Biomass research
EVOLARIS	Interactive media
Know-Center	Knowledge management and technologies
PCCL	Synthetic materials and polymer science
RCPE	Pharmaceutical process and product development
CTR	Intelligent sensor technology
K1-Met	New techniques for iron and steel production
K Projects	
AAP	Advanced audio processing
ASD	Acoustic sensing and design
BioPersMed	Personalised medicine
ECO-COOL	Integrated and controlled cooling circuits in domestic refrigerators
ECO Power Drive	Energy efficiency in mobility
FLIPPR	Future lignin and pulp processing research
focus_sts	Focus solid timber solutions
JOIN 4+	Material and welding technology
MPPF	'Plug & play' facades
MacroFun	Development of biotechnological processes
PolyComp	Functional polymer composites
SeCoS	Secure contactless sphere
SOFTNET II	Software development
Vision+	Integrating visual information with independent knowledge

Source: SFG, http://www.sfg.at/cms/2589/Steirische_Kompetenzzentren/ (accessed 2 May 2014).

The centres of excellence are considered by experts to be the most important element of Austrian innovation policy.[38] In terms of direct effects, 820 high quality jobs have been created in Styria alone. The valuable role of centres of excellence has been acknowledged (Steiner, Gruber et al. 2006), but some of the challenges identified include the need for stronger

[38] Interview with Markus Gruber, convelop, 5 September 2012.

internationalisation, sustainable solutions for funding and the consolidation of the number of centres (Hutschenreiter 2014).

As is the case for the other instruments discussed above, the directive related to centres of excellence do not make any explicit reference to innovation systems (Bundesministerium für Verkehr 2008). The focus of centres of excellence is very much oriented towards research, i.e. to the knowledge generation side of the innovation system and less toward the knowledge application side. Nevertheless, fostering the interaction between these two sub-systems is amongst COMET's stated aims. Centres of excellence should strengthen the cooperation culture between research and businesses and they should be aligned with the interests of both industry and science (Bundesministerium für Verkehr 2008). Hence, centres of excellence are classified as showing implicit impact of the RIS concept.

5.4 Conclusions

Styria has a variety of both innovation-related development strategies and instruments, which make it difficult to identify the most relevant. This is further complicated by national-level strategic documents and nationally-driven innovation instruments. This is partly due to a fragmented governmental responsibility for innovation (see Section 4.5.2). Some strategies focus clearly on the knowledge creation aspect of RIS (e.g. Research Strategy Styria 2005+), while others take a wider view on economic development, prioritising knowledge application (e.g. Economic Strategy Styria 2020). Similarly, the presented instruments tend to target one sub-system on RIS more than another, e.g. clusters are more firm-oriented (i.e. knowledge application) and centres of excellence are more research-oriented (i.e. knowledge creation). Yet, all instruments are 'aware' of their role in the innovation system and the importance of other actors which might operate in other sub-systems.

The impact of the RIS concept changed over time, both on innovation-related development strategies and on innovation policy instruments. Starting with strategies, Table 21 gives an overview of the impact that the RIS concept appears to have had on the strategies briefly presented above. It has to be noted that this is based solely on evidence found in the various strategic documents. The table only looks at *Land*-level strategies, excludes Structural Funds programmes and distinguishes between explicit and implicit impact. The impact is explicit when there is direct reference to a RIS. There can also be an implicit impact, when ideas similar to the principles of RIS led to the formulation of the strategy or RIS terminology is used to such an extent that the use of the RIS concept as an underlying framework during programming can be assumed.

Table 21: RIS impact on primary Styrian innovation-related strategies

Year	Strategies	None	Implicit	Explicit
1995	Economic Development Strategy	x		
1995	Technology Policy Strategy I		x	
2004	Research Strategy Styria 2005+			x
2005	Technology Policy Strategy II			x
2006	Economic Strategy Styria			x
2012	Economic Strategy Styria 2020		x	
2013	Research Strategy		x	

Source: Author.

Table 21 demonstrates that the impact clearly changed over time. While the RIS concept did not have any role in the first economic strategy and only an implicit one in the first technological strategy in 1995, policy-makers explicitly referred to it in the three strategies created in the early to mid-2000s. Since then, namely in the last editions of the economic and research strategies, the term RIS does not appear anymore in the documents, but the concept's rationale is clearly visible in the type of measures suggested (e.g. by highlighting the role of knowledge applicators, i.e. firms, in the innovation processes). It appears that RIS were 'in fashion' in the 2000s, but have since lost in prominence.

However, it has been emphasised by interviewees that there have not been any major changes to the actual content of the strategies over time. The foundations for today's strategic orientations were already laid in 1995 with the Economic Development Strategy (*Wirtschaftsleitbild*) and the Technology Policy Strategy (*Technologiepolitisches Konzept*). Their main messages still resonate in today's policy and any changes to Styria's economic policy since then have only been incremental. Styria mainly focuses on the field of technical sciences, specifically fostering networks and cluster structures. Both early documents from 1995 already included the concept of clusters and were the fundamental strategic bases to make Styria the pioneer of cluster policy in Austria. 20 years on, clusters are still a central element of Styria's economic and innovation policy.[39]

Similar to the assessment of the RIS impact on Styrian strategies, the impact of the concept on Styrian innovation policy instruments is assessed (Table 22). No impact of RIS can identified for SFG support instruments for R&D in firms. The instruments target individual firms and their role in a system is only secondary. The impact is implicit for all four other instruments aimed at networking between different actors in the innovation system. There is no explicit reference to RIS in any related documents, only in the underlying strategies to which they refer (e.g. the Technology Strategy 1995 in the case of impulse centres, see above).

[39] Interview with Markus Gruber, convelop, 5 September 2012.

Table 22: Impact of the RIS concept on Styrian instruments

Year	Instruments	None	Implicit	Explicit
2007/2008	SFG support for R&D in firms	**x**		
1990s	Impulse centres		**x**	
From 1995	Clusters		**x**	
1998	Centres of excellence		**x**	
2001	AplusB centres		**x**	

Source: Author.

The following Section 6 gathers some reflections on Styria's innovation system, its evolution over time (Section 6.2) and some policy considerations (Section 6.3).

6. REFLECTIONS ON STYRIA'S INNOVATION SYSTEM AND POLICIES

6.1 Introduction

These sections draw together answers to the main research question (How has Styrian innovation policy developed over time?) and its subquestions (How has the RIS concept shaped innovation policy in Styria? What are the challenges that innovation policy currently faces in Styria?). First, a look is taken at the evolution of Styria's innovation policy and the impact of the RIS (Section 6.2), before some policy reflections look at current challenges for innovation policy in Styria (Section 6.3).

6.2 Styria's innovation system over time and the impact of the RIS concept

The above sections showed that Styrian innovation policy has widely adopted the principles of RIS. There is sufficient evidence in documents related to innovation strategies and instruments. Although there might not be any explicit references (anymore) to RIS in current key strategies, some crucial basic characteristics, such as the division into the sub-systems of knowledge generation (science), knowledge application (economy) and policy, and the importance given to knowledge flows, are still visible in strategies and instruments. This includes, for instance, the division of the innovation system into three interacting groups of actors (R&D, businesses and policy-makers), as illustrated in the Research Strategy 2013 (Figure 9).

Sections 5.2 and 5.3 have also shown that the RIS impact on strategies appears to be higher than on instruments. However, this is only true in terms of explicit impact, i.e. a direct reference to RIS. These findings are plausible, as strategy documents are more likely to refer to theoretical ideas than more practical directives and guidelines on the implementation of instruments. If the RIS impact on strategies is viewed along a timeline (Table 23), a pattern is recognisable.

Table 23: RIS impact on Styrian strategies over time

Year	1995	1995	2004	2005	2006	2012	2013
Stra-tegies	Econ. Dev. Strat.	Tech. Pol. Strat.	Res. Strat. Styria 2005+	Tech. Pol. Strat. II	Econ. Strat. Styria	Econ. Strat. Styria 2020	Res. Strat.
Explicit			**x**	**x**	**x**		
Implicit		**x**				**x**	**x**
None	**x**						

Source: Author.

The impact over time shows that the RIS concept was 'in fashion' in the early to mid-2000s, but has since lost importance as a conceptual driver of policy. Yet, this does not necessarily mean that the RIS concept lost its relevance. Instead, it appears that 'RIS-based thinking' became mainstream and the understanding of innovation as systemic process does not need

any direct reference. Explicit references to the term RIS have become rarer over time. Both the economic strategy from 2012 and the research strategy from 2013 do not use the term 'innovation system' anymore, although its principles are part of the fundamental assumptions of the two documents.

6.3 Policy reflections

The detailed analysis of innovation strategies and instruments and interviews with policy-makers and other experts allow some policy reflections. There are a series of governance challenges for the RIS Styria, which echo some of the findings of other studies, for instance by Leo and Philipp (2011), Steiner, Gruber et al. (2006) and Pöchhacker-Tröscher (2009). Yet, they go beyond and could provide useful advice to policy-makers.

- **Unclear and changing thematic focus:** The various strategies continue to define core competencies (*Stärkefelder*), thematic foci (*Leitthemen*), action fields (*Aktionsfelder*) etc., varying between a focus on 3 or 11 themes. Some themes are recurring, such as the automotive sector, but other choices appear to be not only based on existing potential but also to be influenced by 'fashions', such as the theme of human technology. The thematic focus is often very wide (e.g. 'environmental technology'), so that no real emphasis is recognisable. Naturally, the choice of themes is also influenced by political considerations, but a focus on '11 thematic strengths' in the context of the Economic Development Strategy 1995 is too wide. A more formalised approach to define appropriate thematic foci is necessary, as has been applied in the form a strength-measurement as part of the WiSt 2020. In fact, the European Commission (2009) argues for a more a content-driven approach to innovation policy in Austria more widely. In this context, Steiner, Gruber at al. (2006) suggest the establishment of ongoing monitoring arrangements of technological development in the thematic foci areas.

- **Too many innovation actors:** Efficient governance of the RIS is challenging, not least due to a large number of actors and instruments. In 2009, a study identified about 685 actors in Austrian RIS, including 275 non-university research institutions and nearly 200 cooperative innovation and technology transfer institutions (Pöchhacker-Tröscher 2009). Also, the Styrian RIS is characterised by a mix of actors at different governance levels, i.e. Styrian and national Austrian actors as well as European ones. Governance arrangements remain one of the main challenges

- **Overlapping policy responsibilities:** Institutional responsibilities at both federal and *Land* level are not always clear-cut. Federal ministries have a certain degree of thematic overlap, leading to occasional competition over policy fields (European Commission 2009). Within the *Land* administration, innovation-related policies are fall under the responsibility of two departments. While Department 8 is covering R&D, Department 12 is responsible for economic development and innovation. This is also reflected in two parallel strategic strands, one more research-driven and one more business-driven. Along these lines, the Regional Innovation Monitor identified a 'strong need for innovations in the governance of innovation' (Leo and Philipp 2011).

- **Fragmented and overlapping instruments:** The Styrian RIS is characterised by a mix of Styrian, Austrian and European resources and support programmes. This has led to fragmented policy context and a lack of coherence (Hartmann and Berger 2007). The large number of measures and instruments, referred to as 'programme jungle' by the European Commission (2009), creates challenges not only for policy-makers, but also for potential beneficiaries in finding an appropriate support scheme. For instance, the differences between impulse centres and centres of excellence are not clear to their potential users.

- **Insufficient exchange of information between RIS actors:** There should be a broader and more open discussion process on the issues of and relation between economy, research, technology and innovation (Steiner, Gruber et al. 2006). Existing platforms and forums could be used, such as the Styrian Research Council and Innoregio. However, more informal and more frequent opportunities for an informal and formal exchange between the various actors in the RIS might be necessary.

- **Dominance of a few large firms:** The Styrian economy proved to be more vulnerable than others. During the economic crisis around 2008/2009, Styria had lost more ground than the other important industrial Austrian Land Upper Austria. Amongst the reasons identified by the IWI is that the Styrian sectoral clusters are too much 'star-shaped', i.e. several small firms are grouped around one large firm (see Section 5.3.2).[40]

- **Lack of policy evaluation:** So far, there has not been any comprehensive evaluation of the Styrian RIS and it has been noted that there is no well-established evaluation culture (Leo and Philipp 2011). Yet, single instruments or policies (e.g. centres of excellence or Structural Funds support) have been evaluated and Styria was part of a more general evaluation of the Austrian R&D support framework (Aiginger, Falk et al. 2009). Also, some strategies have been evaluated as part of their revisions, e.g. the Technology Policy Strategy I in 2005 or the Research Strategy Styria 2005+, which has been evaluated internally. In their Regional Innovation Report, Leo and Philipp (2011), identified the lack of comprehensive evaluation as a main deficiency of the Styrian model, especially considering the relatively high R&D expenditure.

[40] Interview with Herwig Schneider, Industriewissenschaftliches Institut, 4 March 2013.

7. CONCLUSIONS

The study has aimed to describe how Styrian innovation policy has developed over time, how this has been shaped by the RIS concept and what challenges remain for innovation policy. It showed that the RIS concept had a measurable impact on current Styrian innovation policy-making, but that the visibility of this impact changed over time. It has been shown that the Styrian system of innovation policy governance is complex: many actors, many strategies and even more instruments. This complexity brings a set of challenges presented above. This complexity might indeed be a result of RIS-based innovation policy-making itself. The focus on creating and expanding an innovation system might have the side-effect of the creation of too many actors and policy formats, which then exacerbate the challenges of managing a complex system.

In spite of the shown evidence for the impact that the RIS had on policy, it might be argued that the RIS concept might not have such a big impact as it appears to have. The industrial history of Styria shows that the *Land* has always supported RTDI and it could be argued that, building on its historical strengths, policy would have developed automatically in ways similar to 'smart specialisation', building on systems with interacting actors. Styria might be predisposed towards new ways of innovation policy-making as it tends to be proactive in applying new policy concepts (e.g. clusters). Still, Styria used the RIS concept as a useful resource and strategic framework to inform its policy decisions.

Although this study had a clear policy focus, it also allows some theoretical reflections. The RIS concept appears to have come into fashion in policy-making and then to have faded away, albeit not being replaced but rather implicitly becoming mainstream. Similarly, academic interest was highest between the mid-1990s and mid-2000s. Since then, the academic discussions did not necessarily slow down, but they changed focus. The basic assumptions of RIS have not been fundamentally challenged, but instead some aspects were perceived to need refinement. For instance, Trippl (2012) argued for a distinction between different types of regions, as these require different innovation policy approaches (see Section 2.5). The term region remains at the core of the RIS concept, but needs further investigation, not only in terms of the diversity of regions but also in terms of what 'region' actually means. It is becoming increasingly difficult to draw functionally meaningful boundaries to regions. Previous RIS research acknowledged the challenges of unclear boundaries and emphasised the role of extra-regional actors (Tödtling and Trippl 2005), but in increasingly globalised knowledge generation and knowledge application systems, the rather rigid scope of action of the policy dimension of RIS appears, i.e. subnational governments acting in their rigidly defined areas of responsibility, appears to be outdated. Even the trend for increasingly macro-regional approaches (e.g. by the European Union with its macro-regional strategies), which try to follow functional links and relations rather than administrative boundaries is unlikely to keep pace with more and more spatially-blind businesses and R&D actors. This is likely to be even more so in the area of innovation, which puts into question the long-term usefulness of the current RIS concept.

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Sabine Proßnegg, SFG, 12 May 2014 (written)

Herwig Schneider, Industriewissenschaftliches Institut, 4 March 2013 (phone)

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