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New Path Creation in Old Industrial Regions
The Case of the Software Park Hagenberg in the Province of Upper Austria

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Abstract

This paper seeks to enhance our understanding about the opportunities and limits of new path creation in traditional regional innovation systems. Due to their inherited historical legacies, such systems are usually thought of being ill-equipped to give rise to high-tech or knowledge intensive activities. Departing from recent insights on research concerned with the transformation of innovation systems and evolutionary economic geography we identify in a conceptual way enabling and constraining factors for the rise of new development paths in traditional regions. Empirically, we focus on the case of the "Software Park Hagenberg" (SPH) located in the old industrial region of Upper Austria. We examine key events triggering the emergence and subsequent evolution of the SPH and explore the role of the RIS in shaping the development trajectory of the SPH. Moreover, we investigate the pattern of networking between firms, research organizations and educational bodies within the SPH and we provide some evidence on the diffusion of knowledge and innovation generated though these interactions throughout the regional economy.

1 Introduction

The aim of this paper is to enhance our understanding about the opportunities and limits of new path creation in traditional regions. These areas and their regional innovation systems (RIS) are characterized by a long-standing dominance of mature sectors (such as, for example, the steel or automotive industry) and are, thus, often thought of lacking critical conditions for the rise of high-tech and science-based forms of regional development. The legacy of old industrial structures and skill bases prevailing in these areas are seen to limit the scope and opportunities for the emergence on new regional paths based on high-tech activities.

Theoretical arguments derived from evolutionary economic geography (EEG) and recent conceptual work on the transformation of RIS (Tödtling and Trippl, 2011), however, suggest that under certain conditions new industrial trajectories can emerge in traditional regions. The theory of path dependence, more precisely the "alternative model of path dependence of regional industrial evolution" as it has been championed by Martin (2010) is crucial in this context, paving the way for not only understanding regional stability but also regional change. Stressing the importance of change at the micro-level brought about by new strategies, learning and innovation activities performed by existing regional actors as well as the entry of new actors and the disappearance of old ones, regional economies are seen to change continuously. Provided that such changes become cumulative, a new regional path might emerge. Empirical evidence on regional change in various old industrial areas (see, for instance, Hilbert et al., 2004; Trippl and Otto, 2009) provides clear support for this view, pointing to innovation-based regional recovery processes that do not only rest on the restructuring of existing industries but also on the formation of new high-tech sectors.

Our empirical focus is on Upper Austria, an industrial region with a strong specialization in traditional sectors, particularly in the manufacture of machinery, basic metal and metal products, motor vehicles and food products. Upper Austria is an intriguing case and excellent example for studying critical conditions and triggering factors for new path creation in traditional areas. The region hosts "Software Park Hagenberg" (SPH), one of the largest high-tech parks in Austria. SPH is home of research organizations, companies and educational bodies in the field of information and communication technologies (ICT) and has grown to considerable size in the 20 years of its existence. It has become the nation's most successful high-tech park and forms the nucleus of a new regional path in the province of Upper Austria that is based on the ICT industry. We will examine key events triggering the emergence and subsequent evolution of the SPH and explore the role of the RIS in shaping its development trajectory.

The remainder of this paper is organized as follows. Section 2 establishes the conceptual background and provides a short literature review on new path creation in less-favored and traditional regions. Departing from recent insights provided by evolutionary economic geography (EEG), we examine in a conceptual way potential sources for the formation of new regional paths. Section 3 contains the empirical part of the paper. After analyzing the RIS of Upper Austria we investigate the formation and evolution of SPH. Special focus will be given to unravel the relational dimension of SPH's development. Finally, Section 4 summarizes the key findings and draws some conclusions.

2 Conceptual Background

Evolutionary economic geography provides a sound theoretical framework within which to understand the opportunities, potential and limits for new path creation in traditional regions. The concept of path dependence has become a powerful approach to explain the long-term historical development of regional, technological, industrial and institutional forms, stressing that once a particular trajectory is established, it can become self-reinforcing and cumulative, leading to a high degree of regional stability (Martin and Sunley, 2006, 2009; Martin and Simmie, 2008). The past and current states of regional economies and innovation systems have an influence on the future evolutionary trajectories of regions. Martin and Sunley (2006) suggested a set of different sources for regional stability and path dependence such as the existence of natural resources, sunk costs of local assets and infrastructure, regional technological "lock-in", local external economies of industrial specialization, economies of agglomeration, region-specific institutions, social forms and cultural traditions and interregional linkages and interdependencies.

The notion of path dependence provides a solid conceptual base for capturing potential constraints to the formation of high-tech activities in traditional manufacturing regions. The legacy of old industrial structures and an outdated skill base often prevailing in these areas are seen to restrict the scope and opportunities for the rise of new technological and regional paths. The dominance of traditional business practices, the lack of a highly skilled scientific workforce and of supporting institutions of the RIS erodes the innovation and absorptive capacities of these regions, limiting the scope for enhancing and upgrading existing pathways and the potentials for establishing new ones (Martin and Simmie, 2008).

However, regions and their RIS are far from being static. In the medium and long run one can often observe changes of industry structures and innovation activities in particular areas, sometimes reaching beyond existing development paths. Indeed, there is evidence for catching up processes of formerly less-favored regions, reconversion processes in industrial areas, leading to new industrial and technological paths, as well as a loss of innovation capacity and competitive strength of leading regions (Tödtling and Trippl, 2011). The notion of path dependence, particularly the "alternative model of path dependence of regional industrial evolution" as it has been suggested by Martin (2010) does not only provide a set of explanations for understanding regional stability and path dependence (as outlined above) but gives also explicit consideration to the creation and renewal of paths. Martin (2010) draws on ideas from historical sociology and political science and applies them to regional economic phenomena, emphasizing the importance of incremental change at the micro-level in regional evolution and transformation. Provided that such changes at the micro-level cumulate over the long run, a new path can emerge. Regions and their RIS are considered to evolve constantly. New companies and RIS elements, new products and services are more or less permanently added, whilst old ones disappear (Boschma and Martin, 2007). Furthermore, new strategies and behavioral routines of existing actors and the processes of learning and innovation performed by them can be a source of change at the regional level. The emergence and disappearance of actors, products and technologies and the alteration of the characteristics of existing ones generate variety, which is a key principle of evolution. Regional paths are not pure and regional industries and economies are far from being homogeneous units. Even highly specialized regions and clusters are usually composed of very different actors, "among which there are often detailed product variety and different market orientations, specific technologies, competences, resources, routines, and business models..." (Martin, 2010, p. 14),

even though they all belong to the same industry or region. This micro-level heterogeneity is often a key source for the gradual evolution and change of regional economies.

How does path creation in new industries and technologies take place? The hypothesis that chance, contingent events, serendipity or historical accidents play a fundamentally important role and are the main factors in this context becomes more and more challenged in the literature. New paths are increasingly seen to often emerge out of previous and existing regional paths (Martin and Sunley, 2006; Boschma, 2007; Martin, 2010; Tödtling and Trippl, 2011). Martin and Simmie (2008, p. 186) note that "new paths do not emerge in a vacuum, but always in the context of existing structures and paths of technology, industry and institutional arrangements". The rise of a new regional path, thus, is seen to be often linked to the existence of assets, resources and competences rooted in the area (Martin, 2010). These might include, for instance, an excellent scientific base or the availability of a highly skilled labor force. The rise and growth of a new high tech industry might also be driven by a strong local demand (Tödtling and Trippl, 2011). Several authors (see, for example, Martin and Sunley, 2006; Boschma, 2007) argue that new path creation can result from the branching out of existing industries into new but related technological fields. The emergence and formation of new high-tech and knowledge-intensive industries is less based on incumbent firms but more on the establishment of new companies (Feldman et al., 2005). Spin-off processes are frequently regarded to play an important role in this regard (Frenken and Boschma, 2007). Highlighting the significance of new firm creation does not imply, however, that existing endogenous companies or the attraction and arrival of foreign firms cannot be instrumental in bringing new high tech industries to life.

Empirical evidence from less-favored and traditional regions supports the conceptual arguments raised above. Foreign direct investment, for example, has essentially nurtured and shaped the formation of the Irish software industry (O'Malley and O'Gorman 2001). The IT industry in the Finnish region of Tampere is a case in point for the importance of large home-grown firms such as Nokia that triggered the dynamics of a new industry by acting as a sophisticated customer (O'Gorman and Kautonen 2004). The environment protection industry in the Ruhr area is another good example in this context. It has its origins in the old mining and steel complex (Hilbert et al. 2004). The leading firms of this cluster and their suppliers were forced by legal restraints and other political measures to reduce pollution and contamination caused by their traditional business by developing internal solutions to the environmental problems. Importantly, they managed to transfer these competencies situated within the old cluster into new markets, giving rise to the new environment protection sector.

It is essential to note that the rise of new industries (paths) in traditional areas can differ enormously across regions. Traditional regions and the innovation systems of these areas come in many shapes. Some of them constitute strongly networked systems whilst others are characterized by fragmentation. Furthermore, they can exhibit "thin" or "thick" institutional structures (Tödtling and Trippl, 2005), varying fields of specialization and different degrees of lock-in. In other words, the specific existing structures and the inherited historical legacy of a traditional region will have an influence on how processes of new path creation occur, how changes proceed and which mechanisms of change dominate. The rise of new industries is a context-specific phenomenon that varies strongly between traditional regions. Pre-existing regional economic and technological structures and competences, historical and institutional conditions shape and constrain the rise and evolution of new industries in distinctive ways. There is, thus, no single, universal model of new path creation in traditional regions. A path-dependent view proposes a nuanced approach, sensitive to the distinctive features and assets of particular regions and places (Gertler and Vinodrai, 2009).

3 Empirical Part

In this section[1] we analyze critical conditions for and triggering events of the rise and dynamic evolution of SPH. SPH is located in Upper Austria, a traditional industrial region situated in the North of Austria at the borders the Czech Republic and Germany. In the era after the Second World War the region became one of the leading industrial centers in Austria. State-owned enterprises such as the metal and steel company VOEST in the capital city Linz played a strong role for regional development. In the 1980s Austria's nationalized sector was hit by a severe crisis, leading to serious structural problems in the province of Upper Austria. After a period of privatization and reorganization the formerly nationalized sectors regained their competitiveness, favoring the economic performance and recovery of the region under investigation. As will be shown below, traditional industries still are important. Nevertheless, in the past years we could observe the rise of knowledge based sectors such as ICT.

3.1 The region of Upper Austria

The province of Upper Austria covers a territory of about 12,000 square kilometers (14 per cent of Austria) and it has a population of around 1.4 million inhabitants (17 per cent of Austria). Table 1 provides an overview about key socio-economic indicators of the region under investigation.

Table 1: Socio-economic profile of Upper Austria

Population		
Population 2010	1,411.238	(16.9 % of the Austrian total)
Area		
Area in km2	11979,91	(14.3 % of the Austrian total)
GDP		
GDP 2007 (in Mio Euro)	44.748	(16.5 % of the Austrian total)
GDP/capita 2007 (in Euro)	31.800	
GDP/capita 2007 (Index AT=100)	98	
Gross Value Added 2007 (%)		
Primary sector	2.2	(Austrian average: 1.8)
Secondary sector	40.8	(Austrian average: 30.4)
Tertiary sector	57.0	(Austrian average: 67.8)
Unemployment rate 2008		
Total (women and men)	2.6	(Austrian average: 3.8)

Source: Statistik Austria (2011)

As already mentioned above, the province has a long industrial history, which was dominated for decades by the state owned steel industry which produced inputs for the mechanical engineering, machinery and transport equipment industries. The secondary sector still has an outstanding importance. Its share of gross value added (41 per cent) is considerably above the

[1] The empirical part of this paper is based on work (see Maier and Trippl 2008) done in the context of the project "The knowledge economy, economic transformations and ICT in the EU25+: Regional dynamics in the deployment phase", (Contract No. 150605-2006F1SC-IR) commissioned by the Institute for Prospective Technological Studies of the European Commission's Joint Research Centre.

Austrian average (30 per cent), whilst the tertiary sector is of less relative importance. As will be shown below the core industries are of central importance to the software firms located in SPH, acting as customers of consulting, customization and source of outsourcing ICT related activities. GDP per capita is 31,800 Euro, which is below the Austrian average (index 98). The regional unemployment rate is relatively low (2.6 per cent) in comparison to the Austrian average (3.8 per cent).

An analysis of Upper Austria's innovation capacity reveals some weaknesses in generating and commercializing new knowledge. Compared to Austria as a whole, the region is lagging behind in terms of R&D expenditures, availability of R&D talent and size of knowledge intensive service sectors (Table 2). Employment in high tech sectors is also below the national average, reflecting the industrial legacy of Upper Austria and the strong presence of the secondary sector in the region. Table 2 reveals a good performance of the region in terms of patent activities. Regarding high tech patents, however, Upper Austria is lagging behind when compared to Austria as a whole. Again, this pattern could be interpreted against the background of Upper Austria's specialization in more traditional sectors, reflecting the strong path-dependent character of the technological and economic evolution of the region.

Table 2: Innovation indicators

	GERD (R&D expenditures in % of GDP)			Employment in high-tech sectors (% of total Employment, 2008)	R&D personnel (% of total employment, 2007)	Patents (2006)	High-tech patents (2006)
	2007	2004	2002				
Upper Austria	2.33	1.87	1.68	3.14	1.71	239.67	16.18
Austria	2.52	2.26	2.14	4.04	2.22	204.37	35.09

Source: Eurostat database (extracted: May 11, 2011)

A more detailed analysis of the structure of R&D expenditures indicates a strong focus on applied research and development activities (Table 3). Basic research is only of minor importance. Compared to the national pattern, basic research activities are below and applied research activities are above the national averages. Development activities are also of smaller relative importance than in Austria as a whole. The largest part of R&D expenditures (78 per cent) in Upper Austria comes from the private sector (Table 4). This share is much higher than the Austrian average (49 per cent). This mirrors the high importance of the industrial sector in Upper Austria, which also explains the strong focus on applied research and development activities. Public sources are only of minor importance; they contribute about 17 per cent to the total R&D expenditures (national average: 33 per cent). Moreover, it is striking, that the share of foreign sources of R&D financing, which amount for more than 15 per cent of the R&D expenditures in Austria, play a negligible role in Upper Austria (4 per cent of the total expenditures).

Table 3: Structure of R&D expenditures, 2007

	Upper Austria		Austria	
	In 1,000 Euro	%	In 1,000 Euro	%
Basic Research	93169	9.0	1182075	17.5
Applied Research	406165	39.2	2384029	35.4
Development	536676	51.8	3171246	47.1
Total	1036010	100.0	6737350	100.0

Source: Statistik Austria (2007)

Table 4: Sources of finance for R&D, 2007

Region	Total	Sources of finance								
		Private sector	Public sector					Non-profit org.	Foreign sources*	EU
			Total public sector	Federal level	Regional level	Municip.	other			
Expend.:										
Upper Austria	1,044582	808995	181675	109925	28075	1858	41817	1361	44502	8049
Austria	6,867815	3344400	2260857	1649858	263181	8657	339161	32316	1129148	101094
Shares:										
Upper Austria	100.00	77.45	17.39	10.52	2.69	0.18	4.00	0.13	4.26	0.77
Austria	100.00	48.70	32.92	24.02	3.83	0.13	4.94	0.47	16.44	1.47

Source: Statistik Austria (2011)

3.2 Upper Austria's regional innovation system

In the following section, we will provide a brief overview of Upper Austria's regional innovation system, focusing in particular on the main structures and key actors of the three RIS subsystems, i.e. the subsystems of knowledge generation and application and the policy system.

Subsystem of knowledge generation and diffusion

Upper Austria is well endowed with research and educational institutions. Nevertheless, its capacity to generate and diffuse new knowledge is limited when compared with those of some other Austrian regions, particularly Vienna and Styria. Johannes Kepler University (situated in Linz) performs as key actor within the subsystem of knowledge generation and diffusion. It was founded in 1966 and at its beginnings it was specialized in social sciences and economics. Later a law school (1974) and more recently a science and engineering faculty were established. The university has some competencies in the field of ICT related research. Several university institutes carrying out ICT research have been located in the SPH (see section 3.3). In the field of ICT, furthermore, we find amongst others the Johann Radon Institute for Computational and Applied Mathematics (Austrian Academy of Sciences) in the capital city Linz, and Profactor in Steyr which is active in basic and applied research and technology transfer in areas such as intelligent software systems, process design & automation, etc. Another important knowledge generating organization is Upper Austrian Research (fully owned by the regional development agency TMG), which has a focus on medical informatics, sensor technology, biomedical nanotechnology, and plastics technology. Furthermore, nine cooperative research organizations (seven competence centers and five Christian Doppler Laboratories), which are jointly run by universities and industry, have been established with public support in the last years. Some of them are active in ICT related fields, including Software Competence Center Hagenberg, Linz Center of Competence in Mechatronics, Industrial Competence Center Mechatronics and Automation, Industrial Mathematics Competence Center and two Christian Doppler Laboratories for Automated Software Engineering and Integrated Radar Sensores. To summarize, the region has some academic and non-academic research and knowledge producing capacities in the field of ICT.

However, Upper Austria does not host a technical university, which is often regarded as a key element for the development of the ICT industry.

Not fewer than 1,127 educational institutions can be found in the region of Upper Austria, more than 300 of them at the secondary and tertiary level. Johannes Kepler University is not only the most important research organization, but also the main organization in the field of tertiary education present in the region. It is one of the smaller and younger Austrian universities, having 12,000 students and 1,100 graduates a year. Another important player is the Upper Austria University of Applied Sciences which offers around 30 degree programs in the cities of Wels, Hagenberg, Steyr, and Linz, exhibiting a strong focus on engineering. In the fields of software and informatics, we found about 10 degree programs which are all offered in Hagenberg.

Finally, the region hosts around 20 "Impulszentren" (technology and innovation centers, incubators, etc.) which play an important role in technology transfer. Some of them have a focus on ICT. SPH is of capital importance in this context, combining business, scientific and educational competences in the field of software (see section 3.3).

Subsystem of knowledge application and exploitation

Upper Austria hosts about 44,000 firms (14.5 per cent of the Austrian total) which employ 470,000 workers (17.3 per cent of the Austrian total). Examining the structure of the regional economy, i.e. the subsystem of knowledge application and exploitation, shows a strong presence of traditional manufacturing sectors. Compared to the Austrian industrial structure, a disproportionately large share in machinery, metals and automotive and food industries can be found (Table 5). Leading companies (in terms of number of employees) include internationally renowned companies such as Voest Alpine (metal industry), BMW (automotive industry), VAI Siemens (engineering industry) and MAN Steyr (automotive industry).

The regional ICT industry consists of 1,800 firms employing around 9,000 workers. Although the share of the ICT industry in total employment is lower in Upper Austria than in Austria as a whole, one might argue that this sector constitutes a new regional path at the provincial level (for a detailed description of Upper Austria's ICT industry, see Maier and Trippl, 2008).

Upper Austria shows a good performance regarding new firm formation. In the period between 2004 and 2008 a number of 19,562 companies has been created (13.8 per cent of the Austrian total) while 15,333 have been closed (13.2 per cent of the Austrian total).

Table 5: Structure of Upper Austria's economy, 2008

		Upper Austria			Austria		
		firms	**employees**	**% of employ.**	**firms**	**employees**	**% of employ.**
B	**Mining and quarrying**	**71**	**1086**	**0.23**	**381**	**6578**	**0.24**
C	**Manufacturing**	**5457**	**160942**	**34.26**	**26550**	**634348**	**23.31**
	Main industries						
	C10 Manufacture of food products	874	15509	3.30	3719	68422	2.51
	C16 Manufacture of wood …	638	7907	1.68	2974	36374	1.34
	C22 Manufacture of rubber & plastic products	140	10421	2.22	619	28493	1.05
	C24 Manufacture of basic metals	32	12234	2.60	174	35156	1.29
	C25 Manufacture of fabricated metal products	896	17925	3.82	4077	74548	2.74
	C28 Manufacture of machinery and equipment	401	23385	4.98	1436	74437	2.74
	C29 Manufacture of motor vehicles …	73	11233	2.39	312	33510	1.23
	C31 Manufacture of furniture	688	10015	2.13	3394	31904	1.17
				0.00			0.00
D	**Electricity, gas, steam and air cond. supply**	**281**	**3153**	**0.67**	**1553**	**26717**	**0.98**
E	**Water supply; sewerage; waste man.**	**400**	**3172**	**0.68**	**2002**	**17996**	**0.66**
F	**Construction**	**4676**	**52898**	**11.26**	**29967**	**275620**	**10.13**
G	**Wholesale and retail trade**	**12104**	**104503**	**22.24**	**75516**	**624619**	**22.96**
H	**Transporting and storage**	**2009**	**23505**	**5.00**	**14164**	**217702**	**8.00**
I	**Accommodation and food service act.**	**5398**	**27348**	**5.82**	**45025**	**259350**	**9.53**
J	**Information and communication**	**1811**	**9287**	**1.98**	**15549**	**91603**	**3.37**
J61	Telecommunications	45	431	0.09	330	18468	0.68
J62	Computer programming, consultancy …	913	5393	1.15	7934	34957	1.28
J63	Information service activities	546	1813	0.39	4048	15260	0.56
K	**Financial and insurance activities**	**967**	**14222**	**3.03**	**6890**	**127572**	**4.69**
L	**Real estate activities**	**1937**	**6010**	**1.28**	**15669**	**42192**	**1.55**
M	**Professional, scientific and technical act.**	**7067**	**29434**	**6.27**	**55123**	**197793**	**7.27**
M72	Scientific research and development	71	778	0.17	924	8294	0.30
N	**Administrative and support service act.**	**1471**	**33646**	**7.16**	**11943**	**194087**	**7.13**
Q	**Human health and social work activities**			**0.00**	**2**		**0.00**
R	**Arts, entertainment and recreation**			**0.00**	**8**		**0.00**
S	**Other services activities**	**186**	**583**	**0.12**	**1446**	**4459**	**0.16**
		43835	**469789**	**100.00**	**301788**	**2720793**	100.00

Source: Statistik Austria (2011)

Policy subsystem

Upper Austria has the status of a province ("Bundesland") within the Austrian federalist political system. Consequently, a wide range of competences for economic and innovation policy can be found at the provincial level. The regional governance system is guided by a strategic program ("Upper Austria 2010") that was jointly developed by 250 experts, including all relevant actors from academic, industry and government. Upper Austria has been one of the first Austrian provinces which adopted an explicit cluster policy approach and innovation and technological progress rank high on policy agendas. A strong emphasis is put on knowledge transfer, promotion of future technologies, cluster development, human capital and new firm formation. A key player in the political-administrative system is the regional government and its departments for industry and education. The most important organization in the regional governance system is the development agency Technologie- und Marketinggesellschaft (TMG). Its main task is to design the region's location and innovation policy. In the past years TMG has implemented several cluster initiatives (automotive, plastics, furniture & timber construction, health technology, mechatronics, food, eco-energy) and networks (human resources, design & media, environmental technology, logistics). Looking specifically at ICT policy actions we found that no explicit or specific cluster initiatives or networks exist in this field. ICT, however, is regarded to constitute a cross-

sectional area. It is intended to launch a new "Upper Austrian information and communications technology initiative" to provide support for R&D projects, cooperation and new firm formation in the area of ICT.

Upper Austria is considered to constitute a "networked RIS" (Tödtling et al., 2010), because it not only has a variety of cluster programs, but has also implanted formal procedures to link all relevant actors to formulate and a coherent strategic program. Moreover, all important actors from government, academia and business seem to be in constant informal contact.

To summarize, our analysis of Upper Austria's RIS has shown that traditional sectors and structures still dominate, pointing to a high degree of path dependence. At the same time there is evidence for a gradual transformation of the RIS, triggered by new RIS elements which have been implanted in the last years.

3.3 Rise and development of Softwarepark Hagenberg

Current structure

Combining business, scientific and educational competences, SPH is a key element of Upper Austria's RIS. About 1,000 persons are employed in the firms, research and education institutes located in the park, and more than 1,400 students are enrolled in different degree programmes offered there (see also Table 6). SPH hosts

- about 40 companies,
- four institutes of the University Linz (RISC - Research Institute for Symbolic Computation, FAW - Institute for Applied Knowledge Processing, FLLL - Fuzzy Logic Laboratorium - Department of Knowledge-Based Mathematical Systems, and RIPE - Research Institute for Pervasive Computing)
- other research organizations (co-operative research institute Competence Centre Hagenberg, department for Medicine Informatics (Upper Austrian Research),
- and Hagenberg Technical College (Upper Austria University of Applied Sciences), offering about 10 degree programs and carrying out research (Research Center Hagenberg)

Table 6: Number of employees and students at SPH, 2011

Firms	412
Research organizations	215
Educational bodies	355
Others	39
Total	1,021
Students:	
PhD students	23
Master students	5
Students at Upper Austria University of Applied Sciences	1,300
Students at BORG	118
Total	1,446

(Status: May 4, 2011)

Over the last 20 years, SPH has grown to a considerable size, becoming one of the largest and the by far most successful science park in Austria. It has developed a critical mass of

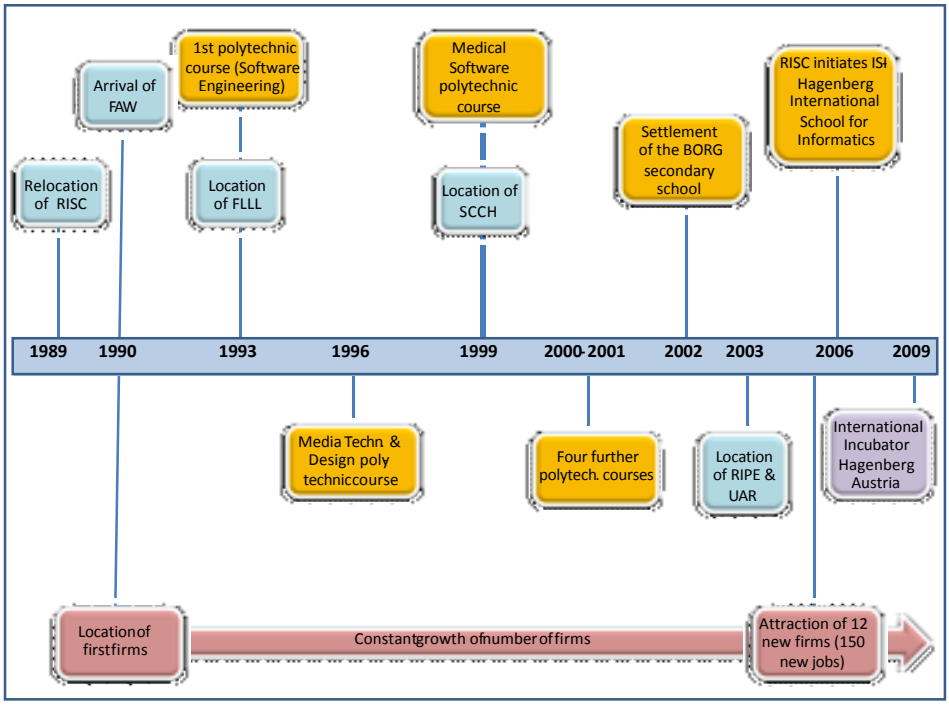
scientific and industrial competences in the field of ICT, exhibiting visibility and a coherent profile at the regional level and beyond. Thus, one can argue that SPH presents the core of an emerging new path that is based on ICT.

SPH: Rise and development of a new regional path

SPH is located about 25 kilometers northeast of Linz (the capital of Upper Austria) in the NUTS 3 region of "Mühlviertel", a rural, traditional less developed area that is characterized by job losses and outcommuting to Linz. Mühlviertel has one of the lowest GDP per capita of all Austrian NUTS 3 regions. Hagenberg is accessible by car from Linz in approximately twenty minutes. Accessibility by public transport is fairly limited as is typical for rural areas.

In the following, we look at the development of SPH, focusing in particular on the conditions, events and actors that triggered its emergence and further evolution. The origin of SPH dates back to the end of the 1980s. Hagenberg lacked any pre-existing capabilities for the rise of a high-tech complex at that time. Our analysis suggests that chance played a fundamentally important role in the emergence of SPH. At this time a new institute in the field of ICT– the "Research Institute for Symbolic Computing" (RISC)" – was founded at Johannes Keppler University (JKU) in Linz. Problems of limited space at JKU and in the city of Linz forced the head of the newly established institute RISC, Professor Bruno Buchberger, to look for facilities outside the university. RISC relocated to Hagenberg in 1989, more precisely to "Schloss Hagenberg", an untenanted medieval castle owned by the community, which in the following years became the nucleus of SPH. The former governor of Upper Austria convinced Buchberger to commit himself to the objective that RISC's relocation should also provide economic impulses to the region. Buchberger is a classic example of a charismatic leader. He developed the concept of a science park that combines business, research and education in the field of ICT. He also became director of SPH and today he is still performing this function.

Figure 1: Key events in the evolution of SPH



In the first years of its existence, the development of SPH was based on a verbal agreement between the federal state of Upper Austria, JKU, the community of Hagenberg and Raiffeisenbank Oberösterreich, a local bank which acted as lead investor by acquiring land and investing in real estate development thus securing the expansion of SPH in the subsequent years. This reflects the networked nature of Upper Austria's RIS that is characterized by a wide range of connections and a high level of trust between the main actors at the provincial level. It was only in 2007 that the informally agreed organizational structure was put in writing in form of a contract between the actors mentioned above.

The interplay between main regional actors, i.e. JKU, policy-makers and financial institutions, thus, has been crucial for the rise of SPH. The relative importance of these actors in the formation of the new regional path, however, varied. Whilst policy and the local bank played a supporting role, JKU performed as key driving force and leading agent for the successful development of SPH.

In the very early phase of the development, two additional institutes of JKU followed RISC and relocated to SPH, enhancing the research capacity in the periphery. The year 1990 saw the arrival of FAW and in 1993 FLL moved from Linz to SPH. The relocations of these university institutes were, indeed, key triggering events for the birth and evolution of SPH. They have played and still play a leading role for the dynamics of the high-tech park under consideration. They have spun off firms which located in SPH and they have been instrumental in creating a local knowledge base that has attracted further R&D institutes (such as SCCH, RIPE and UAR, see below), educational bodies (Upper Austria University of Applied Sciences) and new companies. Over the years, SPH has experienced a constant growth of new firm formation. A recent study (Maier and Trippl, 2008), indeed, found that almost 75 per cent of the surveyed companies located in the park regarded spatial proximity to R&D institutions as important for their development and more than 50 per cent stated that the presence of R&D bodies has been a key factor for their location decision.

Post-secondary education offered in the softwarepark became further strengthened and differentiated with the creation of Upper Austria University of Applied Sciences (FH) in 1993. It has expanded course offers continuously over the years, complementing the classic education provided by the university institutes by conducting more applied research and teaching. In 2002, also a secondary school in the field of ICT was settled at SPH.

In the last 10 years or so the research capacity of SPH was further strengthened. In 1999 SCCH (Software Competence Centre) was established and four years later, RIPE (another institute from JKU) and UAR (Upper Austria Research) opened their doors in SPH. SCCH is a particularly interesting case. It is a co-operative R&D institute (competence centre) that is jointly run by research organizations and firms and receives financial support within the context of the national "competence centre initiative". This policy program provides funding to the nation's best competence centers only. SPH's successful qualification for public funding from this source shows that it has developed a critical mass of high-quality research and industrial competencies.

In the recent past attempts have been made to implement new functions and structures, allowing for entering a new development phase that is characterized by a stronger internationalization of SPH. In 2006, RISC initiated the ISI-Hagenberg International School for Informatics to attract young talent worldwide to study at SPH and found new firms there after having finished their education. Master theses are sponsored by companies, both from traditional industries like Voest and Trumpf and from the ICT sector such as Hagenberg

software and other ICT companies located in SPH. Most recently, in the year 2009 the "International Incubator Hagenberg Austria" was established in the park. It is a co-operation between SPH, tech2b (a high-tech incubator aiming at promoting academic spin-offs), and Raiffeisenlandesbank Oberösterreich, supported by the Land Upper Austria. Its aim is to support new firm creation by foreigners at SPH by providing financial support and know-how.

SPH can be regarded to constitute a key example for a traditional manufacturing region experimenting with high-tech development. In the following, we will examine the relational dimension that is associated with its development.

3.4 Linkages within SPH and beyond

As noted above, SPH is characterized by a unique institutional structure, brought about by the co-location of firms, research institutes and educational bodies. In 2008 we conducted 19 personal interviews with actors located in the park to investigate to what extent they are linked to each other via flows of goods, knowledge and people, thus making use of the synergy potential resulting from co-location. This research step enabled us to find out whether or not networking is a key feature of the development of SPH and thus of the newly emerging regional path. In addition, we explored the extent and nature of connections between SPH and the traditional RIS to see to what extent the creation of the new path based on ICT is related to and complements the existing and still dominating one that is based on older industries.

As of August 2008, 36 companies[2] were located in SPH. Of those 36 companies, 15 could be interviewed in our empirical analysis. Seventeen refused to cooperate for various reasons. Four of the companies had either left the park or could not be contacted despite numerous attempts via email and telephone. As a consequence, we were able to interview 42 per cent of the companies listed on the park website or 47 per cent of the companies in the park that we could contact. Our interview partner was in all cases the manager or executive director in Hagenberg. Table 7 provides an overview of some key characteristics of the companies included in the sample.

In 2008, on average the interviewed companies are located in SPH for 5 years and 9 months, where the numbers range from 1 month (Ninepoint) to the maximum possible of 18 years (STIWA, one of the first tenants). Their main activities include software engineering, customization and expansion of existing software, IT oriented consulting, IT oriented support processes, process engineering, planning and control, development, planning, production and marketing of high end hardware technology and related software applications. The majority of the companies in the park is fairly small. The smallest company interviewed was F-Line with just one employee, the largest one STIWA with 105 workers. In average a company in SPH employs about 20 persons. The employment structure is strongly dominated by R&D. 56.8 per cent of all employees are directly working in research and development. Among the companies the share ranges from 0 per cent R&D employees in the case of Pentadoc (a company specialized in distribution and consulting) to 100 per cent in the case of Apex Gaming (a research section of a larger company).

[2] In a few cases we found two closely related companies that represented separate legal entities, but had a joint management and representation to the outside world. These companies were treated as one entity in our investigation and counted and interviewed only once. Whenever such companies list different representatives, however, we treated them as two separate entities.

Table 7: Characteristics of interviewed companies, 2008

Name of firm	Main activity	Year of location in SPH	Number of employees
APEX gaming technology GmbH	Software for casinos and gambling machines	2006	8
Beckhoff Automation GmbH	Distribution and training	2002	2
bluesource – mobile solutions GmbH	Solutions for mobile technologies	2001	6
CDE – Communications Data Engineering GmbH	ICT components for mobile phones, medical instruments, etc.	2003	12
FAW Software Engineering gemeinnützige GmbH	Information management, database technologies, ICT consulting	2005	15
F-line KG	Software for communication and CRM	1996	1
Gleichmann Electronics Research (Austria) GmbH & Co KG	Software development	2004	6
Hagenberg Software GmbH	Optimization of IT systems and software	2002	18
Jotas Services GmbH	Software development and customizing for medical applications	2007	5
Ninepoint Systems	Communication via Braille technologies	2008	3
Objectbay Software & Consulting GmbH	Consulting for IT solutions for enterprises	2006	4
Pentadoc Ges.m.b.H.	Consulting and support concerning ICT solutions for physicians and medical institutions	2005	2
STIWA Fertigungstechnik GmbH	Software development, process control for industrial processes	1990	105
Tiscover AG Travel Information Systems	Development of software for Internet based tourism applications	2000	14
WURM & Partner Unternehmensservice GmbH	IT customizing and process optimizing, outsourcing solutions	2006	82

The large majority of the interviewed companies are highly innovative. Not less than 62 per cent of the companies reported generating radical innovations by developing new product lines or new software concept. Another 19 percent generate incremental innovations mainly by customizing existing software to the needs of their customers. One has to mention that innovative activities are quite different among the companies. On the one hand there are start-up companies the business of which is based on one innovative idea, often developed by the entrepreneur while studying at the polytechnic in SPH. These companies put all their eggs into one basket and try to develop this one idea into a successful product. On the other hand there are companies closely related to the research institutes that produce innovations on a regular scale and generate spin-off companies in a highly professional way. The know-how

for these innovations always comes from the university in Linz, the polytechnic in Hagenberg or one of the research institutes in the park.

In December 2008 five additional interviews with research organizations were carried out. SPH hosts two other R&D institutes which however were not willing to participate in our study.

Table 8: Characteristics of interviewed research organizations, 2008

	Share of basic research in %	Year of location in SPH	Number of researchers at SPH
RISC - Research Institute for Symbolic Computation	95	1988	45
FAW – Institute for Application Oriented Knowledge Processing	20	1989	15
FLL – Department of Knowledge-Based Mathematical Systems	50	1992	13
FH – Upper Austria University of Applied Sciences Research Center Hagenberg	10	1994	40
SCCH Software Competence Center Hagenberg	20	1999	68

The surveyed research organizations include both smaller (FLL and FAW employing only around 15 researchers) and larger ones (FH, RISC and SCCH employing between 40 and 68 researchers) and they differ strongly regarding their focus on basic versus applied research. RISC has by far the highest share in basic research (95 per cent) while the University of Applied Sciences, FAW and SCCH are overwhelmingly oriented on carrying out more applied research. Their share of basic research amounts to 10 to 20 per cent only. Finally, as will be shown further below, they vary enormously regarding their regional versus national and international orientation.

Linkages within SPH

To what extent are the actors located in SPH linked to each other, capitalizing on the synergy potential that results from the co-location of business, research and education? In other words, to what extent is networking a key element of the development of SPH? Based on the results from the personal interviews we can assess the relational fabric of SPH. When interpreting the findings presented below, however, one has to consider that we could conduct interviews with only about half the companies in the park.

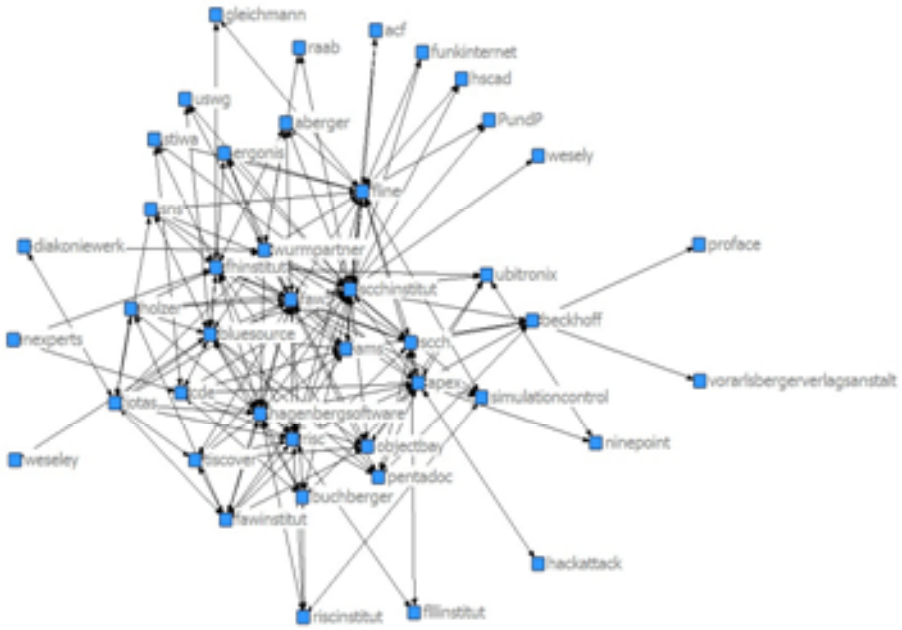
As revealed in Table 9, there are intense linkages among the firms located in SPH. Informal links among firms and supplier relations dominate, but also customer relations and formal links among firms are rather common. The companies located in the softwarepark, thus, absorb and exchange products and knowledge developed by others in the park via close supplier-customer relations and other kinds of linkages. Furthermore, we found evidence that the surveyed companies tend to interact intensively (both in formal and informal ways) with the research institutes present in SPH.

Table 9: Linkages within SPH (results from interview with firms), 2008

	Number of firms reporting sustaining respective links (percentage)		Total number of linkages reported by all firms
Supplier relations	12	(80 %)	43
Customer relations	9	(60 %)	30
Formal interactions with firms	9	(60 %)	32
Formal interactions with R&D institutes	7	(47 %)	12
Informal interactions with firms	13	(87 %)	77
Informal interactions with R&D	9	(60 %)	15

The interviews with R&D institutes located in SPH confirm this finding. There are, thus, rather dense linkages between the knowledge providers and the companies, pointing to a strong capitalization of the synergies which result from co-location of firms and research bodies "under one roof" in SPH. However, as will be shown further below, although collaborating with firms in SPH, the main industry partners of the research organizations are located outside the park. Nevertheless, mapping all intercompany linkages and interactions between firms and research organizations (Figure 2) points to a highly developed co-operation culture within SPH.

Figure 2: Market and knowledge links within SPH, 2008



In addition to the linkages reported above, we could observe intensive flows of highly-skilled people within the park. The interviewed firms stated that qualified labor is recruited on the one hand among the students of the educational institutions in SPH and the researchers of the research institutes, and on the other hand among those attracted to a rural area at the suburban fringe. Commuting from Linz or any other city to Hagenberg is rare. Most employees either already live in the area when they start working for a company in the SPH or relocate to the area shortly afterwards. The research and educational institutes again confirm this result. They

reported providing a considerable share of their graduates to other actors located in SPH (see also Table 10). These shares range from 10 per cent (in the cases of RISC and FAW) to 50 per cent (FLLL). Again, this points to a strong use of the synergy potentials.

Internal networking and flows of goods, services, knowledge and people are, thus, a key element in the evolution of SPH, enhancing the innovation capacity and competence building of the actors located in the park and facilitating the circulation, sharing and joint production of knowledge. The networked nature of Upper Austria's RIS seems to be replicated within SPH.

Linkages to the RIS: relatedness between the new path and the traditional path

The rise and growth of SPH has had an influence on its narrower environment. As of today the SPH acts as an important employer in the NUTS 3 region Mühlviertel and it has substantially changed the rural community of Hagenberg. There is little doubt that it has contributed to population growth in the area. Maier and Trippl (2008) argued that this process has not been without frictions (see Maier and Trippl, 2008). The social structure differs enormously between employees and students located in the software park on the one hand and the local population on the other hand and has led to animosities and conflicts in the past.

We hardly found evidence for economic or knowledge linkages between SPH and actors located in the surrounding area. Indeed, SPH constitutes a high-tech island in the largely rural region of Mühlviertel. Looking at a higher spatial scale, i.e. at the provincial level of Upper Austria, however, revealed that SPH has a wide range of connections to RIS actors and organizations, pointing to a high degree of relatedness between old and new regional paths.

In our interviews we asked the respondents where their main market is located. For close to half the companies interviewed (47 per cent) their main market is in Austria. Twenty percent of the companies stated a more localized market with the main focus on Upper Austria. One third of the companies stated that their main market is beyond the borders of the country and that they serve a global market. Of course, these differences are closely correlated with the type of product produced by the respective company. Consulting and customization tend to be oriented toward the local market whereas specialized software can compete in the global market. For some of the respondents a substantial part of their customers is actually located in SPH as well. Importantly, the larger IT consultants typically have the few big companies of Upper Austria such as Voest, BMW and others among their customers. The penetration of electronic media in form of automation, electronic control technologies, automatic data collection, etc. into other sectors of the economy generates demand for companies located in SPH in form of needs for consulting, management of implementation of a new ICT system, customization of an existing system, etc. The challenges associated with new combinations of ICT and other sectors and their production processes have led to specific research, education and policy initiatives such as mechatronics, bioinformatics, and digital media. In SPH some of these new areas have first been taken up in research institutions and then spun off into business activities.

There is thus some evidence that firms located in SPH sell their services and products to large traditional companies located in the province of Upper Austria. By so doing they contribute to the diffusion of new technologies within the region and the modernization of old industries. The new path is to some extent related to the old path.

An analysis of the main industry partners of the research organizations located in SPH provides strong support for this finding. Arguably, they have many innovation links to firms

from various sectors at the national and international level, but they reported also sustaining R&D co-operations with firms located in the region which are active in more traditional fields such as Voest (steel industry), Rosenbauer (automotive sector), Trumpf Maschinen Austria (machine tools industry), Haberkorn (textile industry), Siemens Transformers Austria (manufacture of electrical equipment), Engel (machinery industry), Alpine Energie (electrical installation) and many others. The presence of traditional sectors in Upper Austria, thus, provides opportunities for cross-sectoral knowledge flows.

By recruiting students and researchers from the region and beyond and by providing skilled graduates the higher education institutes and R&D bodies located in SPH also have a positive influence on Upper Austria's labor market (Table 10). They attract scientific talent (both students and researchers) from abroad to Upper Austria whilst at the same time providing educational and employment opportunities for people from the region. In addition, they provide skilled graduates to the labor market. The respective shares range from 20 per cent (as it was reported by FLLL) to even 90 percent (as in the case of FAW).

Table 10: Research organizations: attraction and provision of students, graduates and researchers (2008)

	Origin of students	Provision of graduates	Recruiting of researchers
RISC - Research Institute for Symbolic Computation	overwhelmingly international (PhD students)	SPH (10%), Austria (30%) international (60%)	Global search & recruitment pattern
FAW – Institute for Application Oriented Knowledge Processing	90% from Upper Austria (PhD students)	SPH (10 %), Upper Austria (70%), Austria (10%), international (10%)	mainly from Upper Austria
FLL – Department of Knowledge-Based Mathematical Systems	no answer	SPH (50%), Upper Austria (20%), Austria (10%), international (20%)	50% from abroad
FH – Upper Austria University of Applied Sciences Research Center Hagenberg	60% of students from Upper Austria, 39% from other Austrian regions, 1% from abroad	*Bioinformatics:* international (50%); *Other courses:* Austria (majority), Upper Austria (partly)	30% from Upper Austria, 6% from Austria, 3% from abroad
SCCH Software Competence Center Hagenberg	80% of students from Upper Austria, 20% from other Austrian regions	no answer	50% from Upper Austria, 35% from Austria, 15% from abroad

4 Summary and Conclusions

This paper sought to contribute to a better understanding of the opportunities for new path creation in traditional regions. Due to the long-standing dominance of mature manufacturing sectors and the lack of a highly-skilled workforce and RIS institutions, traditional regions are often seen as being ill-equipped to give rise to high-tech complexes.

The alternative model of path dependence of regional industrial evolution (Martin, 2010) and conceptual work on the transformation of RIS (Tödtling and Trippl, 2011), however, claim

that under certain conditions new trajectories resting on high-tech industries can emerge in traditional industrial regions. Highlighting the role of change at the micro-level brought about by new strategies, learning and innovation activities performed by existing regional actors as well as the entry of new actors and the disappearance of old ones, regional economies are seen to change continuously. Provided that such changes become cumulative, a new regional path might emerge. Empirical evidence on successful reconversion processes in various old industrial areas supports this view, pointing to the restructuring of existing industries and the rise of new high-tech sectors.

The empirical focus of this paper was on Upper Austria, a traditional industrial region dominated by mature manufacturing sectors. Upper Austria proved to be an intriguing case for analyzing the formation of new paths in old industrial regions. It hosts "Software Park Hagenberg" (SPH), one of the largest high-tech parks in Austria and the nation's most successful one. SPH is home of research organizations, companies and educational bodies specialized in the field of ICT. It has grown considerably in the past two decades, becoming the nucleus of a new regional path in Upper Austria that is based on the ICT industry.

Our analysis of critical conditions and key events triggering the rise and subsequent evolution of SPH has shown a number of interesting results. We found that chance (problems of space availability at Johannes Keppler University in Linz forcing the newly created institute RISC to look for facilities elsewhere) played a critically important role in the rise of SPH. RISC's relocation to Hagenberg (situated in the NUTS 3 region of Mühlviertel, one of Upper Austria's less developed and most rural areas) was crucial in seeding an ICT complex in the periphery. The case study also points to the key role that can be played by individual agents, whose presence can make a difference. Indeed, our analysis suggested, that the head of RISC, Professor Buchberger, was an essential source of new path creation, by initiating SPH and acting as a charismatic leader.

The research organizations present in SPH performed as key driving forces of the rise and further evolution of SPH. The high quality research they conduct has attracted companies, other R&D institutes, educational bodies and more recently scientific talent from abroad, giving rise to a critical mass. Other actors such as policy-makers at the provincial and national level and financing institutions (Raiffeisenlandesband Oberösterreich) played a supporting role. The interaction between policy, university and finance in the development of SPH can only be properly understood against the background of Upper Austria's networked RIS.

Conducting 19 personal interviews with firms and research organisations to analyze the relational assets enabled us to reveal some further key characteristics of SPH's evolution. SPH's specific set-up, i.e. the combination of business, research and education, has generated many synergies and proved to be the key factor in the formation and longer-term development of the park. Arguably, such synergies are usually available at urban locations but not at rural places like Hagenberg located in the peripheral region Mühlviertel. Combining the three functions "under one roof" in SPH contributed to overcoming the disadvantages of periphery. Our analysis of linkages among actors located in the software park has pointed to intensive flows of goods, people and knowledge and a high level of internal networking. Actors thus utilize the synergies resulting from the co-location of firms, research institutes and educational bodies. Internal networking to develop and capitalize on these synergies has been identified as a key element characterizing the evolution of SPH and underlying the creation of a new regional path that is based on ICT.

Another important result of our case study analysis concerns the roles played by the old regional path based on traditional industries and the RIS. The prevailing old path and the newly emerging path were found to co-exist and be related to each other in mutually beneficial ways. We identified a wide range of connections between SPH and traditional companies located in Upper Austria. ICT companies located in SPH deliver products and services to large firms of the traditional manufacturing sector of Upper Austria. In addition to market relations, there is evidence for knowledge links and innovation partnerships between actors located in SPH and larger traditional companies, pointing to a combination of competences from different knowledge bases. The old path did not constrain the formation of the new one, but, on the contrary, it provides favorable conditions for its development. The dominance of traditional manufacturing in Upper Austria generates demand for some of the products of SPH and offers opportunities for applying ICT relevant knowledge in older industries through R&D partnerships. Not only did the new path benefit from the existence of the old one, but also the latter could draw advantages from the rise of the new one. SPH contributed to the modernization of traditional companies and their innovation-based restructuring through the provision of high-tech services, products and knowledge.

Arguably, the results of the case study analysis of SPH cannot and should not be generalized. New path creation is a context-specific phenomenon that varies strongly between traditional regions. Our investigation of the evolution of SPH provided support for this view, showing that its evolution can only be properly understood if the distinctive features and assets at the regional level are taken into account.

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