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Science parks and their contribution to regional development: The example of the Campus Tulln Technopole

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Summary

The Austrian federal state of Lower Austria pursues a set of policies to stimulate innovation with two goals in mind: persisting in the competition between locations and benefiting from EU enlargement. A cornerstone of that set of policies is the extension of the state's technopoles. The technopole programme's goals are to stimulate innovation processes and to contribute to the creation of new technological knowledge and its application in the economy.

The Campus Tulln Technopole was created in 2006 as one of four technopoles in Lower Austria. The University and Research Centre Tulln (UFT), which houses the University of Natural Resources and Life Sciences Vienna (BOKU) and the Austrian Institute of Technology (AIT), crucially invigorated the technopole in 2011. This article's goal is to demonstrate the UFT and the Campus Tulln's effects on the surrounding region and how those effects can be measured.

The involved players have different goals and expectations regarding the research centre. BOKU and the AIT hope for high-quality research and (international) recognition in the scientific community, which they hope will be facilitated by the excellent research conditions and synergies between the two institutions. The city of Tulln and the government of Lower Austria, for their part, aim at improving the positioning of the region as a place to do research. In addition, the creation of jobs for highly qualified employees is important to them. They also seek a transfer of knowledge and technology from and to (regional and supra-regional) firms and an upgrade of educational institutions in the area.

There are examples of institutions in other countries that have successfully combined academic and applied research for many years. Six of those institutions were analysed as reference projects. Our analysis shows that, depending on an institution's strategic orientation and its environment, either education, research or the transfer of knowledge have a preeminent position. In order to benefit from growth potential, for example through the attraction of technology-oriented companies to the region or

the growth of existing local companies, well-functioning transfer mechanisms for knowledge and technology are imperative. Past experience suggests that a research centre can create growth effects if the knowledge it produces can be harnessed to benefit regional firms.

Careful examination of the reference projects also showed that a technopole with its research institutions is an important player in a regional network, which influences the attractiveness and quality of an entire region. Three areas are particularly relevant in the context of the UFT: “Research and education”, “knowledge and technology transfer” and “locational quality”. In the area of research and education (joint) research projects and attractive educational offers contribute to the positioning as a renowned place of higher education. An attractive institution of higher education facilitates the attraction of highly qualified employees and increases students’ demand for university places. Applied research and the cooperation with regional companies play a key role in the transfer of knowledge and technology. The UFT offers products and services to corporate clients and, within the framework of applied research projects, works on commercially relevant problems. Companies strive to stay competitive and have a constant demand for innovation. That demand can be met by the UFT’s services, from which both the UFT and (regional) companies benefit. Tulln’s positioning as a place to do business depends on the competitiveness of local companies, which has a direct influence on the number of jobs and the quality of the workforce.

Based on the relationships within the regional network, a tool to monitor the outcomes for the region can be created. Cause-effect-chains are used for the development of a (regional) impact monitoring, which produces a set of impact and outcome indicators for the UFT and the technopole as a whole. The ongoing evaluation of those key indicators is essentially aimed at making the centre’s regional effects transparent. Moreover, it enables a regular reflection on the observable regional effects and, in consequence, the creation of a strategic steering mechanism.

The UFT as a key player on the Campus Tulln Technopole might produce regional effects in the fields of knowledge transfer and locational quality. The UFT’s success helps to promote the campus, the city of Tulln and the state of Lower Austria as places of science and research both nationally and internationally. Apart from the UFT’s impact on the region’s image, effects on the campus’s daily operations should not be neglected. A good image ultimately depends as much on workers’ loyalty to their employers and to the region as a whole as on the commitment of the participating institutes to the Campus Tulln and Lower Austria as places to undertake research.

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1 Introduction

From the perspectives of certain scientific and political communities, knowledge and innovation are considered crucial factors for the economic development of both nation states and regions. The exploitation, transfer and use of knowledge play a decisive role on the way to the knowledge-based economy and society. Regions are important actors within the knowledge-based economy. However, they are not able to make use of their potential or they are not aware of its scope. Regions are very heterogeneous: they differ in terms of resources (human capital, social capital, technological and financial capital) as well as with respect to their competitive ability, including local spill-over effects and other multiplier effects. Thus, it is necessary to strengthen and intensify the connections between the public sector, businesses and educational facilities. Universities and research institutions contribute to promoting innovation and the transfer of knowledge and technology between regions and to increasing the competitiveness of regions.

The Austrian federal state of Lower Austria, in the northeast of the country, pursues a set of innovative technology policies in order to remain competitive both at the national and international levels. Since 2006 the city of Tulln in Lower Austria has been home to a technopole, which was extended by the University and Research Centre Tulln (UFT) in 2011. By discussing the UFT as an example, the goal of this paper is to demonstrate, first, the effects such an institution can have on its host region and, second, how the effects can be measured through a monitoring system. The findings stem from a project which was carried out by the Institute for Systemic Management and Public Governance (IMP-HSG) at the University of St.Gallen on behalf of NÖ Forschungs- und Bildungsgesellschaft m.b.H., a publicly owned research and education company, in 2011. The research focuses on the following questions:

- Which effects on the location (Tulln) are to be expected from the university and research centre? Which contribution to an increase in the locational quality of the region can the UFT make?
- Which effects on the local scientific community (active in both research and teaching) are to be expected?
- How will the UFT contribute to the transfer of knowledge and technology?
- How can experiences of comparable European institutions inform policy at the UFT?
- How can the goals and effects be monitored on a regular basis?

The analysis emphasized a qualitative view of the effects that were to be expected in the different research areas. From the client's perspective, the study was supposed to increase the transparency of the UFT's internal and external activities. The study should also point towards possibilities for a critical reflection of the goals and the projected effects and increase the project's acceptance amongst the general public, who subsidises the UFT through tax money.

The following chapter deals with the contribution of knowledge and innovation to regional development from a theoretical point of view. In section 3 the characteristics of the UFT, its objectives and the experiences of comparable European institutions are discussed. Subsequently, the regional interdependent networks compiled for the UFT are described and indicators for a regional impact monitoring are derived. In the last section the results are summarised and conclusions are drawn.

2 Knowledge and innovation and their contribution to regional development

In regional science, the questions of which factors have a positive effect on a region's success, how regions develop as they do, and why, have long been discussed. While in the past this was examined from a static point of view, with a focus on traditional location factors (transport situation, taxes, the labour market), today the focus is moving towards a dynamic view of the development processes. Recent theories do not so much examine production factors in the narrower sense, but instead highlight interactive connections between institutions and actors. Thus, the viewpoint is changing from an exogenous to an endogenous perspective (eg, Thierstein, Walser, 2000; MacKinnon et al., 2002; Moulaert, Sekia, 2003) (Strauf, Scherer, 2010:2).

Recent theories of regional science assume either a macro-perspective or a regional perspective. The latter deals more closely with issues of geographical proximity, the capacity to generate and enhance social capital, the capacity to accumulate and exchange knowledge and expertise (ie, codified and tacit knowledge) and other prerequisites that are relevant for the development of regional clusters and key factors of successful science, technology and innovation activities (European Commission (2008):85). Prominent approaches on the regional level are the concept of the "learning region" (eg, Florida, 1995; Stahl, 1994; Thierstein, et al., 2000) as well as the concept of "industrial clusters" or "innovative milieus" (eg, Camagni, 1991; Butzin, 1996; Fritsch et al., 1998).

Against the background of new theoretical approaches to factors of regional development, largely influenced by the work of Michael Porter, Paul Krugman and Richard Florida, the success of a region or a location is evaluated based on its ability to learn and on its competencies, in particular. The spatial concentration of research activities, innovation and the knowledge transfer plays an important role. Research-intensive clusters can usually be found in close proximity to universities and research institutions. However, this alone does not satisfactorily explain which factors positively affect and promote innovation, a transfer of knowledge and spill-over effects. Moreover, with respect to the approach of innovative milieus Asheim (1995: 15) argues that the largest problem consists of identifying the impact mechanisms and processes which promote innovation in some regions more successfully than in others or, in other words, "why localization and territorial specificity should make technological and organizational dynamics better" (Storper 1993: 14). Although many studies focus on knowledge and learning as central conditions for regional development, the comparative empirical data, which would allow for explaining different development paths, are often missing.

With the analysis of the success factors of regional development (public) regional policy focuses increasingly on innovation and knowledge. This is particularly true for the regional and structural policy of the European Union, where the promotion of knowledge and innovation is seen as a crucial prerequisite for economic growth on the regional level.[1]

In this respect, research institutions and technopoles play an important role: they are locational and economic factors as well as image carriers, which can affect the locational quality of a region. The terms research parks, science parks, technology parks, technopoles, science centers, business innovation centers, and centers for advanced technology are often used interchangeably and there appears to be no singular definition of a research park. The International Association of Science Parks defines a Science Park as

> "an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a

1 cf. European Commission 2006

> Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities."[2]

The creation of research parks is increasingly seen as a means to create dynamic clusters that accelerate economic growth and international competitiveness around the world. Specifically, research parks of various sizes and types are widely perceived as an effective policy tool to realise larger and more visible returns on a nation's investment in research and development (Wessner (2009):2).

As in other countries, public programmes for the promotion of knowledge and innovation in order to improve the competitiveness of regions were introduced in Austria. In the year 2000 the federal state of Lower Austria started a technology initiative aiming at the development and conversion of its technopole programme. The intention is to develop locations with public and semi-public R&D institutions as places of "technology-oriented economic activity", to connect them with enterprises and to increase the value creation of the economy of Lower Austria. The government of Lower Austria envisages its technopoles as locations with the following four characteristics:

- They have a critical number of R&D institutions, whose research emphasises one or more key aspects and which have built an appropriate infrastructure for that purpose.
- Furthermore, the direct local links to academic training are essential in order to connect research with teaching.
- Competent businesses create demand for R&D and help to commercialise the generated know-how in the national and international markets.
- Enterprises are located in immediate proximity to the research institutions

Those four criteria were fulfilled at three locations in Lower Austria. By discussing the case of the University and Research Centre Tulln at the Campus Tulln Technopole, the following chapter highlights which areas of the host region's development will potentially be affected by the UFT and how those effects can be measured through a regional impact monitoring system.

2 International Association of Science Parks (2012)

3 Case Study: The University and Research Centre Tulln on the Campus Tulln Technopole

Tulln is one of four sites singled out for development by the technopole programme of the federal state of Lower Austria. The Department for Agrobiotechnology (IFA-Tulln), the University of Applied Sciences Wiener Neustadt/Tulln branch, the Technopark Tulln Ltd, the local technical school of agriculture, Zuckerforschung Tulln Ltd and the city of Tulln all cooperate within the framework of the Tulln technopole. Furthermore, there are additional cooperation agreements with industrial companies. Modern bioanalytics, environmental technology, plant breeding and the development of renewable natural resources are core issues the Tulln technopole is working on. As of May 2011 before the UFT started, there were 236 high-tech jobs in the technology fields, 21 university departments were represented at the technopole and 145 students were enrolled in courses of the the University of Applied Sciences Wiener Neustadt/Tulln branch. Eight companies from the field of agricultural and environmental technology had their offices on the campus, employing 31 people.[3]

3.1 Characteristics of the University and Research Centre Tulln (UFT)

The state parliament of Lower Austria decided to invest €45m into the establishment of the UFT in 2007. The construction and operation of the UFT are financed by Lower Austria and the city of Tulln and supported by the Austrian government with funds from the performance agreement. The total cost of establishing the UFT amounted to €64m. The two-storey university and research centre was constructed on a six-hectare site. It has floor space of 15,000 square meters. Moreover, there is a 45-hectare testing ground and well-equipped greenhouses and laboratories, seminar rooms for up to 150 people and a 70-seats restaurant. After the construction period of two years was completed the UFT was formally inaugurated in September 2011. At the beginning of the winter semester 2011 approximately 250 researchers were employed at the UFT. There is room for a maximum of about 350 people. In january 2012 the Campus Tulln Technopole totally provides 487 high-tech jobs.

The University of Natural Resources and Life Sciences Vienna (BOKU) and the Austrian Institute of Technology (AIT) are the main occupants. The two institutions' teams in Tulln focus on bioanalytics, renewable natural resources and biotechnologies. The BOKU has been active in Tulln since 1994 and cooperates with the Vienna University of Technology and the University of Veterinary Medicine Vienna within the framework of the IFA-Tulln, which employs around 100 people. The AIT is one of Austria's biggest extra-faculty research institutions with more than 1,100 researchers spread across various branches across the country. The AIT's main research areas are the infrastructure issues of the future, including health and the environment, safety and security as well as energy and mobility.

By cooperating within the framework of the UFT, two institutions contribute to the development of the campus Tulln. The campus's resident institutions, the city of Tulln and the state of Lower Austria expect an upgrading and strengthening of the campus Tulln from the presence of the UFT. The specialisation in a few key research areas and the greater competency at the location are supposed to improve the image of the city as a place to do business and to undertake research. The technopole attains critical mass with the aid of the UFT because the research centre improves the external perception of the location and the region and contributes to identity-building on the campus. Cooperation and interconnectedness between the technopole's institutions have already been substantial in the past, but is to be further developed through the UFT, the BOKU and the AIT. Representatives hope that enhanced cooperation will lead the partners to initiate more projects jointly. Synergies are also generated through the use of shared infrastructure, such as the seminar rooms or the restaurant. In the

3 cf. ecoplus 2011

medium and long term, policymakers hope that the UFT will draw new companies to the region. Moreover, they envisage that the UFT will promote spin-offs and the creation of new firms on the campus.

The addition of the UFT invigorated the campus Tulln, which is also reflected in its renaming from "Technopole Tulln" to "Campus Tulln Technopole". To this end, a word mark and logo were created. The participating institutions' commitment to the Campus Tulln Technopole probably varies. While the IFA has had its own identity for many years, which it also demonstrates by using its own logo, the other departments of BOKU and the UFT will continue to focus on their close links to their respective headquarters in Vienna. The AIT, for its part, might grant more autonomy to the Tulln branch.

3.2 The UFT's goals

The UFT, as an interdepartmental and interdisciplinary body, is designed to stimulate the cooperation between BOKU and the AIT and to produce a strategic partnership between the two institutions. Ideal working conditions and the well-equipped laboratories lay the infrastructural foundation of the work at the UFT. Its focus will be on research; however, the modern laboratories are also available for lectures, particularly master's and PhD courses. An enhanced knowledge transfer between basic and applied research is to be produced by bundling the faculty and extra-faculty competencies of the two partners. The research's quality can be improved and new knowledge produced through cooperation within the scope of joint projects. The research's focus on a few issues, its presumably high quality and the improved exploitation of the common projects' results can contribute to a better positioning of both institutions. The need to remain competitive is important to both BOKU and the AIT. In this regard, specialisation and the coverage of the entire chain of innovation from basic research to the marketable product should improve their prospects in the international competitive environment.

In a memorandum of understanding the state of Lower Austria, BOKU, the AIT and the city of Tulln agreed upon cooperation in the fields of science and technology in 2005. The document outlined the following goals:

- A "Center of Excellence" with critical mass is to be created. It shall strengthen a common profile through its focus on "green and white" biotechnologies.
- BOKU shall pursue further development of the IFA-Tulln.
- BOKU and the AIT can expect to obtain facilities including basic equipment. Space for establishing new businesses is to be found in the centre's immediate surroundings.
- The research and technology network is characterised by the fact that, on the one hand, from the first day of its operations there is the option to attract companies interested in R&D to the site. On the other hand, the potential of BOKU and AIT students should allow for research spin-offs and the establishment of new businesses.
- The city of Tulln is to offer a financial incentive package to companies during the first five years, amounting to the equivalent of the municipal tax.
- The Campus Tulln Technopole is a flagship project for the state of Lower Austria. Up to 400 new jobs are to be created out of its academic potential. The attraction of companies to the region and the creation of spin-offs in the state's heartland should stimulate the technological and economic development of the city of Tulln and the federal state as a whole.

As an integral part of the Campus Tulln Technopole, the UFT plays an important role for the whole location. The city expects the UFT to create new high-quality jobs and more options to offer its youth a future-oriented education. The UFT should lead to the attraction of companies to the region and stimulate the local economy. The availability of highly qualified graduates should increase the attractiveness of the city for companies. The transfer of knowledge and technology between the UFT and (regional

and supra-regional) firms is a crucial element to secure the competitiveness of local companies. The UFT is seen as a continuation of the strategic thrust towards the conversion of Tulln into a place of research and science, which contributes to the completion of structural change in the city. Tulln expects positive effects on its image and positioning within the Vienna Region. Through the participating institutions' projects Tulln also hopes for more international links.

3.3 Reference projects

The UFT has just been inaugurated in 2011, so its regional embeddedness and effects are hard to gauge at this point. Yet examining comparable European institutions can provide important insights. A comparative analysis of six research institutions produces information regarding the contribution such institutions can make to a region's locational quality, how the knowledge and technology transfer takes place and what links institutions have within a region and beyond. The following institutions were selected as reference projects: Karlsruhe Institute of Technology (KIT), Karlsruhe (D), Science and Technology Park Adlershof, Berlin (D), SP Technical Research Institute of Sweden, Boras (SE), Institut Poytechnique de Grenoble (F), Technoparco del Lago Maggiore, Verbania (I) and Science City Davos, Davos (CH).

Even if the selected institutions' features differ, they can be compared using the following criteria:

- Links between academic and extra-faculty research
- Promotion of the knowledge transfer
- Entity coordinating the knowledge transfer
- Promotion of start-ups
- Cooperation with regional enterprises
- Regional embeddedness: Cooperation with actors from the region

In the case of some of the institutions (KIT, the Science and Technology Park Adlershof and the Institut Polytechnique de Grenoble) universities belong to their core constituents. For them research and, in particular, its quality play a key role. With their research they pursue the goal of gaining international recognition and a leading position in their field. Apart from basic research, applied research is an important element for the aforementioned institutions — plus the SP Technical Research Insitute of Sweden. Especially the KIT and the SP Technical Research Institute of Sweden are very much engaged in applied research.

The facilitation of a transfer of knowledge is a goal in all cases reviewed for this paper. However, there are distinct approaches: They range from common projects to commissioned research and consulting services to offers of further education. Across institutions the transfer of knowledge is not institutionalised and structured to the same extent. The KIT, the Science and Technology Park Adlershof, the Institut Poltechnique de Grenoble and the Tecnoparco del Lago Maggiore all have organisational units or bodies which establish a connection between academic research results and companies. The bodies offer services to both scientists and researchers of the institution in question as well as to interested companies or external organisations. They see themselves as liaison offices and intermediary bodies between the interests of science and business.

The promotion of start-ups is one of the core tasks of the Science and Technology Park Adlershof and the Tecnoparco del Lago Maggiore. They explicitly aim at establishing companies on their premises. In the case of the institutions with a research focus, the promotion of spin-offs is welcome, but not necessarily a top priority.

Cooperation with companies from the region depends, on the one hand, on the regional embeddedness of an institution and, on the other, on how the cooperation is organised. Moreover, the thematic focus of the institution is important. Cooperation with media companies from the region plays an important role for the Science and Technology Park Adlershof. Cooperation between companies based on the Adlerhof's premises is also encouraged. As for the SP Technical Research Institute of Sweden and the Institut Polytechnique de Grenoble, the cooperation with companies from the region is not as advanced due to those institutions high degree of specialisation.

Close cooperation with regional actors, especially public authorities, is usually the more intense the more closely they are involved in the institution's funding body. In the cases of Science City Davos, Tecnoparco del Lago Maggiore and the Science and Technology Park Adlershof, local and, in some instances, regional public authorities have a financial stake in the institutions. In the case of the KIT, regional embeddedness is achieved through a body made up of representatives of the municipality, the region and the KIT. This body tries to take advantage of synergies between the KIT and the region. The following table provides an overview of the six institutions:

Table 1: Comparison between university and research centres

	Karlsruhe Institute of Technology (KIT)	Science and Technology Park Adlershof, Berlin	SP Technical Research Institute of Sweden, Borås	Institut Polytechnique de Grenoble	Tecnoparco del Lago Maggiore, Verbania	Science City, Davos
Founding year	2009	1991	1975	2007	1977	2004
Turnover	€730m	€2.1 billion	€100m	n/a	n/a	€155,000
Number of employees	8,800	14,100	936	1,100	n/a	2
Number of students	20,000	7,800	-	5,300	-	-
Size of host city (inhabitants)	300,000	3m	100,000	160,000	30,000	10,000
Academic institutions	11 faculties, 12 research programmes	6 institutes of the Humboldt University, 11 extra-faculty institutions	No university, public extra-faculty institution	6 faculties	-	1 institute of the ETH (Swiss Federal Institute of Technology)
Link between academic and extra-faculty research	XXX	XX	XX	XX	XX	X
Promotion of knowledge transfer	XXX	XXX	XX	XX	XX	XX
Coordination centre for knowledge transfer	XXX	XXX	X/-	XXX	XX	XX
Support of spin-offs	XX	XXX	X	XX	XXX	-
Cooperation with firms from the region	XX	XXX	X/-	X	XXX	X/-
Regional embeddedness: cooperation with regional actors	XXX	XX	X	X	XX	XXX

Source: Scherer, Strauf (2011)

Overall, the effects on the host region and the regional embeddedness vary across institutions, depending on their respective mission. If the UFT pursues the goal of establishing links to regional actors, to cooperate with firms from the region and to promote a knowledge transfer, the following aspects are crucial:

- The institutions that constitute the Campus Tulln Technopole and the regional actors need a common understanding of a shared vision in order to be able to assume their responsibility for the region together.
- The quality of the research and teaching are pivotal for the positioning of Tulln as a place to do research. It is the only way the Campus Tulln Technopole can gain international recognition and have a positive effect on the region.
- In order to achieve critical mass and to create regional effects, the Campus Tulln Technopole must be perceived as a whole by both the internal and external actors involved.
- To facilitate the transfer of knowledge between the institutions, regional firms and the region of Tulln, efficient coordinating bodies are needed to facilitate cooperation both within the scientific community and between the latter and its (economic) environment.

The UFT is – just like the reference projects analysed in this paper – an actor in the regional network. Furthermore, a number of other actors contribute to the development and the attractiveness of the host region. In the following chapter the UFT's impact on interdependent regional networks are illustrated. The section's goal is to demonstrate which factors influence the regional systems and which ones have the potential to create the biggest effect.

3.4 Interdependent regional networks

By means of a diagram of the regional network we demonstrate loop effects and interdependencies between single elements (influencing factors) within the network. Our method is based on the approach of so called "Networked Thinking". This method allows for the description of complex issues as dynamic networks composed of parameters, target variables and effects. For the analysis of the UFT networks in the fields of "research and teaching", "knowledge and technology transfer" and "location quality" were deemed to be the most relevant.

The research projects the Campus Tulln Technopole's resident institutions undertake and the degree courses they offer play a central role in the field of research and teaching. The services influence the perception and attractiveness of Tulln as a location for science and higher education. Demand for university spots and the supply of qualified workers depend on the location's attractiveness. The quality of research and teaching is an important factor to create positive effects in those fields. High quality of research can be achieved through cooperation projects and qualified employees. Cutting-edge research, in turn, can attract (international) attention; the positioning of both participating institutions and the location is improved and the quality of students rises, which leads to an increase in companies' demand for graduates.

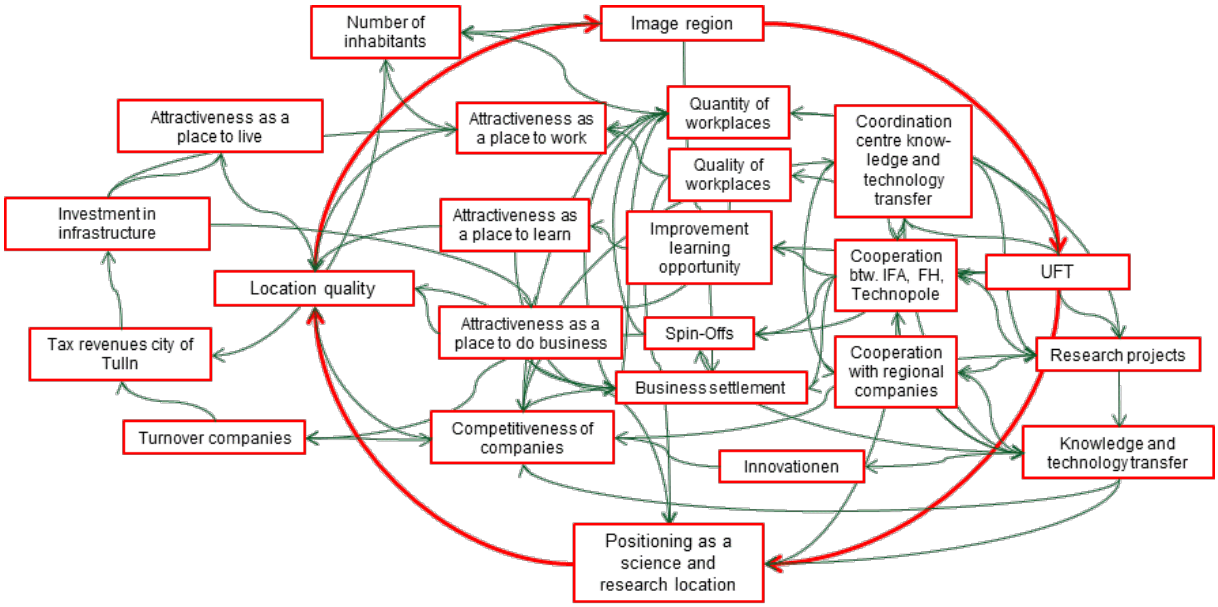
For the analysis of the UFT's effects on the field of knowledge and technology transfer the centre's contributions to companies' competitiveness and capability to innovate are assessed. There is the underlying assumption that the UFT can offer advantages to companies through applied research projects, as firms need innovation to stay competitive. The resulting demand for research results can be met with projects by the UFT. Cooperation and exchange between companies and the Campus Tulln is crucial for the technopole to have a positive impact on the transfer of knowledge and technology within the region. In this context, the cooperation between the campus's resident companies is also important. Only if synergies and common offers can be created will the technopole be able to satisfy the needs of companies and to become an attractive partner in the innovation process. The

centre for knowledge and technology transfer Campus Tulln technopole, a coordinating body, would be an eminent port of call with the task of collecting and combining companies' needs and research interests.

In our analysis of the field of location quality various relevant factors were taken into consideration. Some elements of location quality that are also considered, however, have already been discussed above. Not all factors are separately listed and some are aggregated to maintain clarity in spite of the high degree of complexity.

The UFT and the entire campus are important factors in the process of positioning the city of Tulln as a place to do (scientific) research. High attractiveness of the location improves the city's image which, in turn, has a positive impact on the UFT, for example when it tries to attract highly qualified scientists. Location quality is composed of various factors, such as a location's attractiveness as a place to live, work, learn and do business. All components of Tulln's location quality are directly or indirectly affected by the UFT. The courses on offer there raise the city's attractiveness as a place to learn. The attraction of companies and competitive firms help improve the attractiveness as a place to do business. In addition, the city's investments in its infrastructure raise its attractiveness as a place to live, which leads to an increase in the number of inhabitants. Figure 1 below shows which factors have a positive impact on a location's attractiveness and how they are composed.

Figure 1: Interdependent regional network "location quality"



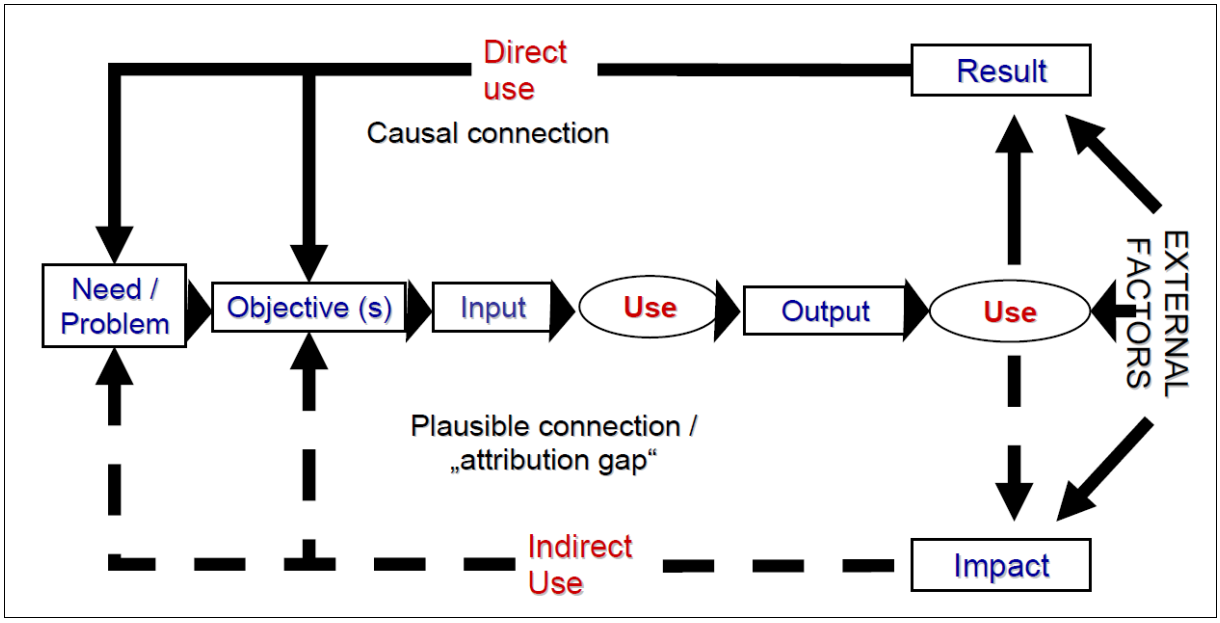
If one looks at the networks in their entirety, it becomes clear what factors have the biggest impact on a region. Those are a system's "levers", which can be used to influence active factors. They can be controlled and specifically influenced. Along with the UFT infrastructure that lays the basis for high-quality research was created on the campus. Apart from the excellent technical infrastructure, which increases the supply of qualified employees, good appointment policy is needed to attract highly skilled scientists. The cooperation between BOKU and AIT should create synergies in the fields of basic and applied research, which can facilitate the transfer of knowledge and technology. In order to identify companies' research needs a coordinating centre should serve as a gateway between scientists and businesses. The centre's task is, first, to facilitate (regional) companies' access to products, processes and services of the research institutions on the campus and, second, to find adequate partners for companies according to their innovation and research needs. For the knowledge and technology transfer to be fruitful for both sides a cooperation between all of the campus's resident institutions

is necessary. There are already two institutions that are actively involved in the knowledge and technology transfer: on the one hand, the technopole management plays an important role as a facilitator between the scientific and the economic systems. On the other, the BOKU departments on the campus have a common research coordinator who assumes a coordinating and mediating role in their scientific work. The rest of the scientific community in Tulln is not served by that coordinator so far, though.

3.5 Regional impact monitoring

On the basis of the interdependent regional networks described in chapter 3.4, a regional impact monitoring was developed. Impact monitoring allows for statements on the regional reasonability and relevance of a project or a (public) infrastructure measure. On the one hand, the impact monitoring is an internal control instrument, which aims to contribute to the effective execution of a measure. On the other hand, the monitoring has also a more comprehensive function, namely to support external communication. The following illustration illustrates the model of the cause-effect-chains, on which the development of an impact monitoring system was based. With reference to the interdependent networks of the fields of "research and teaching", "knowledge and technology transfer" and "locational quality", chains can be constructed. They illustrate what outcome and what impact can be expected considering the relevant objectives in a field.

Figure 2: Diagram for monitoring of impacts



Source: Hummelbrunner (2005:6).

The impact monitoring system is aimed at allowing for an estimation of the regional impact on the basis of the outcome and impact indicators, which are summarised in the following two illustrations. The indicators relate to the so-called intangible effects, which are responsible for a positive contribution of the UFT to its host region in the long term. In addition, the tangible effects can also be measured for the UFT. They include monetary effects, which the UFT generates for regional economic actors. Usually the identification of those effects is relatively complex and afflicted with a set of methodological problems. Nevertheless, it is possible to make preliminary statements about the UFT's monetary effects by using our impact monitoring system. In our view, it is sufficient for this purpose to identify and regularly measure the UFT's expenditures within the borders of the city of Tulln (or a somewhat larger

spatial perimeter). In addition, the spatial distribution of wages and the cost of equipment and services are analysed and the appropriate share of the expenditure is attributed to the city of Tulln. The expenditures represent an outcome indicator in their own right, since there is a direct causal connection with the activities of the UFT.

Table 2: Outcome indicators

quantitative	qualitative
UFT's expenditure at the location of Tulln	Companies' awareness of bio-resources
Number of conferences and seminars	Own business activities
Number of event participants	Degree of integration of relevant enterprises
Percentage of workers with residence in Tulln	
Percentage of equity financing of a cluster	
Number of degree and training courses	
Number of students	
Number of employees at UFT and campus	
Employment ratio for graduates	
Number of joint projects by BOKU and the AIT	

Table 3: Impact indicators

quantitative	qualitative
Trend in population figures	Innovation activities by SMEs
Trend in the number of overnight stays	New products and processes by regional SMEs
Trend in the real-estate value	Integration into (international) networks
Number of attracted and newly incorporated companies	
Additional turnover for regional SMEs	
Spin-offs and start-ups from the UFT	
Number and quality of publications	
Number of (international) research projects	
Amount spent on R&D	
Number of patents	

The continuing collection of relevant indicators of the UFT's regional impact serves different objectives. First and foremost, it makes a contribution to the transparency of the UFT's activities. Second, transparency enables regional stakeholders to reflect on the observable regional effects, which creates the possibility of strategic control. It seems important to us that the results of the impact monitoring are made available to the general public. Only in this way can the monitoring system contribute to the UFT's legitimation and acceptance by both politicians and society as a whole.

4 Conclusions

The Austrian state of Lower Austria pursues a set of innovation-oriented technology policies to gain an edge over its competitors in the national and international competition between regions. By means of its technopole programme the state's government tries to promote innovation processes and to support the establishment of economically successful products and companies through the creation of technology-based knowledge. Since 2006 the Campus Tulln Technopole has been in operation. The University and Research Centre Tulln (UFT), which was inaugurated in 2011, is an institutionally significant addition to the campus. The two institutions contributing to the centre have different goals and expectations of the UFT. They hope to achieve higher quality of their research as well as to gain recognition for their work in the (international) scientific community, aided by the excellent research infrastructure and presumed synergies between both institutions. The creation of jobs for the highly qualified is also a priority. A transfer of knowledge and technology between the institutions and between them and (regional and supra-regional) companies, as well as an upgrade of the learning environment are envisaged. Moreover, the city of Tulln and the state of Lower Austria are determined to improve their positioning as an attractive location for science and research.

In order to benefit from a region's economic growth potential, for example by attracting technology-oriented enterprises or by encouraging growth of existing companies, a well-functioning transfer of knowledge and technology is a necessary condition. International experience shows that a research centre can spur economic growth if regional companies can capitalise on the knowledge contained in such a centre. The appropriate organisational structures to encourage the transfer of knowledge and technology must be created at the UFT or, alternatively, the existing structures have to be further developed.

Thus, a transfer of knowledge and technology contributes to an increase in the quality of a location as a whole. The positioning as an attractive place to do business depends on the competitiveness of the companies in a region, which, in turn, is linked to the number of jobs and the quality of employees. The UFT can contribute to the positioning of Tulln as an attractive place to learn, live and work. Crucial actors in the interdependent regional networks are the UFT – associated with a high quality of research and teaching – as well as the coordination centre for knowledge and technology transfer. Those institutions have the potential to promote the scientific and economic development actively and specifically and to create positive effects in those distinct fields. However, coordinated action of all participating institutions is required to achieve the UFT's goals.

Whether (and to what extent) the university and research centre can make a contribution to the increase of Tulln's location quality depends essentially on whether a vision shared by all actors can be created and acted upon. The UFT's sense of responsibility for the region as well as the support the city and state can give the centre are important in that respect. Also, a regular review of the UFT's goals and the services on offer through a regional impact monitoring is an important instrument. The success of the UFT would help the city of Tulln and the state of Lower Austria, as well as the BOKU and the AIT, to position themselves in the competition to offer the best conditions for science and research, not least in an international context. Apart from those considerations of the actors' image, the UFT's internal effects should not be neglected, though.

In the long run, a successful image is based on the commitment of the employees to their employer and that of the institutions to the Campus Tulln Technopole. Also, the commitment of both the employees and the institutions to their home region is of great importance. The basic conditions for the UFT and the region of Tulln are good. However, efforts from both sides are required to take advantage of the whole potential.

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