BMT21
3rd International Conference
Business Meets Technology.
Valencia, 23rd & 24th September 2021

TECHNOLOGY AMONGST THE FIELDS: MINI CAMPUSES AS ENDOGENEOUS GROWTH POLES IN LOWER DENSITY REGIONS – A CASE STUDY FROM THE NUREMBERG METROPOLITAN REGION

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ABSTRACT: The purpose of this paper is to report about the impact of Ansbach University of Applied Sciences' specialized mini campuses on their surrounding rural lower density regions by considering theoretical regional innovation models, spatial planning concepts as well as Ansbach University's mission(s). The approach we use is pragmatic due to the author's scientific publications and the author's professional experience. For that, newer scientific publication to the key words mentioned below are used for an interdisciplinary line of sight, and press releases and internal data provided are qualitatively evaluated for this study's practical part. Our study reveals that Ansbach University's pragmatic local strategy of appropriately placing specialized mini campuses in rural outskirts has remarkable impact on the innovation processes in the lower density region over time. Our mini campuses follow a clear local Triple Helix (TH) innovation strategy by University-Industry-Municipality cooperations, meanwhile tending to focus also Quadruple and Quintuple Helix stakeholder groups. Besides showcasing local innovation processes triggered by our mini campuses the paper thematises rural-urban interaction scenarios due to the threat of shrinking peripheral areas in metropolitan regions. This case study supports policy makers and regional or local deciders by offering ingredients for the set up of local strategies. For universities in low-density areas the paper can be of value for counteracting a brain-drain to metropolitan centers, thus contributing to spatial equal life conditions by giving modern living, studying, researching, working and recreating an attractive local country-side accent.

KEY WORDS: *Mini campus, Smart specialization, Innovation ecosystem, Triple/quadruple/quintuple helix, Rural-urban development.*

How to cite: Kaiser, N. W. 2021. Technology amongst the Fields: Mini Campuses as endogeneous Growth Poles in lower Density Regions – a Case Study from the Nuremberg Metropolitan Region. In Proc.: *3rd International Conference Business Meets Technology*. Valencia, 23rd & 24th September 2021. 27-38. https://doi.org/10.4995/BMT2021.2021.13693

1. INTRODUCTION

The purpose of this paper is to report about the impact of Ansbach University of Applied Sciences' specialized mini campuses[1] on their surrounding rural lower density regions by considering theoretical regional innovation models and rural-urban interaction aspects together with the University's academic missions.

The research question arises due to the challenge of minimizing rural-urban migration within metropolitan regions together with the request for creating competitive local innovation ecosystems. It should be noted that, as being part of a metropolitan region, our approach is different to other situations where mini campuses are launched far away from urban areas[2].

Located in West Central Franconia - a rural low-density NUTS-3 region south-west to the poly-centric core of the Nuremberg Metropolitan Region - Ansbach University of Applied Sciences (Ansbach UAS) has to face a regional situation illustrated through the poly-centric settlement and land use pattern shown in Figure 1. from COTER (2019), based on Piorr et al. (2011):

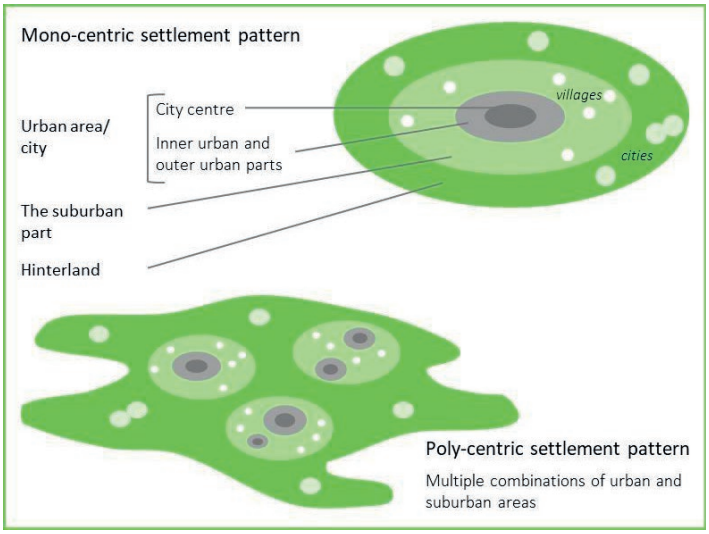

Figure 1. (with permission by COTER/EU 2019).

In their publication COTER report about rural-urban interaction within metropolitan areas and their peripheral outskirts. COTER argues that in a metropolitan region as shown

[1] See Ansbach University of Applied Sciences, https://www.hs-ansbach.de/en/university/branch-offices/, access 17th July 2021.

[2] See Deggendorf Institute of Technology (DIT), https://www.th-deg.de/en/research/technology-campuses, access 17th July 2021.

in Fig. 1 spill-over effects on surround-ding areas are not solely positive. Deciders have to face also e.g. negative impacts like rural-urban migration which means a shrinking of the outer rural areas. By referring to EUROSTAT, COTER note that 2015's EU-28 metropolitan regions contributed to nearly 72% to the European Gross Domestic Product (GDP), whilst less than 60% of the total EU population lived in metropolitan regions at that time. Due to an ongoing rural-urban migration, significantly more people are estimated to move from rural areas to urban regions by 2050, a trend which is confirmed by Maretzke et al. (2021) in their Spatial Planning Forecast 2040 for Germany.

As this trend has an embracing effect on the metropolitan region as an interwoven area, decision makers of all stripes have to develop co-opetitive strategies between cities and rural areas. For propelling the competitiveness of metropolitan regions with a backlash to regional prosperity and international reputation, improving regional and local innovation ecosystems seem to be a strategy worth thinking about.

For that, this paper is structured into three more sections. In Section 2 theoretical models for regional innovation are highlighted: innovation ecosystems, helix models and growth pole theory. Section 3 describes the case itself, aligning results to the theoretical models focused. In Section 4 we report about learnings and ascertain future research needs. Research limitations and future research options will be given shortly in Section 5.

As mentioned, literature to the keywords of this paper is manifold. Therefore, our research approach is pragmatic due to the author's earlier publications (see Kaiser (2019), Kaiser and Bung (2010), Kaiser and Mammen (1999)) and the author's professional background. So, we first take into account relevant newer published papers, studies and books, while the real world picture is given in a second step, leading to our system of mini campuses as an innovative local innovation approach in low density regions.

2. THEORETICAL REGIONAL INNOVATION MODELS

The European Committee of Regions CoR (2016) describe advanced regional innovation ecosystems in their guide about pioneer cities and regions together with their good practices. The guide's regional story telling is based on a set of critical success factors (CSFs)[3] derived from a quick-scan of studies and expert interviews, emphasizing and recognizing the value of scientific study for their classification criteria at all. The guide is useful in the context of the CSFs and the question of their deployment in regions, however all the measures taken in the pioneer regions analyzed cannot simply be rolled out in other regions. In fact, CoR notes that '*pioneering regions are a story altogether*'.

Jackson (2011) gives a definition for innovation ecosystems based on material and human resources which in sum form innovation relevant entities like universities, businesses, clusters, incubators, venture capitalists or business support agencies. The article distinguishes between knowledge and commercial economy for clarifying the

[3] CSFs are (1) vision, (2) actors, (3) policy model, (4) collaborating model, (5) partnering model, (6) resources, (7) physical and digital spaces, (8) innovative instruments and (9) outcomes and results.

question of capital and knowledge flow between those two groups. Along a four phase innovation process – invention, technology demonstration and development (TD&D) and commercialization – Jackson indicates that especially in the TD&D phases investments are low due to uncertainty, defining a 'Valley of Death' for ideas probably never passing the respective resource gap towards market launch.

Sun et al. (2019) investigates the role of government both as planner (top-down regime) and as facilitator (bottom-up regime) for a chinese university science park as innovation ecosystem. The paper emphasizes the role of universities not only as cutting-edge knowledge stimulators but also as important key players in their local innovation ecosystems. Also, intermediaries and social networks are seen as similar important channels for managing knowledge spill-over. Kaiser (2019 & 2020) has scetched the structure of Nuremberg's Metropolitan Region innovation ecosystem as an innovation boiler with relevant intermediaries, clusters and networks for SMEs as well as medium and large firms. The papers also focuses the regional innovation and development process by a set of process-orientated success factors.

Komorowski's study (2019) deals with identifying factors to develop innovation ecosystems, defining them as *'structures that are formed between actors that pursue technology development and innovation as one of their objectives'*. The definition is intentionally kept broad in order to integrate any organized or unorganized innovative patterns or dynamic regional innovation processes. From the results of her survey covering 247 innovation ecosystems throughout Europe, nine criteria are found enabling a rating of innovation ecosystems types by a spider web chart. Also, a cluster analysis of the results identified four archetypes of innovation ecosystems.

As is the case in every management system, also in regional management we have input, operations and output, indicating that overarching governance, human capital, structures, resources and (agile) processes have to be taken into account. To describe those complex innovation scenarios, the Triple Helix (TH) model by Etzkowitz and Leydesdorff (1995) and the Quadruple and Qintuple Helix models derived therefrom are taken as a must to be considered here. The well-known TH model describes regional innovation as a complex process of three intersecting circles representing universities, economy and government. University-industry-government interactions, e.g. as is the case for most science and technology parks or tech clusters, lie within the common intersection of the three. The three circles spiral the construct to new 'heights' due to new roles along a fictous time axis vertical to the three circles. This is the case when the three stakeholder groups innovate their missions, thus keeping the system in transition (Leydesdorff, 2012). In a recent paper, Galvao et al. (2019) show that research on helix models - with the TH model as the most focused on - is unbroken, be it in number of publications or in number of citations. Their cluster analysis of co-cited papers revealed regional policy recommendations such as e.g. active networks and cooperation partnerships as well as entrepreneurial ecosystems for low density regions.

As already indicated, the three stakeholder groups of the TH model might not be sufficient for coping with global innovation demands stamming from a more and more

complex environment. Carayannis and Campbell (2009) have adapted and enlarged the TH model by introducing the public as a new stakeholder group for innovation within their Quadruple Helix (QH) model. As the public is embossed by culture and values, media and social networks can contribute massively to their opinion in nowadays' 21st century. So, in total, both the culture and media based public and media as well as the creative industries are addressed by this QH group fuelling the intertwined helix dynamics. To be short, the QH model calls on involving the public in innovation processes[4], possibly due to their potential for new ideas, the self-image of democracies or the awareness that stakeholder groups accept innovation psychologically better the more they have been involved in the creative beginnings.

A working paper written by Arnkil et al. (2010) goes intensively in this direction. The paper brings in clearly the social dimension and the user driven aspect of the QH model, reporting on several good QH cases e.g. by highlighting Living Labs as R&D&I platforms for involving users. Also, Carayannis et al. (2019) show examples of excellence from Nordic countries with respect to the QH model, while additionally studying Quadruple/Quintuple Helix (Q^2H) Innovation system as an enabler for the circulation of knowledge and a 'spin-doctor' for regional innovation. In this context, as a 5^{th} stakeholder group the (natural) environement is seen as an innovation driver which is of great importance for managing UN SDGs.

As a last regional development model we find essential to focus on Growth Pole Theory developed from the French economist Francis Perroux in 1955. Growth pole theory says that economic growth and development is not balanced equally throughout a region, but takes place around driving nuclei. Driving cores can be universities, (key) industries or e.g. science park (Luger and Goldstein, 1991) leading to agglomeration effects which might be replicated elsewhere in a self-similar way. This is indicated in Figure 2a-c following Rodrigue (2020).

Despite the decades having passed, the growth pole model is still under examination for economically weak(er) developed countries. Examples are works from Benedek (2016), Bere et al. (2015), Jesus and Spinola (2015), ESPON (2014), Iunesco-Heroiu et al. (2013) and Komarovskiy and Bondaruk (2013).

3. TECHNOLOGY AMONGST THE FIELDS – LOCAL INNOVATION BY SPECIALIZED MINI CAMPUSES

In this section, we refer to the various studies from Section 2 by showcasing regional innovation by Mini Campuses.

To begin with, we shortly look back to times where universities had been relevant growth poles according to Figure 2a in Bavaria (regional NUTS-1 level). In the 1960s, their local impact area has been supplemented by Universities of Applied Sciences,

[4] Remark: QH is part of CoR's (2016) critical succes factor 'Collaborating Model'.

emerged as part of a new Bavarian Higher Education (HE) policy. The idea behind had been enriching the Bavarian HE system by application orientated HE institutions, whose profile bridges the gap especially to SMEs by more practice-orientated teaching contents and applied R&D (Figure 2b).

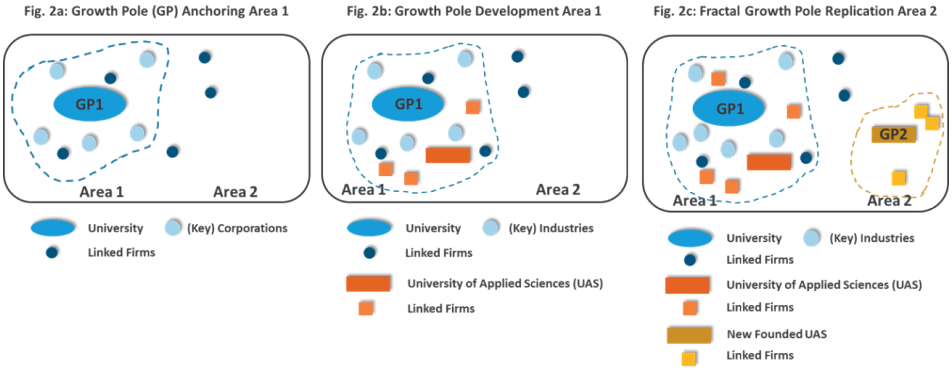

Figure 2a-c. Schematic setting, development and fractal replication of growth poles.

In the 1990s, Bavarian Government again gave their regional HE system a thrust: the existing UASs were topped up by a series of new UASs filling relevant Bavarian sub-spaces of low density or rural character. Ansbach UAS in West Central Franconia, a south-western NUTS-3 region in the Nuremberg Metropolitan Region, is one of them. The self-similar system transfer from center to peripheral regions is schematically scetched in Figure 2c showing the growth pole feature of our university. Figure 2a-c are based on Gavrila-Paven (2017).

Komorowski (2019) identified archetypes for local innovation ecosystems, e.g. the one of a 'Small City' characterized among others by a technology park. Although the 'Small City' archetype may hold for Ansbach City's 40,000 inhabitants and its UAS, chronologically it had been the other way round: Ansbach's centrally posed Innovation and Technology Center (TIZ) was a result from Ansbach's urban innovation strategy together with incubator concepts from Ansbach UAS around 2,000, in these days additionally complemented by a digital business incubator (ANsWERK). In this context, the 'Small City' archetype together with a metropolitan center lying directly 'at the doorstep' makes at least one aspect clear: not only governmental support from outside is key, but also lifting endogenous treasures in 'forests and fields' between local cities of 8,000 to 18,000 inhabitants.

Specialised Mini Campuses, self-similarly replicated (according to Figure 2c) and posed as Higher Education entities in the peripheral outskirts of West Central Franconia, had been an answer to the How-to-question.

Table 1 gives an overview over our four mini campuses, which are appropriately placed close to or in Ansbach's even smaller neighboured cities. Located 'amongst the fields' in that sense, mini campuses can be described in general by the following criteria:

- strategically linked to academic board members of Ansbach UAS
- operationally managed by a responsible management team on site
- clearly delineated from the centered university, but following a specialization strategy according to local and/or international demands either technologically or management-oriented.

Table1. Ansbach UAS's Specialised Mini Campuses and their Local Impact.

Mini Campus	Local City & Residents	Key Partners / Key Networks	Key Impact (selected issues) ...	... refering to ...
Total Productive Management Campus (CETPM)	Herrieden 8.000	City of Herrieden	Image, Radiance and Catchment Area up to National Level	Triple Helix
Polymer Campus	Weißenburg 18.000	Deggendorf Institute of Technology City of Weißenburg Weißenburg-Gunzenhausen County	Appointment as Bavarian Polymer Campus K-Meter Industrial Network	Triple Helix
Smart Energy Campus	Feuchtwangen 12.500	Munich Technical University (TUM) Bavarian Building Academy Feuchtwangen City Ansbach County	New Building Area 'University'; (energy) research involving local residents; Drone Operations (Solar Cell Defect Identification, Fawn Detection and Biodiversity Analysis)	Triple & Quadruple Helix Triple & Quintuple Helix
Intercultural Campus	Rothenburg on the Deaf 10.500	City of Rothenburg Regional Network of Smaller Communities	Endowed Professorship for 5 years; Research Project 'Connected Guest Experience' funded by the German Federal Ministry Program LIFT (LIFT = Performance Improvement and Innovation in Tourism)	Triple Helix

Also, a characteristic feature of mini campuses is their emergence from a significantly and endogenously activated potential:

- For ramping them up, investments in new or refurbished buildings are typically provided by the local cities together with the respective local district, but also private money
- Technological equipment is taken from the University's premises, if possible. In other cases public funding programmes support the establishment of technological facilities
- For operating their campuses, Ansbach university in turn provides the necessary human capital by comprehensive rationalization efforts throughout the university

Other operational expenses are covered by the regional government (Bavarian State) for a starting period of 5 years. For future campus operations exceeding these years, the management team is called to finance a great part of the costs by applied R&D or 3rd mission projects by regional, national or EU funding programmes and/or private budgets allocated to the campuses from local sponsoring associations and local business networks. Based on this cooperative mixture between university, cities, municipalities and government, an impression on mini campus operations can be taken out by the Business Model Canvas of our Smart Energy Campus. Although each campus has their

special features, this canvas can serve exemplarily for the mini campus concept in total (see Figure 3).

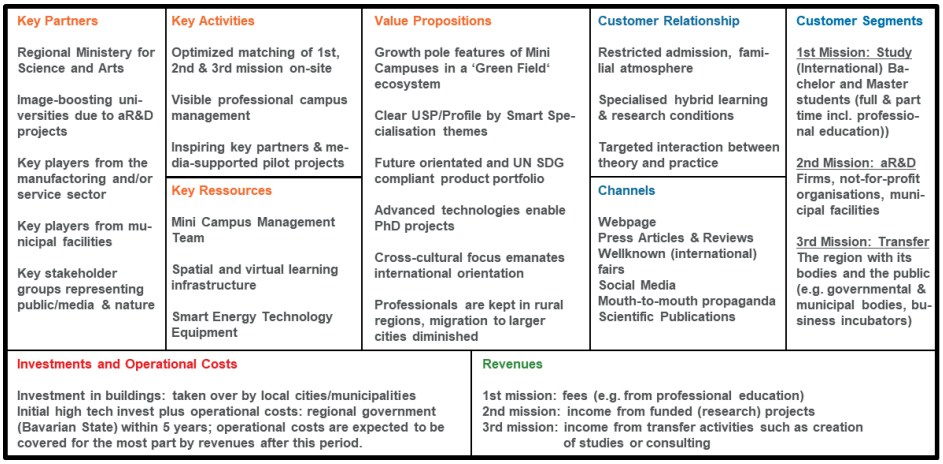

Figure 3.

4. RESULTS AND LEARNINGS FROM THE MINI CAMPUS CONCEPT

Concerning the output of our mini campuses in low-density regions, regional innovation is seen by taking account of the following outcomes in the sense of the TH and Q^2H innovation models:

- Through their HE missions (1^{st} is study, 2^{nd} applied R&D, 3^{rd} transfer to the region) mini campuses actively bundle local, regional and even national stakeholder groups by professional education and applied R&D projects (with industry or local governments or the public)
- Mini Campuses are regarded as new endogenously set up 'growth poles', supporting existing or generating local networks, thus enriching the local innovation ecosystems
- Besides moving into a new building, campuses sometimes may occupy refurbished buildings, which reminds at new innovation districts e.g. reported by van Dinteren and Jansen (2021)
- Recently, one campus is contributing to a newly designated building area designed as a mixed area for residing and businesses. The area will be in close proximity to the campus itself such that energy data from residents can serve as real data for energy research projects
- Campuses could be taken as living labs for society involving the public in local innovation processes, as shown in the QH innovation model.

- More innovation by nature seems graspable and is already partly done by taking into account newest results from one mini campus's drone activities. Animal welfare in forests and fields drives innovations, e.g. successful fawn detection has been carried out from helicopter view, or the demands for radarizing biodiversity will improve airial robot generations. Nature driven innovations are, as mentioned, part of the Quintuple Helix model.

Summing up, we can say that

- within the cooperative partnering described, our mini campuses develop successful, each within a timeframe according to either endogenous shortcomings or to their (mega-) trend attractiveness as well as the their ability to enhance economic producitivity
- the concept can be regarded as a win-win-situation for all parties or stakeholder groups: Bavarian government is able to take stand to their constitutional promise to create equal life conditions in all areas throughout Bavaria. Local cities and municipalities profit from the image of being an official campus site, thus demonstrating innovativeness towards their local businesses as employers and tax payers, and last but not least Ansbach University for clearly showing a regional strategy worth being supported by local and regional stakeholder groups.

Certainly, there are critical aspects as well. Mini campuses amplify logistics due to the fact that not all academic infrastructure, e.g. a physical library, can be multiplied at campus sites. Also, for a real study experience, a critical mass of students should be visible on-site. Despite the digital age and its opportunities, social proximity seems vital.

Also, the critical mass challenge holds for the number of projects to be acquired to finance operational costs. This might cause a search for projects not even locally, but on higher regional level. As capacitiy is restricted and cannot multiplied to any extent, local demands might then have lower priority. And finally, considering local governmental bodies, the sunk costs of public investors should give a return to the public purse, though public amortization times may be long.

5. RESEARCH LIMITATIONS AND FURTHER RESEARCH OPPORTUNITIES

General limitations are given due to data protection regulations, as far as internal mini campus data are concerned. An interesting research field is in that context e.g. to describe the development phases of mini campuses, in order to sensitize policy makers for occurring obstacles in similar situated campus projects. Also, field analysis seems reasonable to ask businesses for their experience with the campuses or the public in terms of campus image and reputation transferred e.g. by media.

ACKNOWLEDGMENTS

The author likes to thank the Mini Campus teams for the timely provision of relevant information, without violating data protection issues. Also, the author likes to note that research on mini campuses has been triggered by the original idea of establishing an international mini campus in a Chinese business park together with a partner university. The respective research idea had been repeatedly funded by BayChina, the Bavarian Academic Research Center for China located at Bayreuth University, Bavaria, Germany.

AUTHOR'S INFORMATION

Dr. Norbert Kaiser ist Professor for Corporate Planning and Organisation, Innovation & Technology Management and Business Excellence at Ansbach University of Applied Sciences (Ansbach UAS). His working fields are Strategic Management, Innovation and Performance Management, both on corporate and regional level. Over decades Norbert Kaiser has carried out a lot of strategic applied (R&D) projects for business support organisations, technology clusters and his home university fostering innovation in organisations and the Nuremberg Metropolitan Region. Norbert Kaiser has been one of the authors for Ansbach UAS's strategic founding concept in 1996, and had been responsible in the past as the University's Vice President for aR&D and Transfer for over 10 years. Due to his international orientation he is Chief Executive Director of the University's Institute for International Strategy Projects (ISP), focusing in his studies e.g. on Science and Technology Parks in the Digital Age. Besides his scientific work and publications Norbert Kaiser assesses the performance of public and private organisations as an EFQM Global Award Assessor.

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