Supernova stars in knowledge-based regions

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SUPERNOVA STARS IN KNOWLEDGE-BASED REGIONS

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Abstract

The process of value creation out of the acquisition, transfer and exploitation of scientific knowledge has become a major challenge for developed economies. Knowledge institutions like universities and R&D centres are important actors in this context. This paper will offer a novel contribution to the assessment of the regional-economic importance of local and regional knowledge centres in the Eastern part of the Netherlands (provinces Gelderland and Overijssel) by exploring the potential benefits of supra-regional synergy that may arise through an alliance of three important distinct regional knowledge clusters (a 'supernova star'), viz. the Technology Valley, the Food Valley and the Health Valley. We will evaluate their performance using the multi-parameter TPN model, to identify the key handles for regional innovation policy. Through a strength-weakness analysis the relative strengths of each of these knowledge clusters will be investigated, and explore whether a strategic alliance of the three knowledge clusters in the form of an integrated knowledge triangle (a 'supernova star') may create significant network economies. The paper will be concluded with some policy recommendations.

Key words: Regional innovation; Knowledge-workers, Clusters; Technopolicy Network model; Creative hotspots; Islands of innovation; SWOT analysis, Supernova Clusters, Regional Economy, Knowledge Valorisation, Benchmarking

1. Sages and Knowledge-workers

In both ancient and modern times, science has played a prominent role in the development of culture, technology and society. In the ancient Roman world, scholars were treated with much more respect, to the extent even that in old Rome laymen and unskilled handicraftsmen were not allowed to live in the same street as a learned man. Sages were surrounded with dignity and esteem, as they were able to reveal universal truth and scientific principles that were not yet heard of before. Reflective thinking by scholars was highly regarded; its direct relevance for the economy was considered to be less important.

In our modern times, the orientation of scientists has drastically changed. Knowledge has become much more instrumental, i.e., focussed on the solution of predefined practical problems. Even curiosity-driven research – or serendipity-driven or blue-sky research – is often defended on the grounds that it may generate unplanned, but nevertheless useful results. Consequently, there is a vast difference between the modern concept of a 'knowledge-worker'– employed to create useful output from his/her scientific skills – and a 'sage' or 'scholar'– appreciated because of his/her intellectual abilities in generating brilliant ideas.

This development has had drastic consequences for regional development policy. While the localisation of academic centres (universities, colleges) was in the past a matter of regional or local prestige and recognition, nowadays such knowledge centres are seen as strategic vehicles for creating added economic value and a competitive economic edge for the area concerned. The knowledge sector has become an instrument of regional development policy.

The present paper aims to offer a novel contribution to the assessment of the regional-economic importance of local and regional knowledge centres by exploring the potential benefits of supra-regional synergy that may arise through an alliance of distinct regional knowledge clusters (a 'supernova star'). To that end, we will first offer a concise overview of cluster principles in regional development policy, from the perspective of a knowledge-driven regional economy. Next, we will introduce a case study from the Eastern part of the country, namely from the border provinces Gelderland and Overijssel. These provinces house three important knowledge clusters, viz. the Technology Valley in the Twente region in Overijssel (with Twente University of Technology as a pivot), the Food Valley in the Greater Wageningen region in Gelderland (with Wageningen University as a main pivot), and the Health Valley in the Greater Nijmegen region in Gelderland (with the Radboud University in Nijmegen as a central pivot). We will then investigate through a strength-weakness analysis the relative strengths of each of these knowledge clusters, while we will next explore whether a strategic alliance of the three knowledge clusters in the form of an integrated knowledge triangle (a 'supernova star') may create significant network economies. The paper will be concluded with some policy recommendations.

2. Clusters and Supernova Clusters in the Regional Economy

Regional development policy has always been strongly influenced by advantages of spatial concentration and density. They appeared in the literature with different names, such as scale advantages, localization advantages, urbanisation advantages, agglomeration advantages, proximity externalities, and so forth. And they also led to a variety of distinct concepts, such as Marshallian industrial districts, industrial complexes, growth policies, 'filières', innovation clusters, knowledge nodes and the like. The literature on these phenomena is abundant.

A very informative and rather comprehensive overview of the literature on regional clusters can be found in a recent article by Cruz and Teixera (2010). These authors have systematically analysed hundreds of scientific contributions to spatial cluster thinking. They aim to offer a conceptual clarity by distinguishing the great diversity in cluster definitions according to a systematic typology comprising 'spatial proximity elements' and 'knowledge and network elements'. They were also able to position the cluster literature in various domains, such as agglomeration theory, knowledge-based theory, innovation systems theory, regional development theory, social network theory, institutional and evolutionary theory.

The rising interest in spatial clusters originates from several background factors, in particular, the need for strong and innovative footholds of competitiveness in a globalizing world, for mobilizing all entrepreneurial and knowledge forces through spatial concentration and network externalities, and for coping with the global economic crises through economic and technological synergy at local and regional levels. 'Smart' regional policy exploiting all knowledge resources in a regional system has, therefore, become a new mission (see also Dill and Van Vught 2010)

This new trend is not an isolated movement, but may be seen as a logical and necessary consequence of the new innovation thinking that started already in the end of the 1970s (see e.g. Nelson and Winter 1977, Dosi 1982, Freeman 1982, Lundvall 1992a and Edquist 1977). It culminated in an avalanche of conceptual, applied, and policy-oriented studies on knowledge-oriented innovation in the past decades (see e.g. Acs et al. 2002, Capello and Nijkamp 2009, or Nijkamp and Siedschlag 2011). New concepts like national (or regional) innovation systems were introduced as well. In many cases, a plea was made for selective innovation strategies based on, e.g., key domains, core clusters or break-though technologies.

The concept of national innovation systems – later on followed by the concept of regional innovation systems – has already a history of more than two decades. The concept originated from an inclusive and systemic view on innovation, in which institutional support systems played a central, but endogenous role in generating and disseminating new technologies (see Freeman 1995, Lundvall 1992b, and Nelson 1994). This idea of interconnected private-public innovation

systems was subsequently extended to the regional scale (see Cooke and Morgan 1998, Asheim and Gertler 2005, and Niosi 2010).

In general, cluster concepts of various kinds appeared to play a role in many policy studies (see in particular Porter 1998, 2003). These clusters were not necessarily based on geographical concentrations of identical activities, but increasingly on economic diversity through complementary activities, often connected by means of knowledge-oriented networks or liaisons. Such economic-technological constellations were mainly the outgrowth of scale advantages, transactional externalities, flexibility advantages and innovation returns. Consequently, many regional clusters obtained a thematic focus around a few selected core industries (e.g., mico-ecolectronics, life sciences, ICT, medical technology, materials technology, and so forth). Such regional clusters are instrumental in achieving a competitive edge in innovation strategies, even on a world-wide scale. There appears to be indeed a positive relationship between regional specialisation (in terms of the degree of economic-technological clustering) and innovation performance (measured, e.g., in terms of the number of patents) (see European Cluster Observatory, 2010).

Clusters are thus based on specialized knowledge, open access to information and industrial networks, a strong liaison with academia and R&D centres, a proper understanding of the market (both local and global), and a world-wide outreach. Only in this way can they be instrumental in creating the critical conditions for the birth of new firms, for the retention of incumbent firms, and for the acquisition of existing bossiness from elsewhere. Clusters are essentially based on strong interfaces between human, social, business and territorial capital, and they are essentially the parade-horses in regional development strategies. They are contemporary appearances of industrial districts and are sometimes also called islands of innovation (see Cooke et al. 2000, Kourtit et al. 2011).

With the rising importance of regional technology and growth clusters in a globalizing economy and with the mounting pressure on eve more competitiveness and innovativeness as a result of the global economic crisis, regional clusters have to seek for novel strategies to enhance their performance and outreach. In a recent study (see Kourtit et al. 2011), the idea has been launched to create linkages and synergies – both functionally and managerially – between different but mutually complementary regional clusters (or islands of innovation), so as to create higher-order economies of scale through strategic alliances and cooperative arrangements (coined ‘creative hotspots’). This new technology model would then connect regional ‘stars’ into a more comprehensive ‘supernova star’ network that could in principle become a leading knowledge, innovation and technology initiative – marked by thematic pluriformity – on a world-wide playing field.

Such a meta-strategy for regional innovation policy might even be further reinforced by seeking for smart liaisons between such a creative hotspot and lower-order technology centres (in the form of a core-satellite hierarchy model forming a ‘supranova star’), so that even more network economies might be generated. This model could then be described as follows. The ‘creative hotspot’ is based on a distinct network of thematically organized technology and innovation clusters (including knowledge institutes and innovative businesses) in a geographically confined space that has a wide variety of positive scale, agglomeration and network externalities regarding both corporate activities and shared knowledge creation. A satellite cluster has a smaller and more focussed scale that may be strengthened by strong liaisons with a cluster or a creative hotspot, inside or outside the relevant region or country. In a landscape with geographically distributed, but thematically aligned knowledge, innovation and technology initiatives and activities, such cluster agglomerates will arise as a network constellation between a creative hotspot (‘supernova star’) and functionally connected sub-clusters (satellites). The advantages of these agglomerates is that they strengthen the interaction on an inter-cluster basis, so as to serve common interests of a broad knowledge, innovation and technology initiative and to create a visible constellation of such an initiative towards the outside world. For regional (or supra-regional) policy, this allows to combine broad national thematic technology stimulation plans and regional cluster-based stimulation plans into one coherent master plan and to align these to (supra-) national innovation systems plans. The previous ideas can be visually represented as follows (see Figure 1).

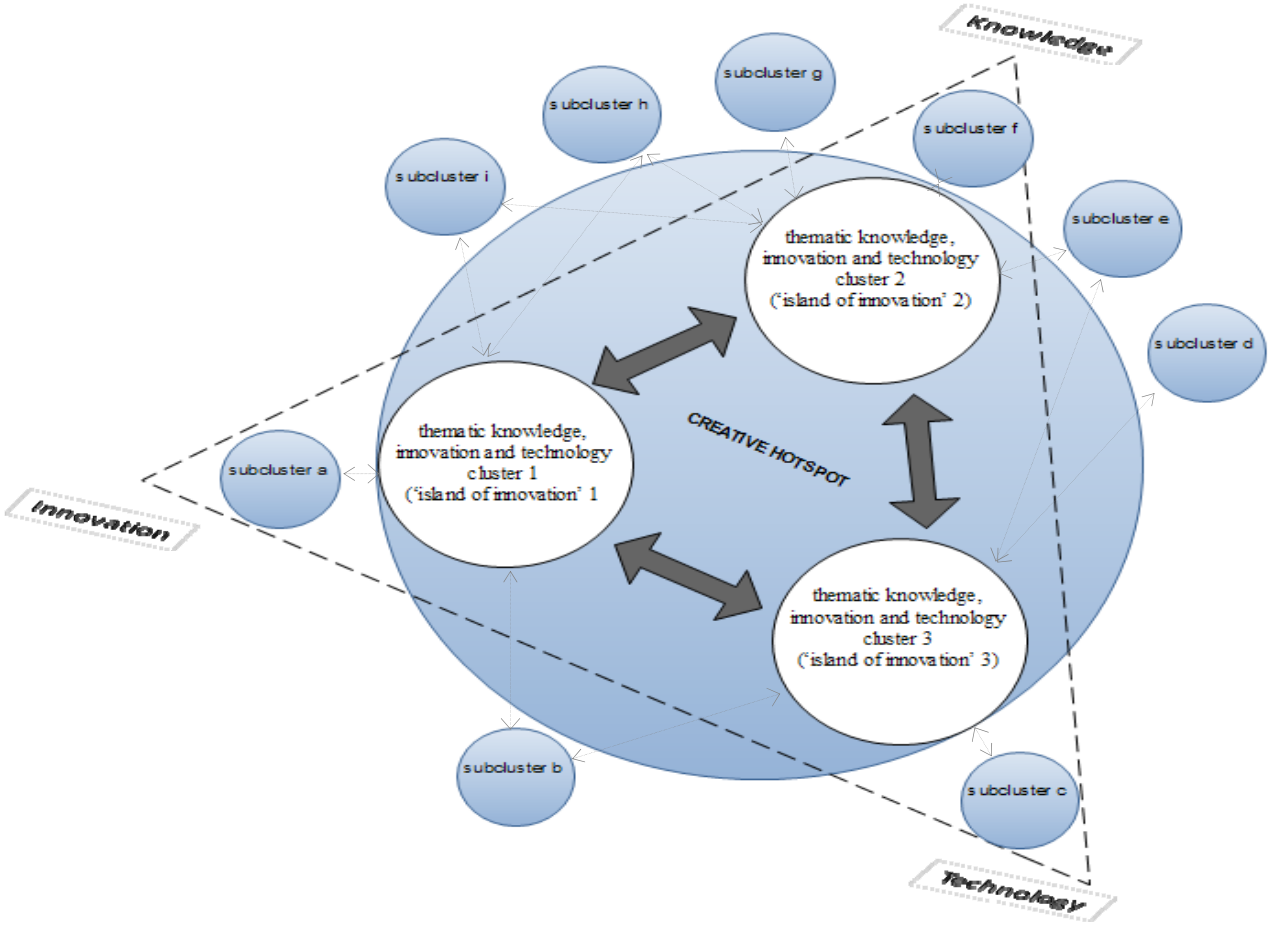

Figure 1. 'Supernova star' of knowledge, innovation and technology constellation

3. Shared Knowledge = Multiplied Knowledge

Knowledge is the only resource that – if shared and used – is not depreciated, but enhanced both substantively and functionally. Free access to knowledge is often considered as a sine qua non for many regional or local innovation initiatives (see Van Geenhuizen and Nijkamp 2011). In the past discussion of the critical success factors for innovation, various analytical frameworks have been put forward. It is increasingly recognized that the traditional *linear and closed innovation model* – in which knowledge centres are generating and transmitting new or existing knowledge through a downward filtering process to potential users or the market – has become an outdated concept. R&D – and its resulting technological innovation – is not 'manna from heaven', but is the result of a mix of technology push and demand pull factors.

This awareness has led to the concept of *open innovation systems* which are based on a close and structural interaction between knowledge generation and knowledge implementation. The market is then not the end of the pipeline, but forms an integral part in the creation, dissemination and application of new knowledge (see Chesbrough 2003). The open innovation paradigm presupposes flexible mechanisms for public-private collaboration, private business involvement and commitment at the local level, and open access and use of publicly available

knowledge. Consequently, more business opportunities at a local or regional scale may arise as a result of an appropriate open regional innovation system. In this context, the role of knowledge institutions is critical, as they may act as a liaison to innovative industries (e.g., through joint ventures or participation in incubators).

The open innovation concept has prompted new ideas on valorisation of knowledge – i.e., the process of value creation from scientific knowledge – through open filters between demand for and supply of knowledge. This process may enhance the societal benefits of knowledge, either for business or economic purposes (commercialisation of knowledge) or for general community purposes (externalisation of knowledge). In all cases, valorisation of knowledge leads to improvements of products or services or to innovations in goods or managerial processes. It is evident that academic research centres are a powerful driver of a modern knowledge-based society. Since much research findings are paid with public money, an interesting debate has emerged on the interface and competences of the public vis-à-vis the private sector (see also Van Looy et al. 2004). Various models on liaisons between universities and private sector initiatives have been materialised in the past decade, such as Silicon Valley around Stafford University, the Greater Boston Region around Harvard University and MIT, the Cambridge Science Park (UK), Sophia Antipolis (France), of the High-Tech Campus in Eindhoven (the Netherlands). In all such cases, valorisation has led to significant (socio-) economic benefits in the form of high-tech jobs created through spin-offs, patents, licencing, pre-seed investment funds, venture capital, business angels or incubator initiatives. As a more general phenomenon, we observe nowadays in many universities the foundation of TTOs (Technology Transfer Offices), which act as a liaison between public and private sectors through a process of information transfer, communication, trust building and joint initiatives among partners. In this way, collaborative partners are much better able to capture and exploit the benefits from research and knowledge in higher education institutions, with revenues for both sides. For the region as a whole, such initiatives encourage the birth and growth of science-based enterprises that are responsible for new job and wealth creation.

Furthermore, the emergence of regional key-innovation clusters calls for a solid and trustworthy cooperation between all partners involved, in particular, industries, universities and governments. This awareness has prompted the popularity of the well-known Triple Helix concept (see Etzkowitz and Leydesdorff 1997). By pooling all resources of these three categories of partners, a significant added value and competitive advantage may be achieved (see also Van Hemert et al. 2010), especially for strategically identified knowledge, innovation and technology clusters.

In conclusion, the success conditions for knowledge-led regional growth comprise intellectual capital (i.e., advanced and open-access knowledge institutions), entrepreneur capital

(i.e., the presence of risk-taking entrepreneurial agents with a strong sense for the 'animal spirit' of innovative businessmen), financial capital (i.e., a sequence of pre-seed investment funds, seed investment funds, venture capital funds, and private equity funds), social capital (i.e., open network constellations of all relevant partners inside and outside the region), and territorial capital (i.e., all physical facilitating infrastructures or flanking facilities that support innovative activities at a competitive edge, such as ICT facilities or transport facilities).

4. Case description of Interconnected Knowledge Regions in the East-Netherlands

The provinces of Gelderland and Overijssel in the Eastern parts of the Netherlands have three important and recognized knowledge institutes, viz. Twente University of Technology (in Overijssel), Radboud University and Wageningen University and Research Centre (in Gelderland), with three important cluster initiatives of very high innovative and economic content: Health Valley (Nijmegen region), Food Valley (Wageningen region) and Technology Valley (Twente region) (see Figure 2).

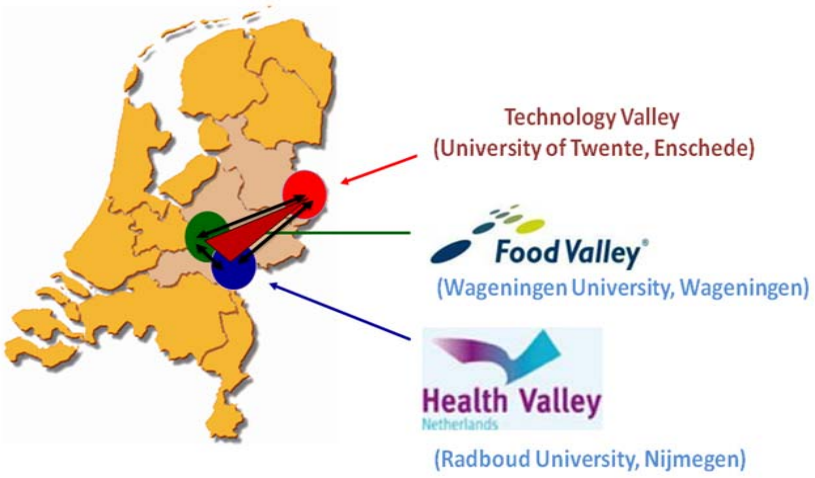

Figure 2. The three important knowledge-intensive clusters initiatives in the East Netherlands

The alliance of these three cluster initiatives as a cooperative network is sometimes coined the East-Netherlands 'Triangle', with a central theme around the concept of 'healthy people'. In the next we will evaluate their performance using the multi-parameter TPN model, which is represented in a form in Figure 3. This model is constructed to identify the key handles for regional innovation policy (see also Nijkamp et al. 2011).

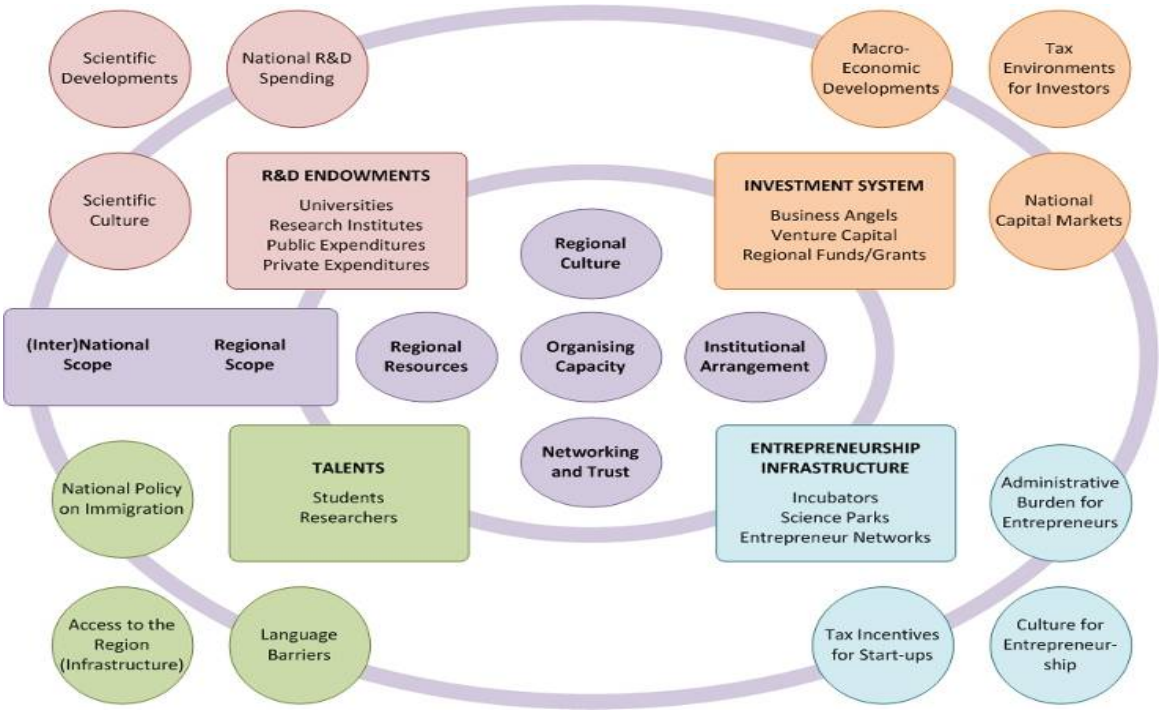

Figure 3. TPN Model

4.1 Health Valley TPN analysis

The Health Valley is situated between the University of Twente and a town called Oss with the University Medical Centre (UMC) St. Radboud in Nijmegen as a central junction, which has a regional specialization in theoretical physics and medical science. The important regional innovation actors in Health Valley are Nijmegen University, UMC St. Radboud, University Twente with its many spin-offs, the cluster organization Health Valley, and the multinationals NXP and MSD. Where the highest intensity of cooperation takes place between UMC St. Radboud and the University of Twente linking the studies of technical medicine and the med-tech institute MIRA in Twente with the UMC in Nijmegen.

TPN results of Health Valley

Figure 3 represents the output of a TPN analysis focused on 7 critical success factors, such as Public R&D, Private R&D, Talent, Public Investment Capital, Private Investment Capital, Entrepreneurship facilities, and Organizing Capacity, for the Health Valley cluster initiative (the island of innovation), as compared with the Triangle (the creative hotspot).

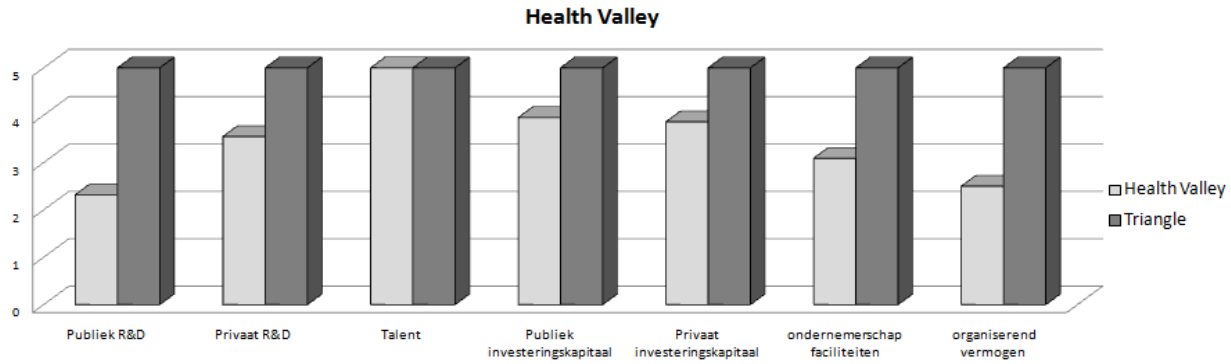

Figure 3. Health Valley TPN analysis

The Health Valley has a disproportionate share from the multinational NXP (former Philips Semiconductors) (*'private R&D')*. Through the presence of Radboud University Nijmegen, it benefits of a high level of vocational and education institutes of approx. 46,000 students and 7,000 employees (See Appendix A and B), and a high total economically active population with higher education qualifications of 41 per cent in the cluster (*'talent'*). Unfortunately, because of the small-sized science park, the incompletely integrated services in the incubators, and low number of employees per cluster organization, *'entrepreneurial facilities'* and *'organizing capacity'* stay behind in this cluster initiative. However, with the arrival of the new Novio Tech Campus and a second Life Science incubator of the UMC, the impact on these factors will be improved considerably.

Based on a qualitative and quantitative stakeholders analysis various findings are briefly summarized in the context of a systematic SWOT (Strength-Weakness Opportunities-Threats) analysis for 7 key domains of interest for the innovation economy in the region Nijmegen and the cluster initiative Health Valley (see Table 1).

Table 1. A systematic overview of the various effects of the Health Valley

Strengths S1: Large University Medical Centre (~7000 employees) S2: New Strategy Med-Tech Highway, connecting Twente, Nijmegen and Eindhoven in the Med-Tech field S3: Clear commitment of University Medical Centre to vlorization of scientific research and contribute to regional economic growth S4: Technical medicine is a new academic study developed as a collaboration between Twente and Nijmegen. This is a world-wide unique discipline with great potential S3: Clear commitment of University Medical Centre to vlorization of scientific research and contribute to regional economic growth S4: Technical medicine is a new academic study developed as a collaboration between Twente and Nijmegen. This is a world-wide unique discipline with great potential	**Weaknesses** W1: Limited Med-tech development within the valley; therefore strongly dependent on technology from Philips (Eindhoven) and Twente University W2: No common vision on strategic position of university complex W3: Weak industrial basis in direct vicinity of the university; no well developed Science Park
SWOT	
Opportunities O1: Open innovation initiatives with Philips and Siemens Medical Systems, may generate economic spin-off O2: Coupling the med-tech highway concept with the national innovation agenda will make it the leading med-tech initiative in the Netherlands	**Threats** T1: Twente and Nijmegen universities need become the central axis in the med-tech highway concept, but have very different cultures in terms of applied research & knowledge valorization

4.2 Food Valley TPN analysis

The Food Valley is a cluster initiative with a strong regional basis in the southwest part of the Gelderse Valley and strong innovation initiative in the agricultural and food sector. Where important actors for regional innovation in the Food Valley such as Wageningen University and Research Center (WUR), Top Institute Food and Nutrition, NIZO Food research are connected.

TPN results of Health Valley

Figure 4 represents the output of a TPN analysis for the 'Food Valley' as compared with the Triangle

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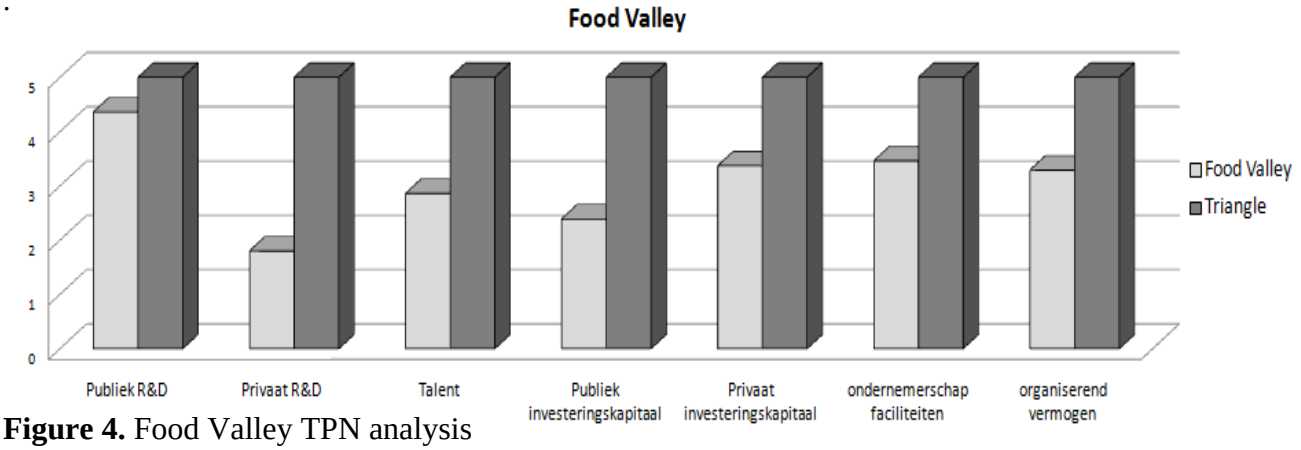
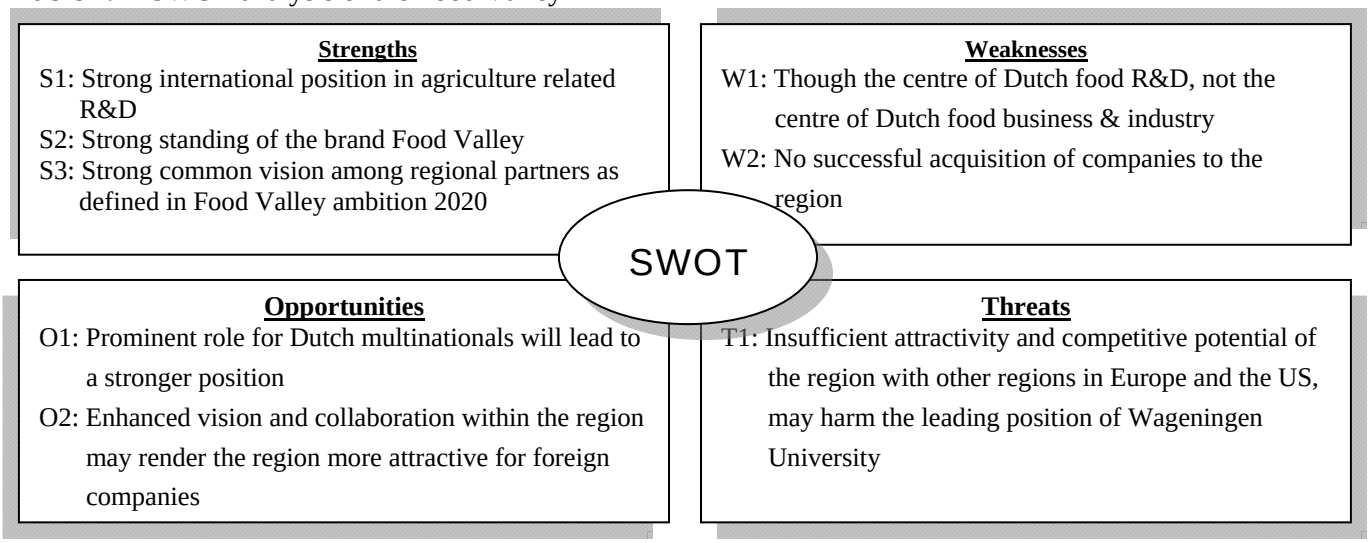


Figure 4. Food Valley TPN analysis

The Food Valley takes a unique position being the Netherlands' only agricultural university, which receives major R&D funding from two ministries, viz. science and education and agriculture (public R&D expenditures of approx. € 520 M). The Food Valley is the centre of public R&D efforts, but of lacks large industrial actors (such as Danone R&D centre (former Numico), Unilever, DSM) in the region, the private R&D efforts are much more evenly distributed throughout the country. With a small-sized university, it has less than 7500 students and only a few large employers in both the public and private domain, which explain the low graduate retention in the region of 33 per cent (See Appendix Table A and B). Finally, the university has a well developed knowledge valorization culture, a well-regarded cluster management organization and sufficient access to angel and venture capital in terms of 'organising capacity', 'entrepreneurship facilities' and 'private investments'.

In Table 2, various findings are briefly summarized in a SWOT analysis of interest for the innovation economy in the region Wageningen and the cluster initiative Food Valley.

Table 2. A SWOT analysis of the Food Valley



4.3 Technology Valley TPN analysis

The Technology Valley is concentrated in the network city Twente with Enschede, Almelo, Hengelo, Borne and Oldenzaal. Where important actors for regional innovation in the Technology Valley such as University of Twente with its MIRA and MESA+ institutes, the Knowledge Park Twente (with over 700 university spin-off companies), Innovation Platform Twente, and multinational industries (e.g., Ten Cate, Thales) are connected. The thematic focus of the region is only partly aligned with the thematic focus of the university that defines nanotechnology, medical technology, ICT and process technology as its core activities.

TPN results of Technology Valley

Figure 5 represents the output of a TPN analysis for the 'Technology Valley' as compared with the Triangle hotspot.

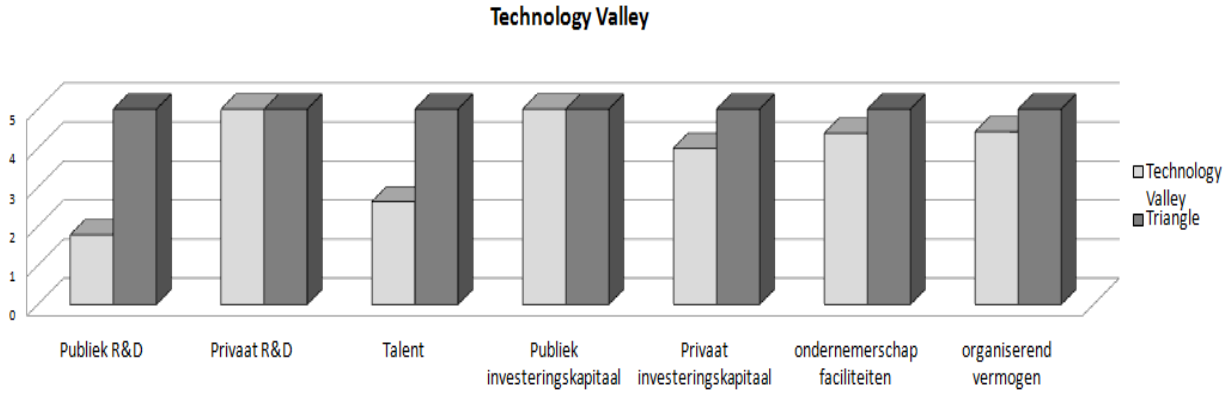


Figure 5. Technology Valley TPN analysis

There are only a few large research institutes in the 'Technology Valley' with a substantial contribution on total public R&D, given the small-sized University of Twente with public R&D expenditures of approx. € 171 M and less than 9,000 students, which explain the lowest graduate retention in the region of 24 per cent. However, because of the high contribution of multinationals in the region, it benefits from their private R&D efforts and 'public investment capital' investing in interesting ideas and entrepreneurs and investing in a proof-of-concept, a solid business plan. This means that there is a healthy and intensive entrepreneurial culture in Twente that will be improved through a future technology fund. Finally, because of a relatively high level of employees in organizations such as 'Kennispark' and IPT, a better strategic alignment of tasks between these organizations can improve the innovation performance and organizing capacity in the Technology Valley and can ensure a sustainable competitive advantage in a dynamic environment

In Table 3, various findings are briefly summarized in a SWOT analysis of interest for the innovation economy in the region Twente and the cluster initiative Technology Valley.

Table 3. A systematic overview of the various effects of the Technology Valley

Strengths	Weaknesses
S1: Very successful spin-off strategy: ~700 spin-off companies from the University S2: Entrepreneurial mentality amongst professors and researchers S3: Intensive collaboration between University, Municipality and Province to promoting regional innovation S4: Interdisciplinary research institutes of the University in line with international trend of cross-disciplinary	W1: No single thematic focus point W2: Spin-off companies do not make the Gazelle leap W3: Regional industry and university not yet fully aligned W4: Limited pool of marketing and commercial talent as required for the success of high-tech starters
Opportunities	**Threats**
O1: University is increasingly involved in Open Innovation collaborations with multinationals in the region and beyond (Boeing, Siemens, Thales and ten Cate) O2: A focus on Med-Tech and Nanotechnology allows a sharper profiling of the university and the region O3: Commitment of regional industry and focussed investment capital can stimulate Gazelle leaps of young starters	T1 Absence of a thematic focus makes the region less attractive both to businesses and (inter)national top researchers T2: The many actors and stakeholders in the regional innovation area render the system diffuse and potentially less efficient

SWOT

4.4 Scientific bilateral collaboration within the Triangle

In this section we will concisely assess synergy and collaboration within the Triangle hotspot of recognized knowledge institutes universities. The TPN Model also can be used here for further research on regional innovation performance regards the scientific bilateral collaboration within the Triangle.

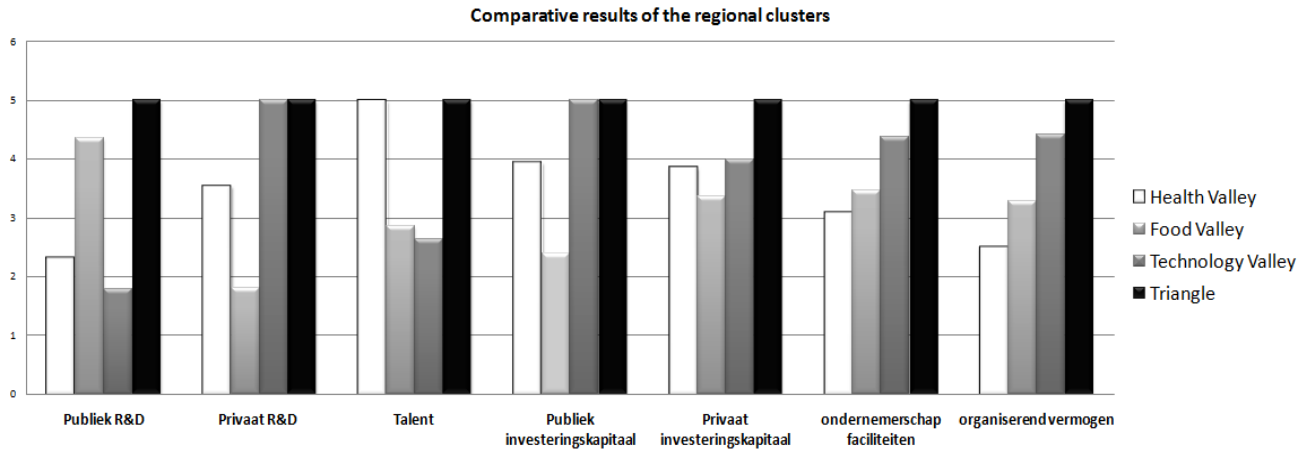
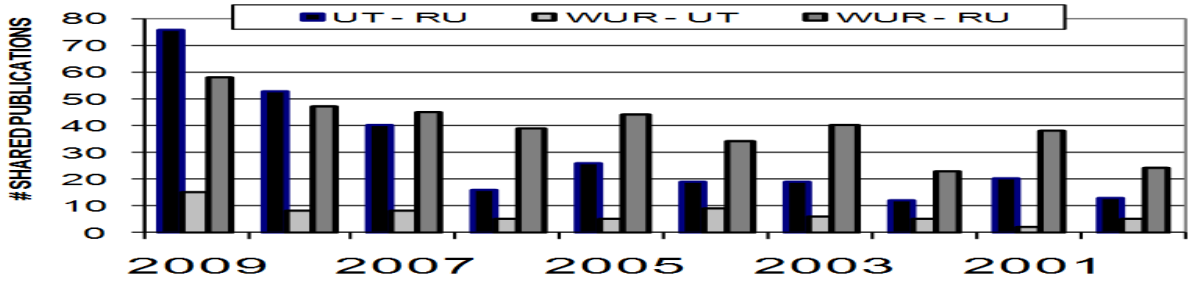


Figure 6. Relative comparison between three clusters, Health Valley, Food Valley and Technology Valley

Figure 6 shows that Food Valley (FV) outperforms the other Valleys on *public R&D'*, because of the many research institutes in the area and the significant contribution of DLO to

public investments; followed by Health Valley (HV), because of the big university, incl. UMC, and which receives more public facilities. Furthermore, because of a high level of well-educated people in the region HV outperform other regions on *'talent'*, but because of the small-sized science park, and the incompletely integrated services in the incubators it and stays behind on *entrepreneurial facilities'*. The Technology Valley (TV) scores relatively high on '*private R&D'*, because of the high contribution of multinationals in the region with substantial private R&D facilities. And because of an increased number of pre-seed and seed funds this region provided each year, and with its large science park it scores high on '*public investments capital*' and *'entrepreneurial facilities'* . This highlighted the innovative and entrepreneurial characteristics of TV. However, the impact of the factor can be improved considerably for HV with the arrival of the new Novio Tech Campus and a 2e Life Science incubator of the UMC. And TV benefits more from the 'organizing capacity' compared to HV, because of a relatively high level of FTE of Kennispark and IPT. Next, because of the insufficient translation of the relative high quality of scientific capacity to attract private R&D to the region, the FV stays behind on *'entrepreneurial facilities'*.

Further, Figure 7 presents results of a scientific collaboration within the Triangle, between Wageningen and Nijmegen (WUR-RU), Twente and Wageningen (UT-RU), and Twente and Nijmegen from 2001-2009.



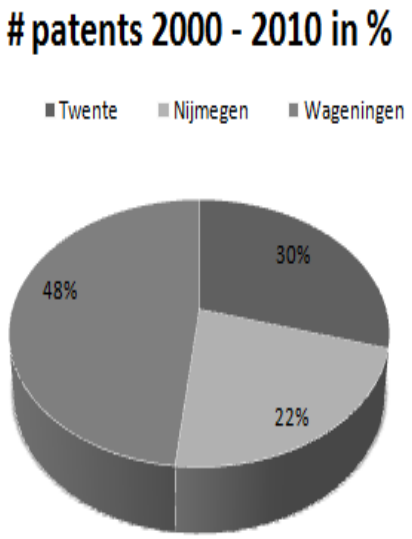
Source: ISI Web of Knowledge

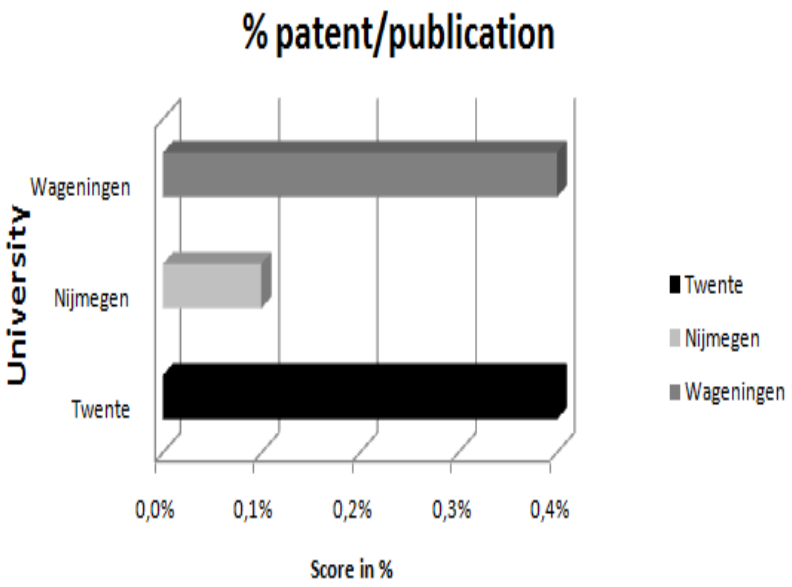
Figure 7. Scientific collaboration within the Triangle

Figures 7 shows the most important themes of inter-university collaboration, where collaboration between Wageningen and Nijmegen (WUR-RU) occurs especially in the area of Biochemistry and Ecology. Collaboration between Twente and Wageningen (UT-RU) expected in the field of biofuels and with a synergy in the field of nanotech and food. And where Twente and Nijmegen collaboration is enhanced in the field of Medical Technology.

Further, Figure 8 shows that both Twente University and Wageningen University have four times more patents per publication than Nijmegen University. This may partly be explained by the fact that the majority of studies of the universities of Twente and Wageningen are

concentrated in the field of natural sciences, while Nijmegen University also, amongst other, has a philosophy, arts, theology and law faculty (Figure 9). Thus, Twente and Wageningen have a much stronger focus on applied research involving private partners in contrast with Nijmegen, for which patents are a good indication.


patents 2000 - 2010 in %
Twente
Nijmegen
Wageningen
30%
48%
22%


% patent/publication
University
Wageningen
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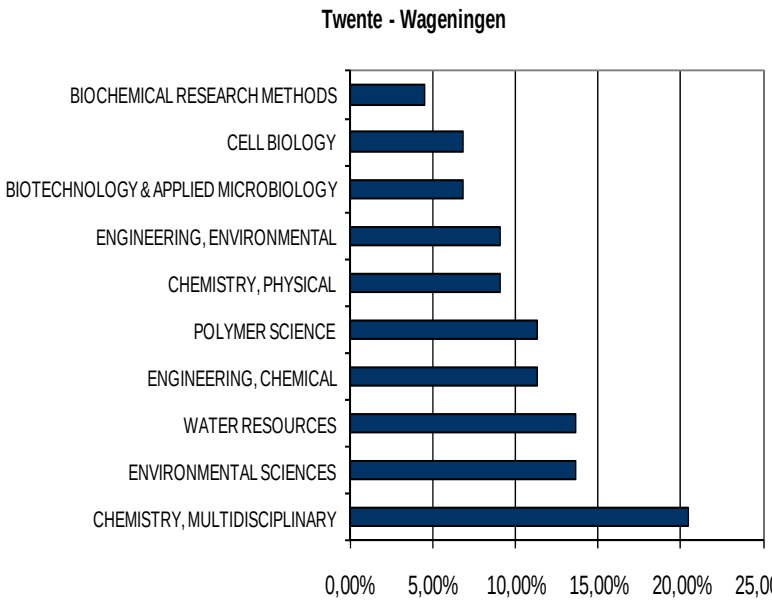
Twente - Wageningen
BIOCHEMICAL RESEARCH METHODS
CELL BIOLOGY
BIOTECHNOLOGY & APPLIED MICROBIOLOGY
ENGINEERING, ENVIRONMENTAL
CHEMISTRY, PHYSICAL
POLYMER SCIENCE
ENGINEERING, CHEMICAL
WATER RESOURCES
ENVIRONMENTAL SCIENCES
CHEMISTRY, MULTIDISCIPLINARY
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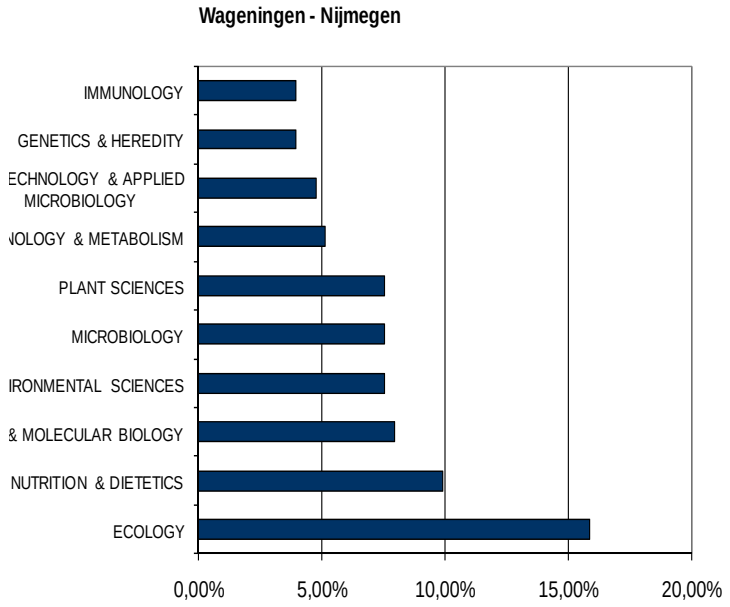
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GENETICS & HEREDITY
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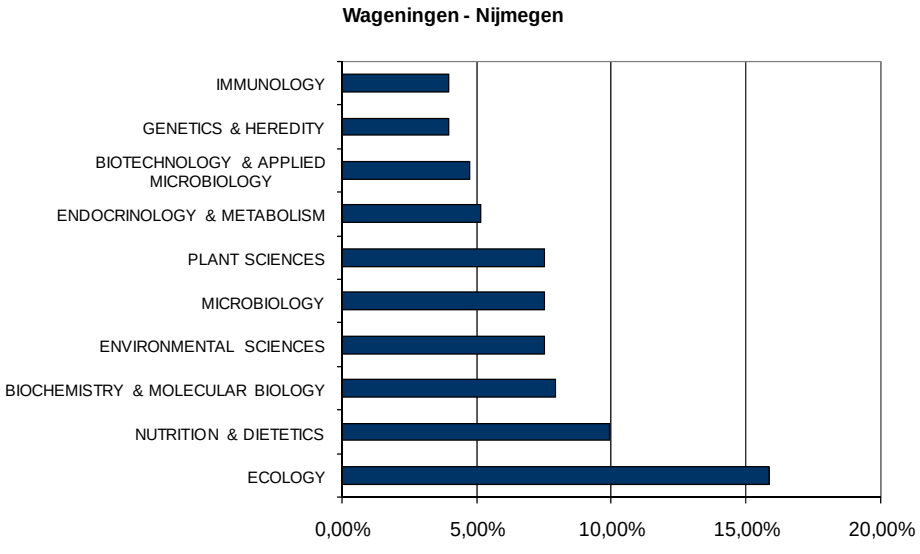
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Figures 9. Triangle top-10 themes publication cooperation (2005 – 2010)

A similar picture appears from Table 4, where Twente and Wageningen both hold a higher ranking when it comes down to public-private research publications and more public-private research collaborations than Nijmegen, and where Twente is in the top 10 of the world regarding public-private publications in this field. Both, Twente and Wageningen have a strong focus on applied research, knowledge valorization and entrepreneurship stimulation.

Table 4. Research Cooperation Scoreboard based on % public-private research publications

University	All Sciences	Physics and Math	Medical and Health sciences	Life Sciences and Agriculture	Engineering-Science and ICT	Social and Behavioural Science
Twente	11-25	51-100	1-10	1-10	101-200	51-100
Nijmegen	201-300	101-200	201-300	51-100	301-400	26-50
Wageningen	26-50	101-200	400+	1-10	400+	201-300

Source: CWTS University-Industry Research Cooperation Scoreboard 2009-2010

In conclusion, efforts to increase collaboration within the Triangle hotspot at university research level are beginning to bear fruit. The main strategic point of attention here is the high level of diversity within the Triangle, in terms of geography, education, motivation, segmentation, creativity, innovation, cluster, experience, and scientific and business scope, which has further enhance trade, enforce contracts, and expand cooperation and collaborations between different knowledge intensive institutions (not identically, diversity in focus on scientific business fields) within the national key areas.

The current national policy of national key areas and “peaks” have a few intrinsic disadvantages, namely the national key areas not specifically focused on geographical concentration of national strengths and the peaks do not give status to less developed clusters elsewhere in the country. These two approaches lead to fragmented policy; on the one hand national perspective, and at the other hand cluster perspective. A solution would be a network of clusters which are related to ‘key innovation areas’, which consists of one leading cluster, the core cluster, and related satellite clusters in the In de ‘Triangle’-strategy. Where the core cluster would be characterized by a strong knowledge base and a large amount of company activities in a thematic field, and among the strongest also within Europe. And where the satellite cluster will have linkages between companies and knowledge institutions that are connectable to one or more core clusters (key areas) within the country or Europe.

However, satellite clusters may have their own identity and specialization, but do not have special comparative advantages (in terms of relative position and volumes) as core clusters have. Crucial is that if attachment to one or more core clusters outside the region is not possible, the cluster should not acquire status of satellite cluster, and not be stimulated by innovation policies.

And with respect to the possible satellite clusters, the next options need to face challenges of East Netherlands that contribute to its success and selective (urban) regional policy activities such as: (1) energy- and milieu technology related to ETP 'Biofuels' and KIC ' Inno Energy'; (2) Nanomaterials related to key areas 'High Tech Systems' and 'Materials' (viz, M2I), and ETP 'Advanced Engineering Materials and Technologies'; (3) Pharma, related to Top institution Pharma and to JTI IMI ('Innovative Medicine Initiative'); and (4) Chemie related to key area 'Chemie' and to ETP 'Sustainable Chemistry'. All these opportunities have to do with improving and enhancing their regional innovation performance regards the scientific bilateral collaboration within the Triangle, and outreach.

5. Benchmarking Three International Regions

The prior results of the performance of the hotspot in East Netherlands provide a proper basis for comparing their performance with three other hotspot regions in Europe that are comparable in innovation focus (Flanders and Oresund), country (north Brabant), and nr. of inhabitants (Oresund & North Brabant), in order to understand the potential of the region under consideration. To offer a systematic overview of a comparative analysis of the various performance effects of East Netherlands against three other most dynamic regions in Europe it is meaningful to use again a TPN model. The most dynamic regions in Europe are Øresund (a geographical and economic) region covers the South of Sweden and the East of Denmark, Noord-Brabant (a region in South Netherlands with Eindhoven as its most important science- and innovation base) and Flanders in Belgium (see Figure 10).

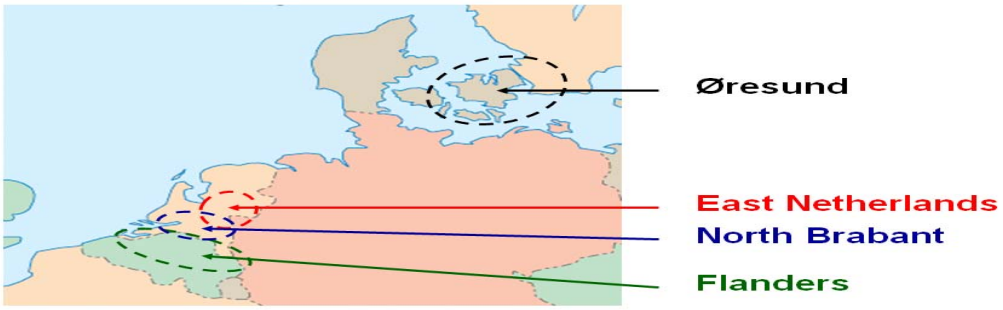

Figure 10. Benchmarking three regions

Based on the findings, a comparison can now be made in terms of the (potential) performance of the hotspot in East Netherlands with the three other hotspot regions using TPN model for an analysis. Figure 8 depicts the results of the results of the multi-parameter TPN analysis of the four regions.

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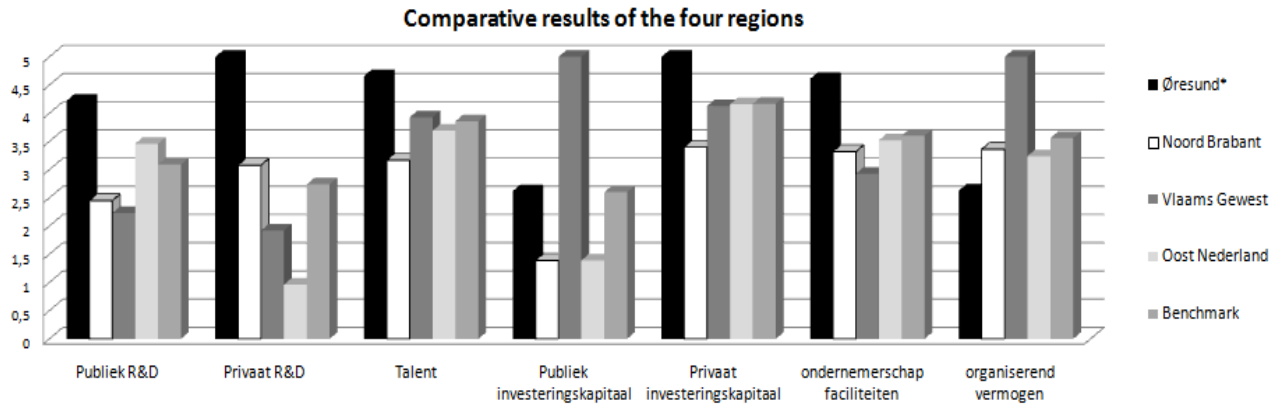

Figure 11. Comparative results of the four dynamic regions Øresund, Noord-Brabant, Flanders and East Netherlands

Figure 11 presents comparative results of the four dynamic regions, and show that there are many universities in Øresund with a substantial contribution on total public R&D, and the availability of high public R&D investments in research institutes in East Netherlands, as compared with the other regions. However, because of the few large multinationals that contribute significantly to private R&D in the region, East Netherlands benefits less from their private R&D efforts and 'public investment capital' investing, where Øresund (approx. € 5,010 M)) and Noord-Brabant benefits more because of the many large multinationals in these regions. And, Flanders benefits highly from the availability of large funds (approx. €836 M) compared to the performance of East Netherlands and Noord-Brabant.

Finally, with a high number of employees in the financial sector in Øresund, the region benefits best from a high '*private investment capital'* and *'entrepreneurship facilities'* with a presence of 8 Science Parks. Where Noord-Brabant has a less well-regarded cluster management organization and insufficient access to angel and venture capital in terms of 'organising capacity' and 'private investments'. And because of the high number of employees and better strategic alignment of tasks, Flanders outperforms the other three regions on *'organizing capacity'*.

6. Knowledge Valorisation of Supernova Stars

The process of value creation (commercial value, societal value) out of the acquisition, transfer and exploitation of scientific knowledge has become a major challenge for developed economies. Knowledge valorisation may lead to competitive products, services and processes. Knowledge institutions like universities and R&D centres are important actors in this context. The interface between knowledge institutions and business has world-wide led to successful innovation clusters, such as Silicon Valley, Cambridge Science Park, Sophia Antipolis, Leuven or Zurich. The success of this business model is normally measured by the number of spin-offs,

the number for patents, the licensing of patents, or the volume of contract research. Valorisation presupposes an effective support infrastructure, in particular TTOs (Technology Transfer Offices), incubator facilities, pre-seed and seed investment funds, a challenging investment climate and a creative entrepreneurial spirit.

Valorisation needs clearly active public-private collaboration, so that the entire knowledge chain – from blue-sky research to applied research – can be exploited. This also calls for structural investments in good ideas and entrepreneurship, for solid investments in proofs-of-concept and proofs-of-application, and for investments in human and social capital. In this context, the Triple Helix concept may play a critical role, as knowledge intensity is a sine qua non for the emergence of high-growth high-tech firms.

Thematic technology clusters (e.g., energy, health care, etc.) may be a meaningful part of a modern regional innovation system. But more synergy can be achieved – and hence, higher revenues – if such thematic clusters are linked so as to create visible hotspots with a high critical mass. This implies a deconcentrated concentration of innovation clusters at the regional level. The spatial impact of such a multi-thematic innovation hotspot can even be further extended, if a system of satellites around an interconnected hotspot can be realized (a 'supernova star' system).

In our case study on the East-Netherlands, the emphasis has been placed on the opportunities and benefits of a spatial distributed, but functionally connected 'supernova star' constellation. The underlying open innovation model is based on two dimensions, viz. a spatial network connectivity and a functional hierarchical technology structure. In this way, an effective and integrated regional innovation policy can be unfolded that utilizes social capital (including partnerships among stakeholders), knowledge infrastructure and technological innovation. From an economic perceptive, benefits from the above sketched model may be expected from efficiency effects (e.g., low transaction costs), flexibility effects (e.g., high labour mobility) and innovation effects (e.g., knowledge spillovers or collaborative agreements between knowledge institutions).

7. Policy Perspectives

Regional policy is increasingly positioned in the context of spatial innovation policy, with a strong emphasis on regional innovation systems, for which urban clusters (or spatial 'industrial districts') are a major ingredient. The challenge is to improve the competitive performance of industrial key sectors, to strengthen the regional and local R&D capacity, to incorporate innovation and technology in overall developmental strategies, and to create facilitating conditions that support strategic business initiatives. In this context, establishing creative hotspots, upgrading institutional support systems, enhancing information and knowledge dissemination with a view to valorisation and commercialisation, fostering fruitful business

networking initiatives, favouring high-skilled job opportunities, recruiting new talents on the labour market, and ensuring a sufficient and effective venture capital system are critical conditions for a promising business environment. A blend of spatial innovation initiatives, geographic knowledge cluster and integrated and interconnected business organisations may be regarded as the constituency of a successful regional innovation system.

Clearly, successful regional innovation policy is not based on top-down public policy strategy, but requires dedicated, focussed and coherent knowledge and technology initiatives that are driven by private sector leadership and long-range commitment of all stakeholders, with an open eye on the future. Commercialisation of scientific research is thus a prerequisite for a successful R&D and regional innovation cluster policy, but this has to be positioned in a broader set of framing conditions, such as accepted regional leadership, entrepreneurial spirit and target-oriented intermediary institutions in order to develop an inclusive development strategy on the basis of place-based advantage of the region under consideration.

In our empirical case study on knowledge-instigated innovation policy in the Eastern part of the Netherlands, we have focussed our attention in particular on the economic and technological synergy from the establishment of inter-cluster linkages of regional innovation systems. The triangle of three regional innovation systems (Technology Valley, Health Valley and Food Valley) appears to create new opportunities for economic and technological synergy as a result of a strong knowledge and R&D based. This 'creative hotspot' is able to exploit its economic returns even more, if it has a set of strongly connected, complementary satellites (leading to a 'supernova star' development). Consequently, a combination of a strong core cluster policy, an integrative hotspot approach, and an open satellite strategy may be seen as critical success factors for a modern regional innovation systems policy. In conclusion, a core-satellite perspective on spatial innovation systems may offer untapped opportunities for geographically focussed, thematically-aligned and knowledge-based business activities driven by valorisation and commercialisation.

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Appendix. Data on Four Regions

Table A: Benchmarking of the regions: Øresund, Noord-Brabant, Flanders, and East Netherlands

RESOURCES	ØRESUND	NOORD-BRABANT	FLANDERS	EAST NETHERLANDS
# inhabitants	3,73E+06	2,44E+06	6,12E+06	3,09E+06
GRP (Gross Regional Product)	1,30E+11	8,04E+10	1,70E+11	8,69E+10
# universities	6	2	5	3
Public R&D expenditures	1 430 M€	241 M€	903 M€	1 090 M€
Private R&D expenditures	5 010 M€	1 930 M€	2 560 M€	6 50 M€
Number of students	165.000	51000	154451	94932
% students / population	4,42%	2,09%	2,52%	3,07%
% population with higher education	32,00%	29,50%	37%	28,90%
# Incubators	5	4	6	4
# Science Parks	7	1	5	3
# Regional (pre)seed funds	3	5	5	4
Size public regional (pre)seed funds	416 M€	32 M€	836 M€	88 M€
Size financial sector	56803	33700	71529	36439
Size Economic development agency (# FTE)	55	30	166	62,5
Entrepreneurship societies	yes	yes	yes	yes
Business angel networks	yes	no	yes	yes
Shared innovative strategy	yes	yes	yes	yes

Table B: Benchmarking of the Clusters: Health Valley, Food Valley, and Technology Valley

RESOURCES	Health Valley	Food Valley	Technology Valley
# inhabitants	3.02E+05	1.42E+05	3.59E+05
GRP (Gross Regional Product)	1.83E+10	6.80E+09	9.70E+09
Public R&D expenditures	4.02E+08	5.20E+08	1.71E+08
Private R&D expenditures (estimate)	3.17E+08	5.97E+07	2.36E+08
Number of students	45571	7457	25114
% students / population	15%	5%	7%
% population with higher education	41%	33%	24%
# Incubators	2	1	1
Science Parks surface (in ha.)	1.5	10	40
# Regional (pre)seed funds	3	5	5
Public regional seed investment	17 M€	12 M€	18 M€
# preseed grants	18	7	28
Size Cluster Organisation Agency (# FTE)	4	7.4	12
Entrepreneurship societies	yes	yes	yes
Business angel networks	yes	yes	yes

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