

Innovation Project:

## Innovation Eco-Systems and Innovation Drivers



Contributors:

Oliver Demmer	Life Science Consultant
Jon Pers	ICT Consultant
Emilie Normann	Innovation Attachè
Nikoline Strømholmt Bach	Project Assistant
Caroline Lindholm Eskesen	Project Assistant

### Contact

Email: [olidem@um.dk](mailto:olidem@um.dk) Phone: +49 89 545 854 23

## Table of Contents

1. Introduction	3
1.1 Innovation ecosystem definition	4
1.2 Approaches to promote innovation	4
2. Innovation Ecosystem Germany	6
2.1 The German innovation system in numbers	6
2.1.1 Macro-level: The Innovation Framework	7
2.1.2 Meso-level: Institutional pillars	8
2.1.3 Micro-level: Companies	9
2.2 Bavaria – a successful regional example of Germany’s eco innovation system	11
2.2.1 Geographical closeness to the industry	13
2.2.2 Culture of entrepreneurship/ entrepreneurial universities	14
2.3 Real life case: The Novo Foundation visits the Life Science Ecosystem in Munich	15
2.3.1 BioM	15
2.3.2 TUM	16
2.4 Regional Case: Zentrum Digitalisierung Bayern	18
2.5 Institutions and universities in Munich working with innovation and entrepreneurship	22
3. Innovation Ecosystem Switzerland	29
3.1 The Swiss Innovation System in Numbers’	29
3.1.1 Macro-level: The Innovation Framework	30
3.1.2 Meso-level: Institutional Pillars	31
3.1.3 Micro-level: Companies	34
3.2 Real life case: Swiss innovation through new science parks	34
4. Innovation Ecosystem Denmark	36
4.1 The Danish Innovation System in Numbers	36
4.2 The clusters and GTS institutes - effective eco-innovation environment	40
5. Summary and Opportunities	44

## 1. Introduction

The origin of the concept of national innovation ecosystems dates back to the 19<sup>th</sup> century when German-American economist Georg Friedrich List formulated his theory of a national economics as opposed to the concepts of individual or cosmopolitan economics (*The National System of Political Economy*, by Friedrich List, 1841, translated by Sampson S. Lloyd M.P., 1885 edition). The actual term National System of Innovation was created by Christopher Freeman and Bengt-Åke Lundvall in the late 1980s referring to the distribution, availability and exchange of information and technology between people, companies and public institutions. The Dane Lundvall subsequently explored the social interactions of stakeholders within the economic system (Lundvall, B.-Å. (1985). *Product Innovation and User–Producer Interaction*. Aalborg University Press.).

With these strong Danish and German roots in the theoretical concepts of national economic systems, this report ‘Innovation eco-systems in the DACH region and Innovation Drivers’ revisits the actual innovation eco-system in Denmark, Germany and Switzerland highlighting strengths, and showing opportunities to learn from each other using selected examples.

A special focus on Bavaria, a leading region in innovation and the ICT, cleantech and life science sectors highlights how this regional innovation eco-system creates value and knowledge and transfers cutting edge research into application. Bavaria is especially relevant for Danish stakeholders because it is a successful example how through a politically driven innovation and high-tech strategy a rural state was transformed into a leading region creating more than 30% of the German patent applications, a GDP putting it ahead of 21 of the 28 European member states and Munich alone harbouring 11 of the world top 100 companies. That is illustrated with concrete examples from clusters, universities and initiatives and their innovation related output in numbers and facts.

Parts of the report draw heavily on public, trusted sources and websites and uses large text material from BMBF and BMWi – Federal Ministry for Higher Education and Science and German Federal Ministry for Economic Affairs and Energy as well as other cited literature.

## **1.1 Innovation ecosystem definition**

As the theory of national (innovation) ecosystems has developed over time and spawned different interpretations there is no one singular definition. However, there are several common grounds which will serve in this report as a basis to discuss and compare the Danish and German-speaking models for national innovation ecosystems.

**Area segmentation:** Innovation processes are divided into national, regional and sectoral levels to help to explain and use different levers to stimulate innovation.

**Stakeholders:** Activities and relations between the actors serve as anchor points to promote innovation and advancement in technology.

**Interactions:** The kinds of interaction between the stakeholders are differentiated into producers and appliers of knowledge and innovation.

The stakeholders in the innovation ecosystems consist of public administration and politics, universities and public as well as private research institutes from the science and research sector, the educational sector with schools and universities and the producing sector of the economy with the companies. (See figure 1)

## **1.2 Approaches to promote innovation**

There are as many national innovation systems as there are countries. Every country has its individual strengths and weaknesses and the innovation system has to be designed in each case to create the highest value. Even though there is no “one-size-fits-all” solution some of the building blocks and smaller parts of the innovation system can be copied and customized successfully to another country as long as three general principles are followed: reinforce the stakeholder’s capacities, build bridges between them and improve framework conditions.

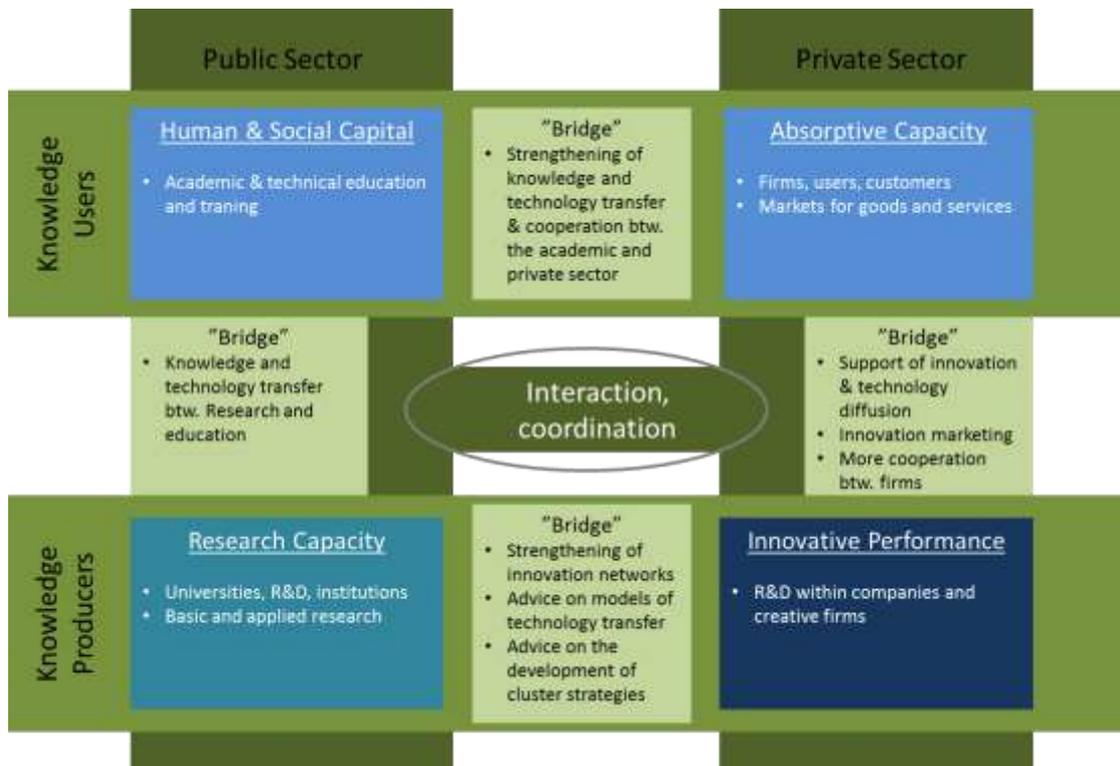
**1. Strengthening of existing structures** can be achieved by financial support and fostering innovation-oriented thinking and mind set. Examples range among others from enabling a high

quality education system, fostering high quality and quantity of research, entrepreneurial thinking at universities, supporting SMEs with innovation centred public and private service offers.

**2. Connecting the stakeholders** and creating an environment of exchange in the ecosystem is of utmost importance to support the formation of partnerships and help the stakeholders work together to maximize possible synergies and increase chances for new ideas. In detail this can be facilitated by providing expert knowledge in the form of intermediaries like business incubators or consultancies that can advise on topics like cluster strategy or technology transfer e.g. for the promotion of spin-offs.

**3. Improving the framework conditions** to shape the behaviour and opportunities of the various players in the ecosystem is a further step to create the right mind set for cooperation and accelerated innovation. At the local, regional and national levels the governments have to implement structures and the legal framework that facilitate access and use of e.g. intellectual property, taxation, regulation and availability of information and communication technologies.

**Figure 1:** The four players in the national innovation eco-system and how they interact and depend on each other. Adapted from “Innovation Ecosystem: Cooperation Matters” 2<sup>nd</sup> MSME Summit 14<sup>th</sup> March 2013, Deutsche Gesellschaft für internationale Zusammenarbeit GmbH, p. 9.



## 2. Innovation Ecosystem Germany

### 2.1 The German innovation system in numbers

From the viewpoint of developing and emerging countries the national innovation system of Germany is an outstanding example and role model to base their own innovation ecosystems upon. Especially when looking at the mere numbers this leading role of Germany is evident:

- **2.82% of the Gross Domestic Product (GDP)** in Germany was spent on research and development (R&D) in 2010; the private sector accounts for the lion's share of these investments (1,9% of GDP) (Eurostat 2013).
- **Germany is in many ways a top-performer** in regards to **patent applications**: the absolute number of patent applications at the European Patent Office (EPO) is the highest in Europe and in the top three worldwide in front of China.
- **65%** of German companies are so-called **"innovative companies"**; this expression encompasses all enterprises active in process and/or product innovation.

Only through a plethora of research organizations, higher education institutions (HEIs), training institutions and companies can this output be generated by the German innovation ecosystem. All of these entities are supported by a diversity of hundreds of different initiatives and programs in the field of economic development, vocational training, education, and research. The collaboration and communication between public research and science with industry is encouraged and is the norm rather than the exception. These interactions towards more innovation have a long-standing tradition and since 2006 have been part of the "High-Tech Strategy" lead by the Ministry for Education and Research. This strategy is based on three main pillars:

1. Four selected focus areas of innovation are supported: **health, climate protection/protection of natural resources/energy, mobility, security**) together with relevant technologies (such as biotechnology, nanotechnology etc.)

2. Promoting the cooperation of science with private companies
3. Enhancing the framework conditions to foster innovation.

Not only the federal government is responsible to support innovation but also the individual states promote innovation with their own programs. In Germany the implementation of innovation policy and programmes is managed by a set of different research associations, companies and organisations that are called “Projektträger” and which translate to project executing agency (European Commission 2009). This is different to other European countries which have often established independent and specialized agencies to fulfil these tasks.

To give a structured insight how this system works on the different levels and how the different players interact and influence each other to promote innovation the national innovation ecosystem can be described from its macro-level to its micro-level.

### **2.1.1 Macro-level: The Innovation Framework**

The overall innovation framework focuses on following six areas to support innovation:

The Federal Ministry for Economic Affairs and Energy in Germany supports the access to **finance** in different ways. There are individual so-called EXIST programs that fund researchers and research groups from academia with the aim of commercializing their ideas and innovations. Additionally, the ministry, together with investors from industry, is involved in the High-Tech Gründerfond (HTGF, high-tech start up fund) to facilitate access to capital aimed at innovative high-tech companies.

**New legal entities** for companies with less capital requirement like the Unternehmergesellschaft (haftungsbeschränkt) have been created and the financial **barriers to found** a company have been **reduced**, e.g. for the GmbH from 25.000 Euro to 10.000 Euro. Additionally an electronic commercial register makes it easier and faster to register new companies.

In the area of **public procurement** the federal ministries have changed the laws so that tender procedures are now more favoured towards resource-efficiency and innovation.

On a European level Germany works on increasing the coherence of **intellectual property rights** and their enforcement. Apart from these initiatives universities and research institutes are creating and expanding their patent and tech transfer offices to support not only their institutions

and researchers but also SME's in filing and applying for patents as well as the commercial utilization. The individual employee is motivated to create patentable innovations as they are legally entitled to a compensation by the so-called Arbeitnehmererfindungsgesetz (employee invention law).

**Reduction of bureaucracy** is achieved through the so-called Nationalen Normenkontrollrat (national norm control council) is independent and consists of ten honorary members and since 2006 supports the federal government in reducing the costs associated with bureaucracy.

The **communication quality and infrastructure** for SMEs is strengthened by the creation of dialogue platforms that help to introduce norms and standards in education and training.

### 2.1.2 Meso-level: Institutional pillars

The institutes in education and research create not only innovation with their research they also educate and supply industry with qualified employees that use their knowledge to create innovation in the private sector. The three pillars consist of:

The **dual education system** which has developed from the apprenticeship model of earlier times consists of in-company trainings in combination with classroom instructions in both humanitarian as well as technical topics. This interdisciplinary and multi-level education is only possible through a close collaboration and coordination of practical learning in industry, theoretical knowledge building in technical schools with standardized certification and testing from the chambers.

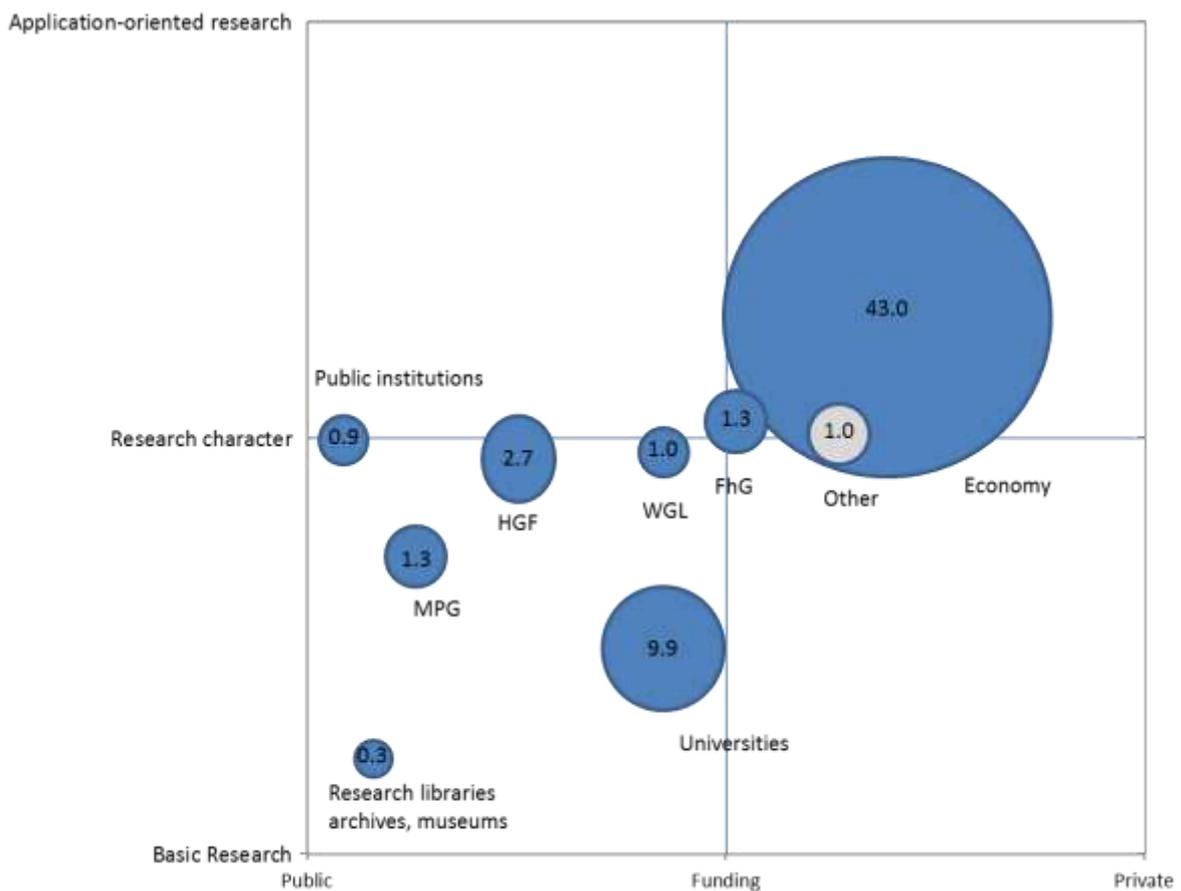
Similarly the **universities of applied sciences** (UoAS) focus on a close collaboration with industry. The intensive exchange between both actors is evident by the many professors that are representatives from companies and the fact that students write their final thesis at or in close collaboration with industry.

**Research institutes and facilities** in Germany are found in and outside universities and can be publicly but also privately financed. Figure 2 shows the major players their funding and how close their research is to commercial application.

**Figure 2:** R&D expenditures in Germany segmented into the different players, funding and the relation towards applied research.

Abbreviations: Economy: Fraunhofer-Gesellschaft; HGF: Hermann von Helmholtz Gemeinschaft; MPG: Max-Planck-Gesellschaft; Other: Non-Profit research institutions which are neither supported mainly by the public nor private sector; WGL: Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz

Adapted from “Innovation Ecosystem: Cooperation Matters” 2<sup>nd</sup> MSME Summit 14<sup>th</sup> March 2013, Deutsche Gesellschaft für internationale Zusammenarbeit GmbH, page 11, original source: Bundesbericht Forschung 2010.



### 2.1.3 Micro-level: Companies

Individual businesses are the major source of R&D funding as evidenced in figure 2 and especially the small and medium-sized enterprises (SMEs; the so-called German “Mittelstand”) are the backbone of the German economy. The companies and their innovative capacity are supported by

business competitions that are often linked to specific programs and aim at identifying promising innovations. But not only existing businesses are supported as various programs aim at promoting and supporting the formation of start-ups.

The reason why especially SMEs are strengthened is their high innovative capacity based on their high degree of specialization, flexibility, long term orientation, responsible organizational culture and long-term vocational training.

Concrete measures of support include the various **EXIST programs** to support the founding of high-tech start-ups transferring research to an application. Innovationsgutscheine (**Innovation vouchers**) are available from the Federal Ministry of Economic Affairs and Energy and can be used by SMEs to co-finance ex-house consultancy in the various stages of developing innovative products from market mapping to realization. For larger research programs the **Central Innovation Program for the SMEs** grants funding. This successful program creates three Euros added value for every single invested Euro.

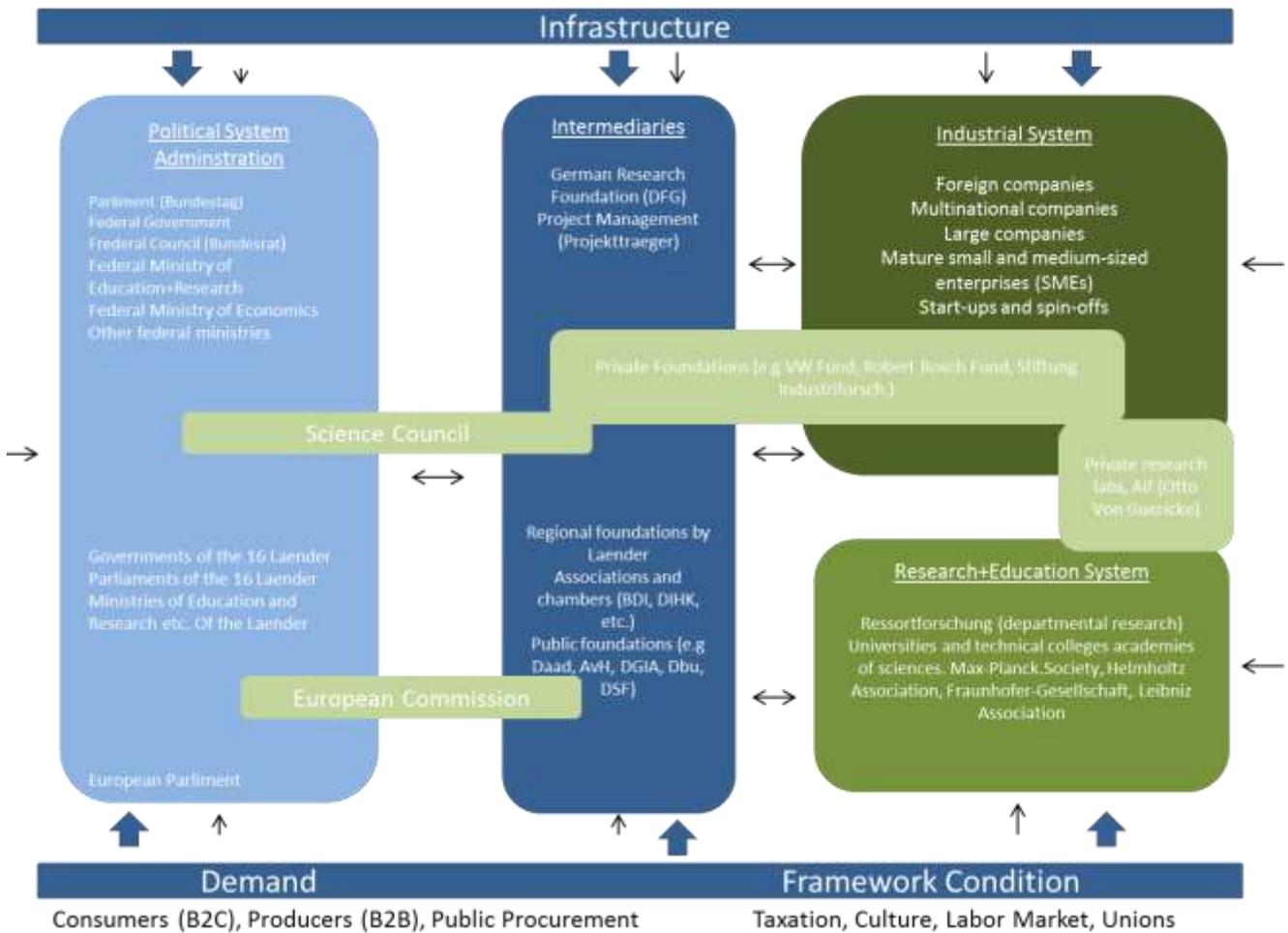
Apart from individual funding **clusters** that focus on specific sectors support the industry. They are networks between of industry, research institutions and universities and the cluster management organizations provide services in various categories. The vast majority of these activities and services are in the following fields:

- 1) acquisition of public funding
- 2) tech transfer and collaborative technology development
- 3) networking and matchmaking in and outside of the cluster
- 4) specialized training and education
  - (i) entrepreneurship
  - (ii) sector specific knowledge and work requirements
- 5) internationalization

Figure 3 summarizes how the stakeholders interact and how the innovation system is driven and influenced.

**Figure 3:** The players of the German innovation eco-system and their interactions

Adapted from “Innovation Ecosystem: Cooperation Matters” 2<sup>nd</sup> MSME Summit 14<sup>th</sup> March 2013, Deutsche Gesellschaft für internationale Zusammenarbeit GmbH, page 13.



## 2.2 Bavaria – a successful regional example of Germany’s eco innovation system

In 2013, Bavaria invested 3.2 % of its GDP on R&D activities and has set a target of 3.6% by 2020. With a share of over 3 % of gross domestic-product invested in research and development, Bavaria is positioned well above the average R&D-spending in Germany.

Together with Baden-Württemberg, Bavaria is the most ambitious R&D- states in Germany. An outstandingly constructed transportation, telecommunication and energy infrastructure provides for an optimal supply of necessary goods and services, linkage to the global market and direct

access to nearly half a billion consumers; an ideal business location. At the same time, highly qualified professionals consider the Free State as a popular location to live and work. The pool of highly qualified specialists, a state-wide network of researching and educating universities, as well as the consequent support of research and innovation result in both a concentration and combination of future technologies to an extent unique throughout Europe.

With an exceptionally high share of researching high-tech companies, the industrial sector forms the center of strength of the Bavarian economy. The sector serves as a pulse generator for economic development and likewise generates countless industry-oriented services. The free state's industrial structure covers the entire scope of services, from conventional industrial production up to hightech categories.

Bavaria has a number of very large and lively student cities with more than 320.000 students living in the state. Bavaria has a high number of R&D institutions and Higher Educational Institutions, as shown in in figure 4. There is a rich mix of universities and universities of applied sciences (German: Fachhochschulen), plus a high number institutes from the four research institutes e.g. 12 Max Planck institutions and Fraunhofer's headquarter.

**Figure 4:** The Bavarian Ministries of Economic Affairs and Media, Energy and Technologies regional map of research institution.



The universities, research institutions and companies cooperate within coordinated networks and ensure a strong transfer of knowledge from basic research to hands on applications. The universities of applied sciences in particular provide students and staff with apprenticeships close to business and provide numerous options for mutual benefits between science, education and economy. Following Berlin, Munich has the strongest start-up scene in Germany, and it is a key objective of the Bavarian and Munich government to support the local start-up environments ever further. The local HEIs play a central role in in this process.

In 2010 the Bavarian Ministry for Economics, Technology and Media (Bayerische Staatsministerium für Wirtschaft und Medien, Energie und Technologie) together with the Bavarian Ministry for Science and Higher Education (Bayerisches Staatsministerium für Bildung und Kultus, Wissenschaft und Kunst) decided to establish one common institution to support research and innovation in Bavaria: Haus der Forschung (House of Research. The Haus der Forschung focuses on research infrastructure and efficient design, technology transfer in Bavaria as well as the attraction of EU funds. The initiative aims to form consortia from science, SMEs and industry, and have an overview of eligible funding and advice in technology.

The Haus der Forschung has four main R&D institutions of which Bayern Innovativ is the most important. Bayern Innovativ is the centre of innovation and knowledge transfer, cooperation platform and network and administers four of Bavaria's clusters including the automotive cluster and the energy cluster, where Smart City innovations fall under. BayFor, the Bavarian Research Alliance, is also based in the Haus der Forschung and acts as an interface between research and companies and is a member of the European Enterprise Network. It is an active champion of alliances between Bavarian universities and companies and EU partners. BayFor runs an office in Brussels and works systematically to attract H2020 funds to Bavaria.

### **2.2.1 Geographical closeness to the industry**

The Bavarian HEIs are spread across the states, in part due to the fact that Bavaria is the largest state in Germany, but more interestingly because of a deliberate policy for R&D environments to

be close to the actual industries and SMEs that they work closely with. 94% of all companies in the region are SME's.

The interaction of these organisations and the flexible advancement of university structures are in Bavaria viewed to be some of the key reasons why Bavarian scientists, students and entrepreneurs are successful, why the state can attract highly skilled international labour, and why it can retain high growth and employment rates.

### **2.2.2 Culture of entrepreneurship/ entrepreneurial universities**

Over the last two decades the Germany federal state together with the individual states have been supporting start-up and entrepreneurial activities at education and research institutions, often in partnership with industry. In addition to the large national programs and other public support schemes, there exist a number of private support schemes.

The German government wants to realize long-lasting impact and transformation of HEIs towards more entrepreneurial activities. This is achieved by supporting more than individual activities but through a holistic culture of entrepreneurship in the sense of a 'presence of entrepreneurial spirit permeating all aspects of the university' - across faculties, the campus, and the university administration. A continuous willingness to recognize entrepreneurial opportunities, to value them - and in a best case scenario - also to implement them, characterises an academic culture of entrepreneurship. The focus is clearly on individual universities and getting them to develop a culture of entrepreneurship, but other institutions may also benefit from the funding as subcontracts.

Innovative business start-ups are regarded as an important tool for the commercialisation of knowledge and research, and the federal government through BMBF (Federal Ministry for Higher Education and Science) want to put in place and entrepreneurial culture at the universities and help support innovative (technology-based) spin-offs. Promoting 'transfer' and more commercialisation so that research findings reach the market quicker and with long lasting impact is also a clear objective.

Germany identified a number of challenges in its educational system:

- Only a small number of university graduates ventured on into professional self-employment or started their own companies after leaving university
- There was not a very strong culture of entrepreneurship and entrepreneurship was not featured in curricula. This was also a problem at teaching and staff-levels.
- Despite the increased number of innovative business start-ups appearing in the 1990s, the potential for universities playing a role in supporting start-ups was lacking. Only a few universities had a tradition of supporting start-ups and the subject of entrepreneurship was not strong across the HEIs

### **2.3 Real life case: The Novo Foundation visits the Life Science Ecosystem in Munich**

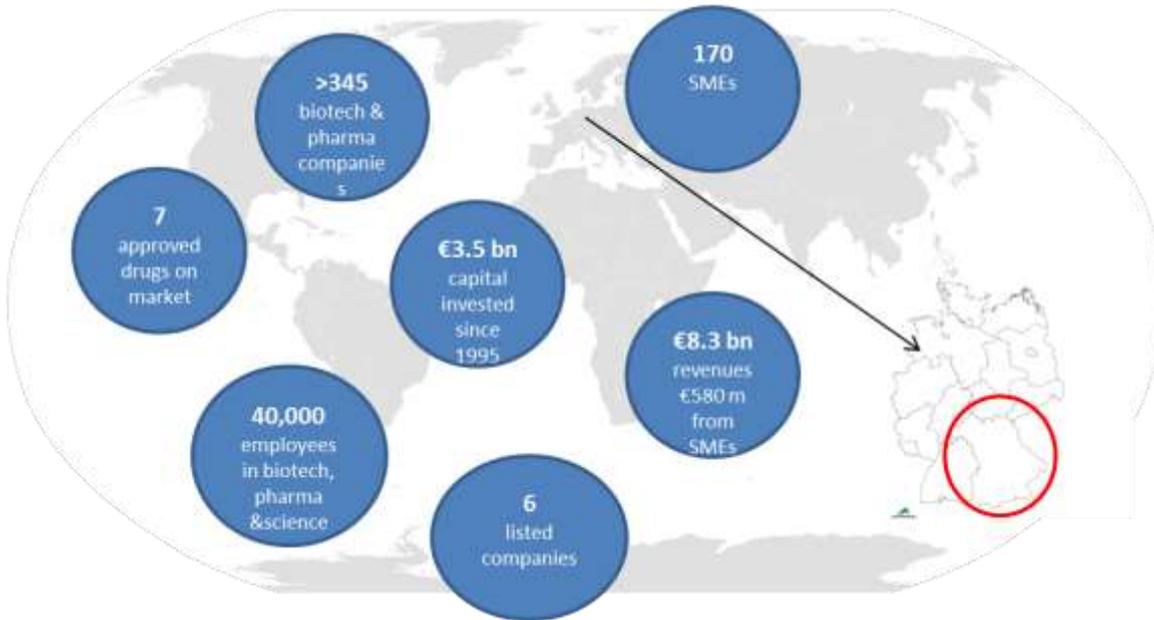
In the course of this innovation project the ICDK Munich organized a two-day program for the Novo Foundation in Munich to inform their delegation about the innovation eco-system in Munich in the life science area. Two of the players of the local eco-system, the life science and biotech cluster BioM and to the tech-transfer office of the Technical University of Munich (TUM), were visited at this study tour and are highlighted to give a focused and detailed description of the regional innovation activities in numbers.

#### **2.3.1 BioM**

BioM is the clustermanagement organisation that since 1997 acts as networking agency for the biotechnology sector in Munich and Bavaria. They support biotech companies with a focus on start-ups by providing consulting, organizing events and representing the location internationally. The non-profit organization has been funded by the Bavarian State Ministry of Economic Affairs and among other achievements won the leading-Edge Cluster Competition in 2010 and been involved in several EU projects.

BioM contributed to making Bavaria and especially the area around Munich one of the top European biopharma hotspots. The numbers in figure 5 illustrate how the innovative capacity and strength that has been created pans out in hard facts and numbers.

**Figure 5:** Facts about the life science environment Bavaria.



An excellent example how initiatives within this cluster foster innovation is the “Munich Leading Edge Cluster m<sup>4</sup>”. 50 R&D projects have been created since 2010 with:

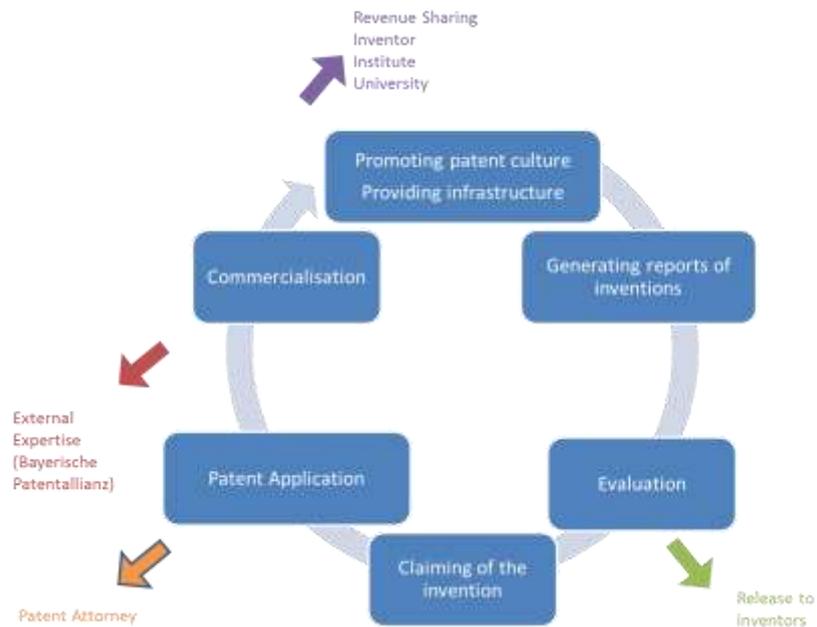
- 21 preclinical development projects of new therapeutics
- 5 clinical trials have been initiated
- 11 diagnostic R&D projects
- 13 biomarker identification projects

These efforts led to **312 patent applications** and **264 granted patents** in the leading edge cluster until now.

### 2.3.2 TUM

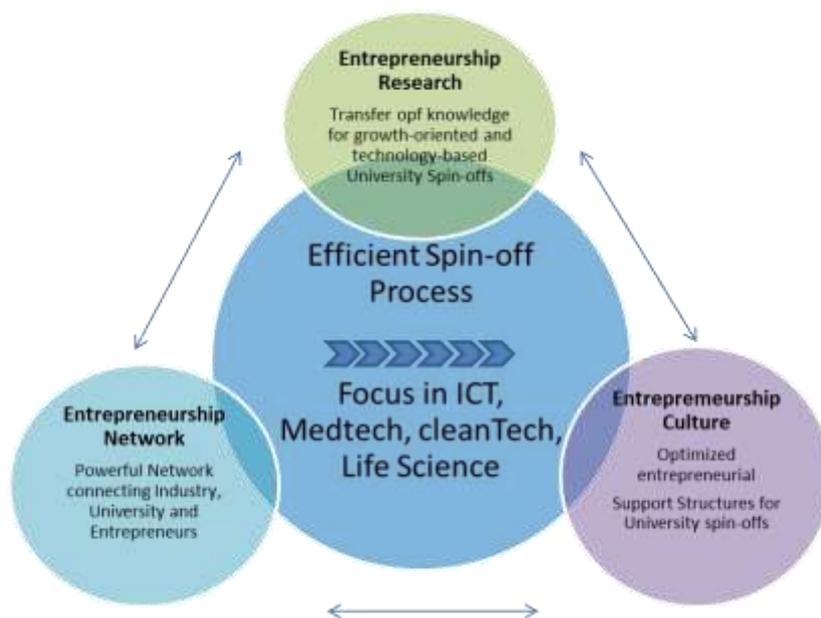
Another important player in the innovation eco-system in Munich and surroundings is the Technical University of Munich (TUM) that established a tech transfer office that deals not only with patents but also is closely connected to foster entrepreneurship to spin-out projects and ideas. Figure 6 shows the model how the patent culture is promoted towards actual commercialization. This leads to 180 patent applications per year, from which 35% originate from industry projects, currently 450 patent families, 120 granted patents and more than 10 commercialization projects.

**Figure 6:** The TUM supports not only patenting of ideas but helps in the whole process from reporting of inventions to the final commercialization making also use of external partners.



Additionally to the support in patenting the TUM also encourages the founding of technology based start-ups and spin-outs from the university. Figure 7 summarizes the core technological areas and sectors as well how entrepreneurship is supported through the creation of a supportive culture, providing a network and technology and knowledge transfer.

**Figure 7:** The TUM model for promoting entrepreneurial activity



## 2.4 Regional Case: Zentrum Digitalisierung Bayern

Digital technologies cause and accelerate fundamental changes in our society. They increasingly determine innovation, economic competitiveness as well as lifestyle and organization of people during work and leisure. There is demand for rapid action: The development of digital technologies is escalating. Countries like the US, UK or China invest with large-scale, strategic initiatives massively in digitization of science, economy and society. Competitiveness, regional development, research and development, innovation power and growth have not been spared by the digital pressure that has already disrupted entire industries and changed the global value ecosystem. Regions and various stakeholders need to adapt to the new and more importantly digital era.

The State Government of Bavaria has in the past two decades set a solid foundation with their technology initiatives "Bayern Online", "High-Tech Offensive", "Bavarian Future" and "Bayern 2020" with the aim to reinforce intensive networking and a lively exchange between universities, other research institutions and the economy as the common denominator. To meet the above mentioned digital pressure and nurture the regional innovation ecosystem the Bavarian government established the Bavarian Centre for Digitization (Zentrum

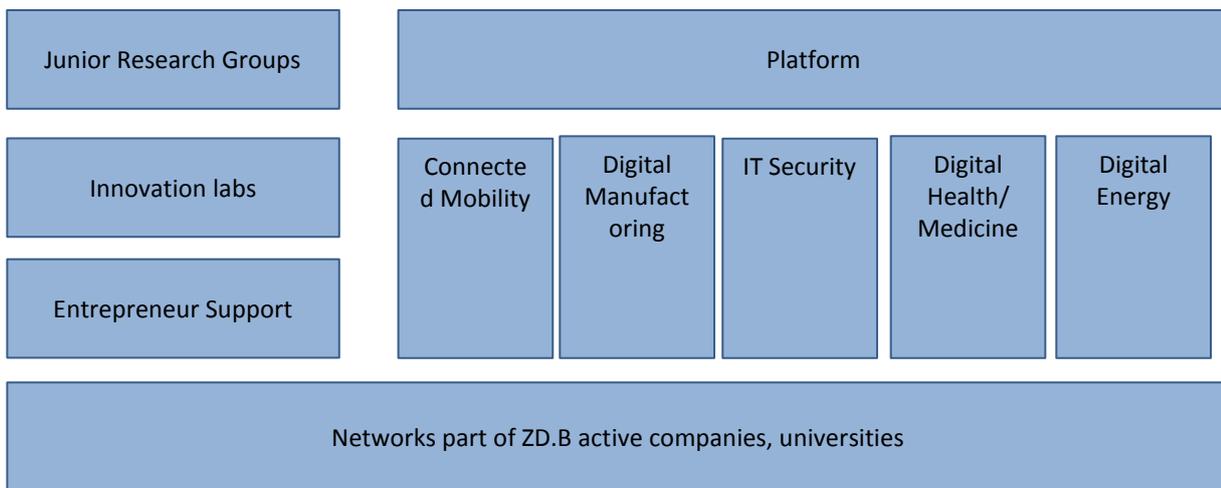
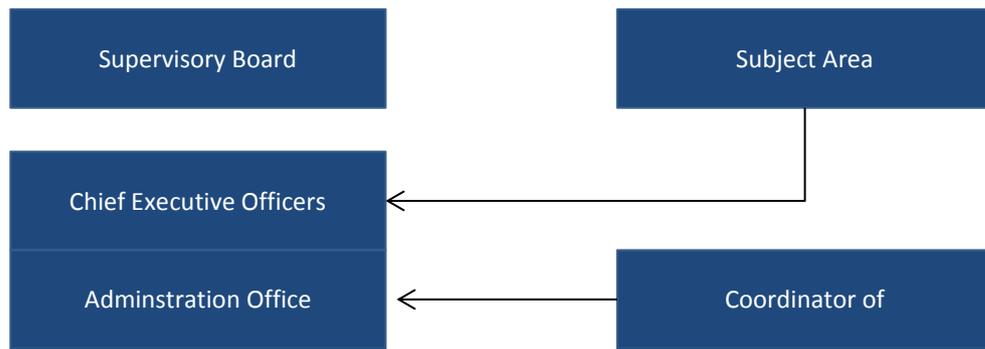
Digitalisierung Bayern, ZD.B). The newly (2016) established centre offers platforms for initiatives, expertise and cooperation of partners within and outside the centre within selected topics and fields of application of special significance for the Bavarian economy. The platforms are the link between university research, extra-university research and industrial R&D and lead the various actors in a field of collaboration. In the steering committee of the 5 platforms is one representative from a private enterprise and a professor who is leading in the given field. See list below:

**"With ZD.B we have invested in brains, not in concrete"**

– Ilse Aigner, Bavarian State Minister of Economic Affairs and Media, Energy and Technology

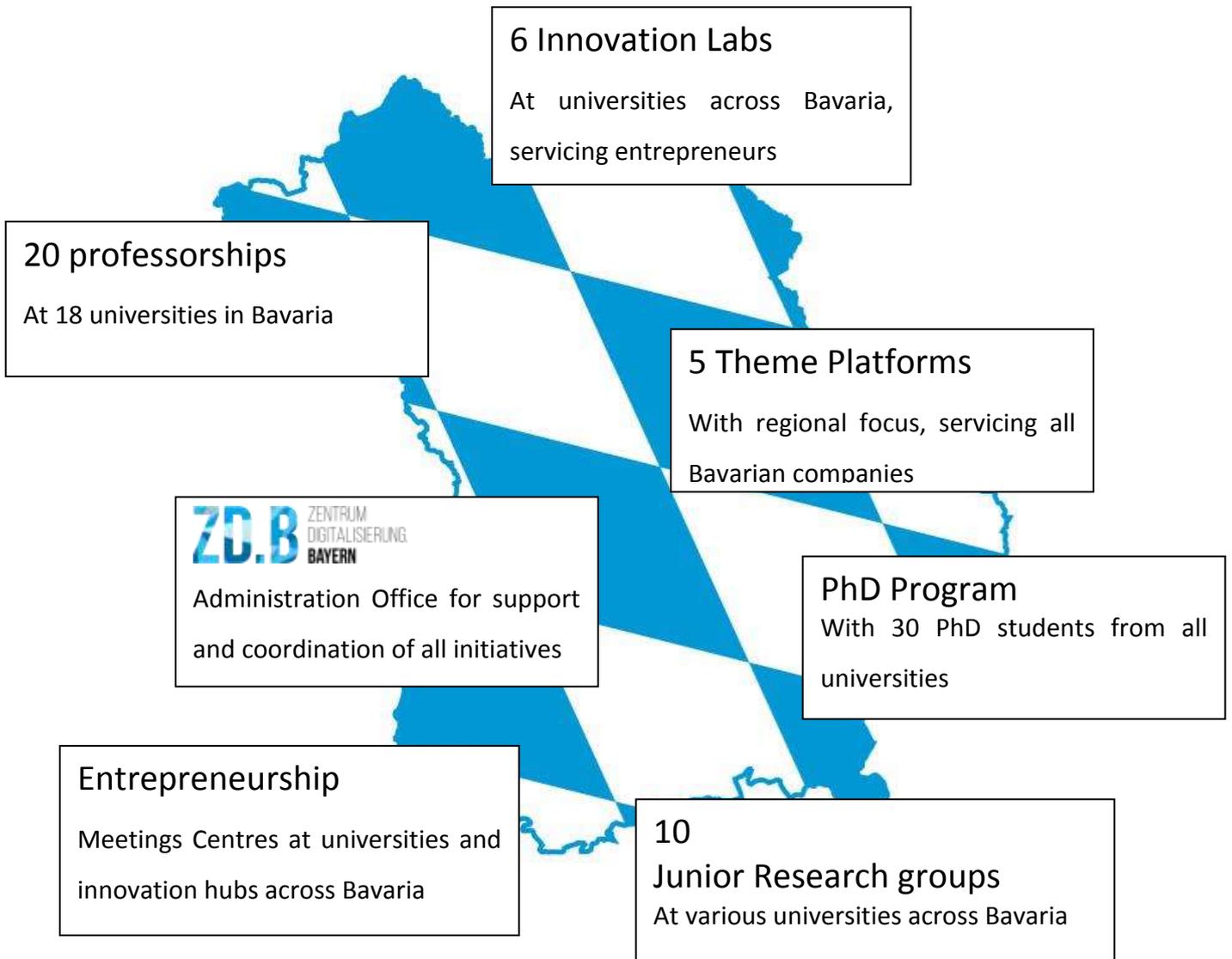
<b>Connected Mobility</b>	<ul style="list-style-type: none"> <li>• Prof. Dr.-Ing. Reinhard German (Friedrich-Alexander-Universität Erlangen-Nürnberg)</li> <li>• Dr. Christoph Grote (BMW)</li> </ul>
<b>Digital Manufacturing</b>	<ul style="list-style-type: none"> <li>• Prof. Dr.-Ing. Gunter Reinhart (TU München)</li> <li>• Dr. Christian Schlögel (KUKA)</li> </ul>
<b>Digital Health/Medicine</b>	<ul style="list-style-type: none"> <li>• Prof. Dr. Christoph Reiners (Universitätsklinikum Würzburg)</li> <li>• Prof. Dr.-Ing. Erich Reinhardt (Medical Valley)</li> </ul>
<b>Digital Energy</b>	<ul style="list-style-type: none"> <li>• Prof. Dr.-Ing. Joachim Schenk (Hochschule für angewandte Wissenschaften München)</li> <li>• Dr.-Ing. Roland Hofer (Bayernwerk AG)</li> </ul>
<b>IT Security</b>	<ul style="list-style-type: none"> <li>• Prof. Dr. Claudia Eckert (TU München und Fraunhofer AISEC)</li> <li>• Dr. Walter Schlebusch (Giesecke &amp; Devrient)</li> </ul>

Each topics platform is dedicated to 4 core tasks. These include the identification of digitalization topics, putting up references and guidelines, networking and pooling of skills (for example, in the form of events) as well as the communication and visualization of results. For each of the topic platforms a platform coordinator at ZD.B is responsible for taking care of the substance and organization of work areas and ensures the link with other ZD.B platform activities and topics. The organisation is visualized in figure 8 below.



**Figure 8:** The office of ZD.B runs a coordination committee, which is the management advisory support and operationally involved in the various activities of platform. For each of the topics a platform coordinator at ZD.B-office is responsible for supporting the operational work of the platform and ensures the link with other activities and topics ZD.B platforms.

A central task of any the above outlined platform is to obtain an overview of ongoing activities and to engage early in exchange with interesting projects and activities. This association provides a basis that allows and enables exchange between subjects and projects and ensures that both research and industry follow the same path. Both sides win by the association. Joint research and development projects of universities, other research institutions and enterprises are a key tool for knowledge-building and mutual know-how transfer between science and industry. The responsible ministry in a given topic can through recommendation from the administration office of the ZD Bayern promote specific projects to strengthen the theme platforms.



**Figure 9:** The administration office in Munich is the central organization of a variety of decentral initiatives aiming at strengthening Bavaria within digitalization by building upon existing and creating new ties between industry, universities and the public administration.

Even though the effects of the newly established centre haven't crystalized and the platform projects have not yet been evaluated in terms of impact, the centre has meet wide recognition and support from all innovation ecosystem stakeholders. The centre condenses the business location Bavaria, reinforces the status of the already high-ranking universities, makes political agendas and programmes visible and feasible and provides a both central and decentral navigation tool for companies and new established entities.

## 2.5 Institutions and universities in Munich working with innovation and entrepreneurship

### **Ludwig-Maximilians-Universität - LMU Entrepreneurship Center (LMU EC)**

The LMU Entrepreneurship Center (LMU EC) promotes entrepreneurial thinking and practice as major drivers of today's knowledge society. It seeks to translate research findings and ideas generated at LMU Munich and in the Munich region into business models and corporate concepts. To this end, LMU EC offers courses tailored for students from all faculties and for researchers, employees and partners. In collaboration with LMU's Research and Technology Transfer Office, LMU EC advises students, graduates, scientists and academics who wish to found their own companies. The Center conducts scientific studies that enhance understanding of the economic and social significance of the entrepreneurial spirit, and uses the results to develop policy recommendations for budding entrepreneurs and economic decision-makers.

[http://www.entrepreneurship-center.uni-muenchen.de/ueber\\_das\\_center/index.html](http://www.entrepreneurship-center.uni-muenchen.de/ueber_das_center/index.html)

### **Technische Universität München - TUM**

The faculty for Innovation & Entrepreneurship

The Academic Department of Innovation and Entrepreneurship explores developments and extends research into management of innovation and company start-ups. The research focus lies on empirical investigation of innovation and start-up processes. Research subjects include corporate strategies to profit from innovation, openness in innovation processes, innovation by users, patent management, the recognition of business opportunities, entrepreneurial individuals' and teams' psychological processes, strategies for young companies, as well as understanding the consequences of entrepreneurial failure.

<https://www.tum.de/wirtschaft/entrepreneurship/>

### **UnternehmerTUM**

UnternehmerTUM provides everything for a successful start-up. They offer students, academics, founders, start-ups and established companies individual support and systematic coaching and in developing new products and services, in building up a successful business, when entering the market and in the growth stage.

To make ideas and technologies into successful products and services, UnternehmerTUM works with Business Design. Business Design combines principles drawn from design and strategic management, providing targeted help to identify and realise opportunities for new and sustainable business.

Their work focuses on the future industries of Information and Communication, Medical Engineering and CleanTech.

<https://www.unternehmertum.de/index.html;jsessionid=2DD917B745202090FA891CBBB481D8FF>

### **Strascheg Center for Entrepreneurship (SCE), Hochschule für angewandte Wissenschaften München**

Strascheg is placed at Hochschule Münchens campus, and has during the last 11 years made a huge effort to enhance the environment and skills for entrepreneurship in Munich. It's a place where students can get advises and education in innovation and entrepreneurship or maybe to an Idea to a start-up or to develop strategies for an established start-up etc. Strascheg is one of the three start-up institution, part of the EXIST-program.

<http://www.sce.de/ueberuns.html>

### **Social Entrepreneurship Akademie (SE Akademie)**

In cooperation with the incubators of the other three major Munich universities LMU, TUM and UniBW (4Entrepreneurship) launched SCE in 2011, the Social Entrepreneurship Academy (SE Academy). The SE Academy offers a training program that specifically promotes social foundation projects and wants to continue to build a broad network for anchoring the theme of social entrepreneurship in the society. Promoters include, without limitation Falk F. Strascheg and Bernd Wendeln, the BMW Foundation Herbert Quandt, BonVenture, the Vodafone Foundation and the Association of German Science.

<http://www.seakademie.de/socialentrepreneurshipakademie.aspx>

### **Universität der Bundeswehr München - Entrepreneurship Center CeTIM**

CeTIM is an internationally oriented Center for Technology and Innovation Management. As academic institute it is dedicated to Research and Higher Education. As the Entrepreneurship

Center of University Bw Munich, Germany it is dedicated to engaging in practical industrial innovation action.

CeTIM serves collaborative, "open" research, development, and innovation projects from definition to partnering, implementation, and entrepreneurial exploitation. It furthermore provides career development support for technology entrepreneurs and technology management professionals in a global network.

<http://www.cetim.org/>

### **Flügge**

The former Bavarian State Ministry of Sciences, Research and Arts launched in 1997 "Förderprogramm zum leichteren Übergang in eine Gründerexistenz" ( FLÜGGE ), which is located since 2014 in the Bavarian Ministry of Economic Affairs and Media, Energy and Technology . Since the existence of the program more than 130 projects have been funded, this created more than 1,300 jobs. They are based on the expectation that additional jobs in Bavaria have been mainly developed by new companies with highly innovative products and services.

<http://www.fluegge-bayern.de/>

### **Hochsprung**

The Hochschule program for business establishment was founded in 2000 in the context of the "High-Tech-Offensive Bayern ins Leben" and is an initiative of the Bavarian State Ministry of Education, Science and the Arts. The project management is at the Ludwig-Maximilians-Universität München.

The program targets students, scientists and graduates with an interest for starting up a business. In the early years developed initiatives across Bayern like the "5-Euro-Business-Wettbewerb", the founder competition HOCHSPRUNG-MediaAward or the conference "Bayerischer Hochschul-Gründertag".

Meanwhile Hochsprung has established itself as a Bayern network of establishment consultants and entrepreneurship educators of the Hochschulen.

<http://www.hoch-sprung.de/index.php?page=ueber-hochsprung>

## **Entrepreneurial support schemes and start-up support in Bavaria and Munich:**

### **Haus der Forschung**

"Haus der Forschung" provides Bavarian stakeholders with integrated advisory services on funding, including comprehensive information and assistance in the application procedure for EU funding programs. It is based in Nuremberg and Munich and is a cooperation of Bayern Innovativ GmbH, BayFOR GmbH, Bayerische Forschungstiftung (BFS) and Innovations- und Technologiezentrum Bayern (ITZB).

<http://www.hausderforschung.bayern.de/>

### **Bayern Innovativ**

Bayern Innovativ is part of Haus der Forschung, and geographically placed in Nürnberg, founded in 1995 by the government in Bayern. It is owned by the two ministries for Economy and Education & Research. The purpose is to enhance innovation and knowledge transfer, to increase growth, development and life quality in Bayern. BI has about 120 employees, 80.000 customers from more than 40.000 companies and 80 organisations. BI works and cooperates with a wide range of industries, technologies and knowledge environments, with a cross-linked approach. They try to create cooperation's about "innovation of tomorrow".

<http://www.bayern-innovativ.de/?>

### ***Bayern Kapital***

Bayern Kapital GmbH is a public Bavarian venture capital company and was founded as part of the "Bavarian Future Initiative" as a wholly-owned subsidiary of the LfA Förderbank Bayern (Bavaria's development bank) at the end of 1995. The objective of Bayern Kapital is to finance research and development and market the launch of new products. In this effort, Bayern Kapital usually acts as a co-investor in cooperation with a private lead investor. The "Bayern Kapital model" is unique in Germany. Bayern Kapital has now developed into an essential location factor and driver of private financing in Bavaria.

<http://bayernkapital.de/en/>

## **BayStartUP**

BayStartUP is the Bavarian institution for company formation, financing and acceleration. It is supported by the Bavarian Ministry of Economics as well as by private sponsoring partners. Apart from the Bavarian Ministry of Economics and company sponsors, BayStartUP ist supported by the private members of two Bavarian associations (“Förderverein innovatives Unternehmertum Nordbayern e. V.” and “Förderverein innovatives Unternehmertum Südbayern e. V.”). Amongst the association members there are many startups that had been supported before.

BayStartUP was established in 2014, merging the two Bavarian start-up organisations netzwerk nordbayern and evobis/Munich Businessplan Competition that had been active since 1996. BayStartUP supports innovative startups through the challenges of setting up the company and accelerating the growth. Investors profit from a broad range of startups in different technology markets and are offered qualified matching services.

<http://www.baystartup.de/baystartup/>

## **GründerRegio M**

Gründer Regio M is an initiative made in cooperation between the ministry of Research and ministry of business relations. The purpose is to enhance knowledge sharing between Start-ups and educational institutions in Munich. They guide young entrepreneurs, so they at the best and most successful way can use their academically knowledge into their start-up strategies.

Gründer Regio M is organized is an umbrella organisation including partners from Bayern like universities, research institutions, incubators, consulates etc. They do not only have focus on projects including Munich and Bayern, but also at EU. They work with the following four goals:

- Establish a strong and sustainable entrepreneurship-culture in Munich
- Increase the motivation to establish Start-ups
- Increase the amount of start-ups at the universities
- Present Munich in European start-up project

<http://www.gr-m.de/index.php?id=55,48,0,0,1,0>

## **Munich Network**

With a broad-based backbone in technology and industry, Munich Network is a tech-industry driven independent but not for profit organization geared to promote innovation and entrepreneurship. It links strong global companies, established medium-sized companies and ambitious new technology ventures with research establishments, investors, financial service companies, consulting firms and entrepreneurs. This vibrant technology ecosystem illustrates a broad cross section of the dynamic German innovation and technology landscape.

In this role Munich Network is personally and directly connected with many of the most important technology centers here in Germany, in Europe and internationally. We function as a “Matchmaker,” connecting technology enterprises and entrepreneurs with key contacts in industry and in the user community. These contacts include research and development organizations, investors and especially regional, national and international initiatives. Munich Network has access to business and technology contacts, and can help to identify key talents and innovations, seek investors, and help better understand technical know-how and perspectives

It operates in four business fields:

- Networks - for building contacts and fostering the exchange of experience and ideas
- Technology & Innovation Network - for providing access to innovation, industry and capital
- Collaboration Network - for sharing technical knowledge and expert insights
- Munich Network Conferences - for examining and discussing technology perspectives, markets and trends.

<http://www.munichnetwork.com/homepage.html?L=1>

## **Munich Startup**

Munich Startup is the official Startup portal for Munich and the surrounding region. It was developed by the City of Munich, the Chamber of Commerce and Industry for Munich and Upper Bavaria and the entrepreneurship think tank 4Entrepreneurship within the framework of the Entrepreneurship Strategy Munich. The portal is run by Münchner Gewerbehof- und Technologiezentrum GmbH (MGH), the organization that operates Munich’s industry centers. The Free State of Bavaria is one of several entities that support the initiative.

The portal aims to become the standard initial point of (virtual) contact for Startups in and around Munich. It strives to present both content and players objectively, independently and transparently. The Munich Startup portal sheds light on the Startup community and encourages networking between entrepreneurs and potential partners, investors and mentors. All key stakeholders in the Munich Startup community are involved. Ultimately, the aim is to establish Munich and the surrounding region as the location of choice for fast-growing young companies in Europe.

<https://en.munich-startup.de/about/>

### 3. Innovation Ecosystem Switzerland

#### 3.1 The Swiss Innovation System in Numbers'

For many consecutive years Switzerland is on top the Global Innovation Index (GII), as well as topping a number of other international scoreboards.

Switzerland is particularly strong in the area of innovation output which **is the outcome of market oriented research and innovation.**

This is the ranking by the Global Innovation Index (2015)<sup>1</sup>.

Country	Ranking
Switzerland	1
United Kingdom	2
Sweden	3
Netherlands	4
United States of America	5
Finland	6
Singapore	7
Ireland	8
Luxembourg	9
Denmark	10
Hong Kong (China)	11
Germany	12

Switzerland is very competitive in the field of research and innovation. It is also among the countries with the highest spending on R&D in relation to their gross domestic product. The private sector bears the cost of over two-thirds of Swiss R&D expenditure, which currently amounts to nearly 3 per cent of GDP, or around CHF 16 billion per year. Public research funding hinges mainly on the proactive work of researchers, the principle of competition and international

---

<sup>1</sup> Global Innovation Index 2015

cooperation<sup>2</sup>. The largest part of Swiss R&D takes place in the companies: around 82%. Most of the spending in R&D is from the pharmaceutical companies in Switzerland, where in 2012 they stood for 45%<sup>3</sup>. There has been a positive development since 2000, when both larger companies as well as SME's invest more in R&D.

The key success factors of the continuously high Swiss ranking are among others the excellent educational system as well as the collaboration between all players in the innovation ecosystem. Universities and in particular the Universities of Applied Science work closely together with key industries and associates and this collaboration is one of the reasons for the high success in innovation outputs. Switzerland has a well-developed system to support any person / group / company that has an idea to answer to a market need. Coaching, funding and guidance are mainly in the hands of regional initiatives. Start-Up companies can take advantage of federal programs too. These federal programs wouldn't be able to produce such measurable outcomes, if there were not public-private partnerships and well anchored organizations working with the established industries, foundations and academia, if required<sup>4</sup>.

### **3.1.1 Macro-level: The Innovation Framework**

In order to ensure a favourable framework for innovation in Switzerland, it is worth looking at the key innovation actors and the various initiatives that exist to promote both research and innovation.

The Swiss Confederation is responsible for providing grant funding for research and innovation. This is done through the two national institutions Swiss National Science Foundation (SNSF) and the Commission for Technology and Innovation (CTI). SNSF primarily funds research, whereas CTI is the Confederation's innovation promotion agency. SNSF support research within any fields and fund over 3.400 projects a year<sup>5</sup>.

---

<sup>2</sup> SERI (Secretariat of Education, Research and Innovation)<https://www.sbf.admin.ch/sbf/en/home/topics/research-and-innovation-in-switzerland.html>

<sup>3</sup> "Forschung und Innovation in der Schweiz 2016" page 76

<sup>4</sup> "The research and innovation landscape in Switzerland and new funding possibilities for Danish research environment – An overview report."

<sup>5</sup> <http://www.snf.ch/en/Pages/default.aspx>

The Commission for Technology and Innovation was set up by the Federal Council and is responsible for the promotion of innovation and is affiliated with the Federal Department of Economic Affairs, Education and Research. CTI has both coaches and innovation mentors, where the coaches help selected young companies, and the innovation mentors supports and advice SME's. CTI is active in 3 funding areas: R&D project funding, Start-ups and Entrepreneurship and KTT (Knowledge- and Technology Transfer) support. They co-fund R&D projects between universities, mostly Universities of Applied Sciences, and companies. In particular they fund projects within engineering sciences, enabling sciences, life sciences and micro- and nanotechnology. For start-ups and entrepreneurship they offer training programs and coaching<sup>6</sup>. Switzerland is known for their high level of patent seeking, which is also one of the key factors as to why they are at the top of GII. With the Patent Cooperation Treaty (PCT) as well as the World Intellectual Property Organisation (WIPO) the patents are made international and patent protected in more countries. Switzerland had around 296 PCT-patent registrations per million citizens in 2013<sup>7</sup>. In 2014 Switzerland and Denmark were close in numbers of patent applications – Switzerland had 1.480 whereas Denmark has 1.377<sup>8</sup>. Many patent applications made from Switzerland is also from foreign companies, which documents the extent of foreign knowledge investments in Switzerland approximately 29% of the Swiss patent applications are from foreign companies<sup>9</sup>.

### **3.1.2 Meso-level: Institutional Pillars**

In Switzerland the higher-educational system consists of cantonal universities (10 universities), federal institutes of technology (2 institutes), universities of applied sciences, both public and private (7 public and 2 private UoASs) and universities of teacher education (14). Fundamental research is mainly carried out by the Cantonal universities and the federal institutes of technology. Applied research is mainly carried out by universities of applied sciences in collaboration with the private sector.

---

<sup>6</sup> <https://www.kti.admin.ch/kti/en/home.html>

<sup>7</sup> "Forschung und Innovation in der Schweiz 2016" page 89

<sup>8</sup> <http://data.worldbank.org/indicator/IP.PAT.RESD?end=2014&locations=CH-DK&start=2000>

<sup>9</sup> "Forschung und Innovation in der Schweiz 2016" page 89

According to the report *Higher Education and Research in Switzerland*, produced 2015 by SERI (State Secretariat for Education, Research and Innovation) Swiss higher education institutions have demonstrated internationally recognised performance and have made significant contributions to the economic, cultural and social development of our country, based on these strong points:

- A diverse range of high-quality study options in all disciplines and fields of study. Various tier-one universities figure prominently in international university ranking lists;
- The open access to higher education: enrolment is possible for anyone who has recognised upper-secondary level qualifications;
- High employment rates of university graduates;
- High level of internationally recognised research performance
- Strong international appeal. Foreign nationals account for around a quarter of all students and over 40% of researchers enrolled at Swiss higher education institutions” (p 4. *Higher Education and Research in Switzerland*).

Part of the eco-innovation system and the reasons for the strong collaboration between industries and HEI ins Switzerland is also the very well established system of dual studies, or Professional education and training (PET) and “*berufsbegleitene*”<sup>10</sup> in Switzerland. (PET) is integrated part of Swiss tertiary education... “PET allows broader swathes of the population to obtain specific professional skills that suit their own needs as well as those of the labour market. The PET sector therefore indirectly strengthens the higher education sector, which focuses mainly on academics and research. The PET sector also helps to ensure that employers are able to find qualified workers with an ideal blend of different types of skills”. (p 21. *Higher Education and Research in Switzerland*)

One of the federal institutions of technology EPF Lausanne is one of Switzerland’s most innovative universities<sup>11</sup>. It has around 350 laboratories and research groups on campus. One innovative initiative is The EPFL Innovation Park, which houses start-ups, SME’s and large companies within several areas. These possible tailored partnerships between the university, research and the

---

<sup>10</sup> The terminolgy for Dual Studies in Switzerland is *berufsbegleitene*.

<sup>11</sup> <http://www.reuters.com/article/idUSL1N11K16Q20150915>

companies are critical instruments for innovation<sup>12</sup>. Together with the Science Park set up by Switzerland Innovation, EPF Lausanne is indeed a university focusing on the innovation ecosystem.

One of the largest Universities of Applied Sciences in Switzerland is Zurich University of Applied Sciences, ZHAW <https://fh-hwz.ch/>. This is an innovative partner that works closely with both companies and business institutions. The many projects Switzerland is Zurich University of Applied Sciences is involved in ensure knowledge and technology transfer between the universities and the industries; primarily within energy and social integration where ZHAW first and foremost wants to strengthen the technology innovation in the society.<sup>13</sup> ZHAW (Zurich University of Applied Sciences) has an **Innovation to Business (I2B) program**, where innovative ideas from the ZHAW research is selected and accompanied to the spin-off stage. Entrepreneurship@ZHAW is a contact point for start-ups at ZHAW and members of ZHAW, who wants to found a company. Here CTI offers their assistance with the CTI-startup training, RUNWAY functions as an incubator for start-ups. Zurich University of Applied Sciences also has GROW (Gründerorganisation Wädenswil), which was started by ZHAW and the town of Wädenswil and other partners. Here they have around 20-25 start-ups they guide at implementation, financing and personnel planning stages<sup>14</sup>.

Another Innovation measure established within Zurich University of Applied Sciences is the **Technopark Winterthur**. This is an environment for innovative people, start-ups, established companies as well as research institutions to be able to interact and collaborate and share knowledge. This was established in 2002.

**Clusters in Switzerland** mainly have the same setup as in Denmark. It is a network of large and smaller companies within the same industry as well as consisting of universities and some public organisations. The Federal Government SECO and their departments promote the possibilities for industry clusters in Switzerland. There are also cluster initiatives within the cantons, where some cantons also support cluster initiatives financially.<sup>15</sup> In Switzerland clusters are either limited to a certain territory or an industry, and not all are open for international memberships. Some clusters

---

<sup>12</sup> <http://www.epfl-innovationpark.ch/community/companies/venture-capital/>

<sup>13</sup> „Higher Education and Research in Switzerland“ p. 49

<sup>14</sup> <https://www.zhaw.ch/de/hochschule/>

<sup>15</sup> "Cluster Policies; Country Report: Switzerland" p. 4

are very international and promote the international aspect of the certain industry. They often have many strategic partners not only with foreign companies, but also with foreign clusters within the same industry<sup>16</sup>.

### **3.1.3 Micro-level: Companies**

As mentioned earlier the Swiss companies have the highest spending expenditure of R&D in Switzerland. In order for them to continuously stay innovative, they work together with many universities in order to benefit from the emerging new students, who have great educational background thanks to the education system in Switzerland. Therefore they also participate in the initiatives from the universities such as the mentioned EPFL Innovation Park as well as the Science Parks being established by Switzerland Innovation over the next couple of years. Not only do the large companies invest a lot in innovation, which can be seen through patent applications, the large number of start-ups in Switzerland is also a good innovation indicator. The start-up scene is also very well supported by the aforementioned initiatives in Switzerland, not only by CTI but also through various universities and connected start-up initiatives.

## **3.2 Real life case: Swiss innovation through new science parks**

### **Switzerland Innovation – Science parks**

The organisation Switzerland Innovation<sup>17</sup> has created five science parks in Switzerland, with the purpose of establishing a platform where the collaboration between companies and universities is strengthened. The aim is to continuously ensure that Switzerland is the leader within innovation and research. Switzerland Innovation focuses on 7 innovative areas: life sciences, industry 4.0, energy, materials, information and communication technology (ICT), transportation and mobility and enabling technologies. Each Science Park has its own focus within the 7 innovative areas. Mainly Park Zurich and Park Network West EPFL are involved within almost all of the focus areas. Companies have their own development teams available at the five different sites depending on the focus area. In Park Basel the main focus is R&D within biotech and biomedical engineering,

---

<sup>16</sup> <http://www.ansiedlung-schweiz.ch/2014/02/cluster-in-der-schweiz/>

<sup>17</sup> Switzerland Innovation „Switzerland Innovation – The best place for your innovation“, 2016

sciences and technologies. Not only are some of the most important life sciences ecosystem companies such as Novartis, Roche, Actelion nearby but the park is also placed within the leading Life Science cluster in Europe. This together with also a handful of SME's makes Park Basel a very innovative area for Life Science. Partners at the Science Parks are both universities, companies, SME's, cluster networks. Especially the Science Park build within EPFL has a long list of innovative companies and since this science park covers most focus areas so does the companies; Siemens, Logitech, Nestlé, Merck are only some of the companies involved in this Science Park. The Science Park Network West EPFL is spread out with six innovation centres, where they all have different main focus areas.

## 4. Innovation Ecosystem Denmark

### 4.1 The Danish Innovation System in Numbers

Denmark historically has been one of the leaders in the EU in promotion of sustainable economies and innovation. According to the recently released European Innovation Scoreboard 2016, Denmark is no 2 (same position as last year), after Sweden, and followed by Finland, Germany and the Netherlands. The European Commission, which publishes the Innovation Scoreboard, notes that *“Denmark is performing above the EU-average in all dimensions, most notably in Open, excellent and attractive research systems, Linkages and entrepreneurship, and Intellectual assets. In particular in International scientific co-publications and Public-private co-publications, the country is performing well above the EU average. Relative weaknesses are in Non-R&D innovation expenditures. Performance has improved for 14 indicators and on average most strongly in the dimensions Human resources (5.3%) and Economic effects (3.4%). Performance has declined in Finance and support (- 2.0%), due to a relatively sharp decline in Venture capital investments (- 9.0%)”*. (EC, July 2016).

One of the characteristics of the Danish innovation system is that it is in fact *a system*. A system, or framework, that is fairly transparent and well established, where key actors – industry, SMEs, universities and Universities of applied Sciences, as well as the intermediaries such as clusters, technological institutes, and public authorities such as regions, growth houses, and ministries collaborate in a systemic and, compared to many other European countries, seamless way. In that sense, the eco innovation system in Denmark is strong and interdependent, and has many similarities to the German eco-innovation systems.

Looking at two indicators of a strong eco-innovation system, namely the *level of investment in R&I* by Danish companies and their *collaboration with universities*, the Danish Agency for Science, Technology and Innovation ( DASTI, UFM) published a report in July 2016 on Danish industries and SMEs research and innovation development<sup>18</sup>, which shows that the 3.400 active R&D –orientated companies in Denmark in 2013 invested app 36,3 billion DKK<sup>19</sup>.

---

<sup>18</sup> Kortlægning af forskning, udvikling og innovation i Danmark – med et regionalt perspektiv, FI, Forskning og Innovation: Analyse og Evaluering 1/ 2016

In many innovation and business support programs knowledge institutions, particularly universities, play a central role as a knowledge partner for companies. The eight universities in Denmark have a long tradition for close collaboration with external partners and a number of different, formalised frameworks, project and match-making networks, etc., within which tech-transfer, innovation and knowledge exchange takes place- mainly with applied research activities, but also new business development entrepreneurship and some basic research activities.

An interesting example of formalised eco-innovation environment is the Manufacturing Academy of Denmark (MADE). MADE is formed by a number of senior and major Danish companies (or companies located in Denmark) - Danfoss, Grundfos, Lego, NKT, Terma, Danish Crown, Siemens and Haldor Topsoe - along with a number of universities and research institutions. The focus is to help companies in key areas such as new production processes, flexible automation, sensors, quality control, etc., whilst ensuring that latest research innovation is integrated into the projects<sup>20</sup>.

However, the universities are not equally involved. Most companies collaborate with Aalborg University and University of Southern Denmark. The two universities have cooperated with private companies 2,300 and 2,200 times respectively. For Technical University of Denmark almost 2,000 companies are cooperating through a program with the University.<sup>21</sup> All universities mainly cooperate with companies in the region in which their headquarters is located. Again, there are considerable differences between universities: from Aarhus University where only 34 pct. of the company collaborations are located in the Central Denmark Region, to Roskilde University, where 79 pct. are from Region Zealand.

---

<sup>19</sup> Kortlægning af forskning, udvikling og innovation i Danmark – med et regionalt perspektiv, FI, Forskning og Innovation: Analyse og Evaluering 1/ 2016, p. 11.

<sup>20</sup> DI(2013), 'Forskning og Uddannelse', side 12

<sup>21</sup> Styrelsen for Forskning og Innovation, 2014, page 16, Sammenhængsanalyse

## **The innovation framework**

Overall, looking at the industrial bases of Danish innovative sectors, Denmark is one of the leading exporters of environmental solutions and technology. Today, products and services related to energy and environment have become the second-largest export sector in the country, only surpassed by the transport sector but more important than food products. A number of sectors have high potential for future eco-innovations; among those are shipping, bio-technology, and industrial symbiosis. With only few natural resources, the Danish economy relies almost entirely on human resources. The service sector makes up the vast amount of the employment and economy. Today, this sector accounts for 68% of total GDP in the private sector, 64% of total private employment, and for 80% of new jobs in the country (Dansk Erhverv, 2010). Therefore, it is recognised by the Danish government that innovation and research, especially in the private sector, will be a key driver to sustain growth. Denmark has in recent years experienced a sharp increase in the share of GDP of total R&D expenditures which is mainly due to higher contributions made by the public sector, while the share of the business sector remains unchanged. In the public sector universities accounted for 73 % of research and development with costs amounting to EUR 2.2 billion in 2014, with an almost equal distribution of costs on applied research and basic research.

- Among the EU Member States Denmark holds a third place among the highest R&D intensities in 2013 with a total of 3.06 % on RD spending's of GDP (Eurostat 2013).
- In 2014, the business sector contributed with EUR 4.88 Billion or 1.87 % of GDP on R&D. The public sector contributed with EUR 3.01 billion, corresponding to 1.15 % of GDP.
- In terms of patent applications in 2013, 1.000 patents were granted and 4.000 trademarks were registered (Dansk Statistik, 2016).

In Denmark a wide range of public Institutions are involved in supporting eco-innovation, either through policy-making (setting standards, strategies, programmes), or through direct funding or co-financing programmes for development and demonstration of new technologies, green business scheme, etc.

The regional economic systems in Denmark consists in total of approximately 250 operators, which annually serves and helps about 100,000 entrepreneurs and companies to elucidate, manage and solve growth challenges.

The many operators represent a diverse and specialized system, where a number of operators, helping companies solve specific growth challenges. For example, the field of internationalization, innovation, knowledge collaboration, business start-up, technology, finance, etc. At the same time established local inputs in most municipalities can keep close business contacts.

The national programs can be grouped in three. One group consists of programs within the Ministry of Higher Education and Science. The second group consists of other national programs administrated by specific ministries like Ministry of Food, Agriculture and Fishery of Denmark. The third group is programs targeted towards SMEs.

A number policy frameworks and innovation support schemes help strengthen as well as partially finance the Danish eco- innovation system<sup>22</sup>. In 2012, the government launched the national innovation strategy '*Denmark – the Country of Solutions*'. The innovation strategy is designed to ensure a tighter coupling between research, education and business and by that foster innovation, growth and job creation. At the same time the strategy contributes to the wish for more targeted innovative solutions to tackle global challenges. The Innovation Strategy contains 27 concrete initiatives in three areas of focus:

- 1) **Social Challenges must drive innovation:** Demand for solutions to specific challenges in society must be given priority in the public innovation efforts.
- 2) **More knowledge has to be translated into value:** Focus on mutual knowledge between businesses and knowledge institutions and more effective innovation systems.

---

<sup>22</sup> The most important strategic policies are:

- The regional growth and development strategies

They include e.g. the local industry and development strategies, The sub-regional growth strategies (ex. Business Region Aarhus, Business Randers, etc), the governmental innovation strategy, the governmental growth policy, Strategy of the Trade Council (Ministry of Foreign Affairs), the universities individual strategies for industry collaboration, the annual Væksthus-aftale between Erhvervsstyrelsen and KL.

- 3) Education should increase innovation capacity.** A cultural change in the education system with more focus on innovation.

#### **4.2 The clusters and GTS institutes - effective eco-innovation environment**

Denmark has more than 50 **clusters and innovative networks**, aiming at create growth and innovation nationally or regionally. 22 of these are approved Innovation Networks by the Ministry of Higher Education and Science reinforcing the national agenda of promoting innovation, collaboration, growth and internationalisation<sup>23</sup>.

Danish clusters and innovative networks are forums where companies and knowledge institutions share experience and develop new ideas within a specialist or technologically delimited field. The clusters provide access to the right knowledge and the right people who may inspire, lift ideas to innovative and promising businesses and help find funding.

The Danish clusters are supported by the secretariat of Cluster Excellence Denmark- the national support function for clusters and innovative networks in Denmark<sup>24</sup>. Cluster Excellence Denmark provides a number of services for the clusters and innovative networks in order to ensure optimum working conditions, including for instance support for internationalization, helping the clusters to find international partners, and engage in matchmaking.

In 2013, 13.000 companies participated in the activities in the Danish clusters. 3418 companies developed new ideas. 2979 companies were introduced to new competences and tools, which significantly improves their capability to innovate. 1353 companies developed new products, services or processes as a result of cooperating with one of the Danish clusters.

Another key actor in the Danish innovation system is the **GTS Network** (Advanced Technology Group) and the group of independent GTS institutes. They support customers' innovation and constitute the core of the technological infrastructure in Denmark, also acting as technology and

---

<sup>23</sup> *Cluster Strategy 2.0 Strategy for Denmark's Cluster and Network Policy 2016-2018*; Ministry of Higher Education and Science, DASTI, 2016

<sup>24</sup> <http://www.clusterexcellencedenmark.dk/> Cluster Excellence Denmark is co-funded by the Danish Agency for Science, Technology and Innovation and the Danish regions.

knowledge transfer agents particularly to SMEs. The GTS institutes offer knowledge, technology and consultancy, co-operation on technological and market-related innovation, testing, optimization, quality assurance, certifications and benchmarking – all of which contribute to enhancing the international competitiveness of the Danish business sector and benefit Danish society in general. An example of how integrated the GTS institutes are within the Danish eco-innovation system is the recent DASTI (Agency for Science, Technology and Innovation) allocation of 909 million DKK to 94 ICT-activities that the eight Danish GTS-institutes will implement in the period 2016-18<sup>25</sup>.

The below Figure 10 is a map (2014<sup>26</sup>) showing how the public innovation programs have been used and which institutions have been involved.<sup>27</sup> The study called *Coherence for Growth and Innovation* is a data-based impact study on the demand/supply structure of the Danish innovation and industry-promotion system. The lines thickness is determined by the number of companies that have participated in both schemes.

---

<sup>25</sup> In April and May 2015, the website [bedreinnovation.dk](http://bedreinnovation.dk) (Better Innovation) was open to suggestions and comments on which technological knowledge the Advanced Technology Group (GTS) should focus on developing and communicating in the coming years. Companies, professional organizations, business promotion agencies, researchers, public authorities and private individuals delivered more than 2,000 comments, which formed the basis of the contracts with the GTS institutes for the coming three-year period.

<sup>26</sup> A 2014 study commissioned by DASTI, undertaken by DAMVAD

<sup>27</sup> DASTI 2014. *Sammenhæng for vækst og innovation*



## The role of companies and start-ups

Denmark spawns many entrepreneurs, but only a few new high-growth companies and even less new, large companies based in Denmark. Denmark is in the top 5 in terms of establishment of new companies in OECD. However, during the last thirty years, Denmark has only added five new companies to the list of the country's hundred largest companies by turnover. There is a consensus that this has to be changed. Initiatives to promote entrepreneurship and innovation are funding intensively by the 5 regions in Denmark. The Region of Southern Denmark, Region of Zealand, North Denmark Region, Central Denmark Region and the Capital Region of Denmark are responsible for regional development programs that reinforce the national agenda of entrepreneurship, collaboration and growth.

The regional councils have established regional growth forums (Vækstforum) and invest in business productivity, growth and exports. Many have entered into partnership with the Government in order to increase growth and internationalisation<sup>28</sup>.

The goal is for companies to develop new products and technologies, seek new export markets and qualify employees to solve new tasks. Investments can also go to the establishment of new physical test facilities. Combined the forums invest around DKK 350

million from the EU's Structural Funds annually by recommending to the Danish Business Authority, how funds are to be used, and the Danish Business Authority gives the final approval. The targeted growth initiatives that are rooted in each region have in five years created almost 14,000 jobs and increased revenue by 34 billion from private companies.<sup>29</sup>



<sup>28</sup> <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/policy-document/growth-partnership-between-government-and-capital-region%E2%80%99s-growth-forum>

<sup>29</sup> <http://www.regioner.dk/services/nyheder/2016/juli/regional-vaekstindsats-medvirker-til-tusindvis-af-arbejdspladser>

**In summary** the level of Denmark's expenditures on R&D are high and both private and public sector contribute to the fact that Denmark's ranks high on a European comparison. To ensure this position however, Denmark needs to revise the relation between public and private players. It is well known that especially research in Life Science in considerable extent is driven by a few large Danish companies and private foundations. Overall, the ten largest Danish companies make up 40 % of the total private sector research in Denmark, and it is very much the big medico-oriented enterprises being the main driver here.<sup>30</sup> There are prospects to extend such cooperation to other parts of the Danish business community.

## **5. Summary and Opportunities**

In many respects, the Danish and German innovation and education landscape can be seen to be alike, as many Danish Universities, University Colleges and Business Academies already have well-established relations with external partners and a lively student environment with start-up activities, innovation camps etc. However what differentiates Germany and Denmark and are good learning points are:

- The very systematic approach to creating entrepreneurial environments and schemes, and to collaboration with external partners
- The sheer scale – the clusters in Bavaria and Germany are larger with more members and larger industries and SMEs, meaning that collaboration often concerns much bigger and financially more ambitious projects;
- Relationship with universities of applied sciences and industry is very close and HEIs are often placed in close proximity to the industry partners in the country side or in industrial areas;
- Staff at the universities of applied sciences is often required to have had a professional career of minimum five years before being employed at a UoAS and there is generally a very flexible, fluid and well-established career path between HEIs and private sector

---

<sup>30</sup> Produktivitetskommissionen(2013), 'Uddannelse og Innovation'

- Entrepreneurial support and creating strong entrepreneurial universities is seen as valuable and necessary ambition for Germany HEI.
- Testimony to the importance of creating entrepreneurial universities is the EXIST funding programme, which has existed for 16 years. It is a very comprehensive and wide reaching programme, managed by the German Federal Ministry for Economic Affairs and Energy (BMWi), and co-financed by the European Social Fund.

Based on these differences a multitude of opportunities for Danish public and private stakeholders emerge to support and promote innovation, to create value by adapting successful approaches to the Danish innovation eco-system, getting in touch with the German partners and entering into joint ventures and partnerships. These opportunities span all the national, regional and communal levels, universities and institutes on the public side in regards to enhancing the framework or larger (joint) projects as well as direct collaborations with the private sector.

Especially the southern German region and in particular Bavaria has an enormous potential for Danish stakeholders as it is the economically strongest region with the highest degree of innovation. The research expenditures with more than three percent are above the German average and half of the employees working in the high-tech sector where Bavaria is leading in ICT, bioengineering, nanotechnology as well as medical, energy and environmental engineering and the gross value share of this R&D-intensive sector amounts to almost two thirds of the industrial performance.

National government can learn from programs like EXIST and get in touch with the project executing agency Jülich as well as successful spin-outs and companies to explore similar possibilities in Denmark to promote entrepreneurship and to increase the numbers of start-ups.

To support innovations regionally the Danish regions should initiate a dialogue and knowledge exchange with regional actors from the most successful German states like Bavaria. Since the very tight network between government, public and private institutions and companies is the core for collaborations and synergies leading to a high degree of excellency and innovation a study tour

with round tables and case stories will support the promotion of the regional innovation in Denmark with inspiration for concrete and successful concepts.

The GTS or Advanced Technology Group and other research institutes: Opportunities to strengthen access to cutting edge research and science, create more innovation, and profit from the German innovation eco-system is to get in contact with their counterparts like the Fraunhofer Institute. Thereby not only an exchange platform for knowledge is created, but also possibilities to outsource work to specialists and in return getting access to customers from Germany in the relevant areas of competence.