

Securing Australia's Future - Project 9 Translating research for economic and social benefit: country comparisons

Denmark

A Study of Measures to Encourage the Translation of Public Sector Research for Economic and Social Benefit in Denmark

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1. Introduction

Population: 5.6 million (2013)

GDP per capita: €32,100 (2012)

R&D intensity (GERD/GDP): 2.99% (2012)

Private sector share of R&D: 66% (2012)¹

General elections were held in Denmark on 18 June 2015 leading to a change of Government

This modern market economy features a high-tech agricultural sector, state-of-the-art industry with world-leading firms in pharmaceuticals, maritime shipping and renewable energy, and a high dependence on foreign trade. Denmark is a member of the European Union but has elected not to join the European Monetary Union. Denmark is a net exporter of food and energy and enjoys a comfortable balance of payments surplus, but depends on imports of raw materials for the manufacturing sector.

Denmark maintained a healthy budget surplus for many years up to 2008, but the budget balance swung into deficit in 2009, where it remains. In spite of the deficits, the new coalition government delivered a modest stimulus to the economy in 2012. Nonetheless, Denmark's fiscal position remains among the strongest in the EU with public debt at about 46% of GDP in 2013.²

Denmark has strong business innovation, particularly in emerging and renewable energy technologies. BERD stands at 2.99% of GDP and triadic patenting is at the top of mid-range in the OECD area. The share of public R&D expenditures financed by industry is below the OECD median, whereas the rate of patents filed by universities and PRIs is above it. International co-operation in science and innovation is mixed as well - while Denmark is at the top of the mid-range performance in terms of international co-authorship of scientific publications, international co-applications for PCT patents are below the OECD median. ICT infrastructures are well developed, and Denmark ranks third in terms of fixed broadband subscribers per 100 inhabitants within the OECD area. S&T occupations represent 41% of total employment but at 34%, the tertiary-qualified adult population is just above the OECD median.³

Since the election of the government in October 2011, STI policy has received renewed attention in Danish policy. The ambition has been to develop Denmark's first comprehensive innovation strategy based on collaborative efforts between the involved ministries, i.e. the Ministry of Science, Innovation and Higher Education, the Ministry of Business and Growth and other relevant sectoral ministries, as well as stakeholders from the Danish innovation system.

It built particularly on the action plan 'Innovation Denmark 2010-2013'⁴ released in 2010 by the Danish Council for Technology and Innovation to foster collaboration between enterprises, universities and ATS-institutes.

The vision of The Council was that “Denmark in 2020 rightfully can call itself an innovative nation. Private and public sector production and service enterprises alike must once again be among the most competitive and innovative in the world. Through dissemination of new knowledge and technology, the council also wishes to contribute to solving major societal challenges and to support the development of new forms of innovation in the business community.”

Three clear and measurable goals were announced:

- Danish enterprises must become more innovative. This is particularly the case for SMEs. At least 50% of all Danish enterprises must be innovative (in 2008, 42% were innovative) and at least 25% must be involved in R&D (in 2008, 24% were involved in R&D).
- Danish universities must be attractive business partners. At least 15% of innovative Danish enterprises must collaborate with universities (in 2008, 14% collaborated with universities).
- The share of enterprises with less than 50 employees employing a highly educated employee must exceed 30% (in 2007, this was 27%).

A Research and Innovation Indicator Report in 2014 gives an indication of progress towards achieving these objectives⁵:

| Measure | Denmark % | OECD Average % | Danish Ranking |
|---|-----------|----------------|----------------|
| Share of innovative companies | 52.56 | 50.10 | 11 |
| Private investments in research and development as a % of GDP | 2.03 | 1.33 | 7 |
| Share of highly educated in the private sector | 23.5 | 26.4 | 14 |
| Public investments in R&D as a % of GDP | 1.06 | 0.73 | 4 |
| Share of external funding of public research | 19.84 | 16.86 | 13 |

The Danish government and legislature allocated more than DKK 3.5B¹ to the Council’s initiatives for 2010-2013. The action plan was reported to contain more than 50 specific initiatives to be completed by 2013. These were organised around four themes: collaboration between business and research, developing a highly skilled workforce, strengthened technological services and commercialisation of research, In addition there were a number of cross-cutting issues including evaluation and impact analysis, service innovation and the public sector, the future of production, internationalisation and SME strategy.

However, none of these were implemented, as a new innovation strategy, ‘**Denmark - a nation of solutions: enhanced cooperation and improved frameworks for innovation in enterprises 2012-2020**’ was launched in December 2012.⁶ This strategy represents a shift to a demand-driven innovation policy approach, with an emphasis on enhanced knowledge flows and stronger innovation capabilities in the educational sector. The Danish Council for Technology and Innovation which was responsible for the previous strategy was dismantled.

¹ DK1 = €0.13

The new strategy outlined three broad objectives:

1. Innovation for the grand societal challenges shall be stimulated by re-focused public demand and procurement policies.
2. The knowledge and technology transfer between public research and companies shall be improved.
3. The education system shall set a stronger focus on innovation in order to enhance the innovation capacity.

A cornerstone of the innovation strategy was the RESEARCH2020 catalogue which was published in June 2012 and contains a presentation of five visions that are intended to represent strategic research horizons to be pursued until the year 2020:

- A society with a green economy
- A society with health and quality of life
- A high-tech society with innovation capacity
- An efficient and competitive society
- A competent, cohesive society⁷

There followed a four-stage process was applied to develop focus areas for investment in what was called the INNO+ Catalogue. The stages were:

- i. Mapping of potential focus areas for strategic investments in innovation - in December 2012, the Danish Ministry of Science, Innovation and Higher Education invited a number of stakeholders (trade and industry organisations, ministries, councils and foundations, higher education institutions), to develop proposals for INNO+ focus areas within the societal challenges described in RESEARCH2020 – a basis for prioritising strategic investments in research – as a starting point.
- ii. Stakeholder dialogue on selection of the proposed focus areas - Based on almost 500 proposals five workshops were held in spring 2013, in which the stakeholders were invited to prioritise the proposals.
- iii. Identification of thematic areas and focus areas - the Ministry of Science, Innovation and Higher Education prepared a first draft of the INNO+ Catalogue. RESEARCH2020, Horizon 2020 and the recommendations made by the Danish government's growth teams were also used in the selection process. The catalogue was subsequently submitted for consultation to the stakeholders in May 2013.
- iv. Finalisation of the INNO+ Catalogue - the INNO+ Catalogue was adjusted and finalised during summer 2013.⁸

The growth teams referred to in Stage iii were a separate initiative. Being a leader among OECD countries in bio- and nano-technologies and environmental technologies, the Danish government commissioned eight growth teams with members from industry in areas in which Danish businesses are or can be internationally competitive. Based on their recommendations the government has published specific growth plans for each of the following seven areas: the Blue Denmark; Creative Industries and Design; Water, Bio and Environmental Solutions; Health and Care Solutions; Energy and Climate; Food Sector; and Tourism and Experience Economy. A growth plan for ICT and Digital Growth remains to be published. The plans address specific barriers to investment and focus on areas in which new markets can be developed. For example, government regulations mandating efficiency improvements in the wastewater sector could help to develop more cost-effective technology through which savings can be achieved in the cost of wastewater treatment for large businesses that currently pay higher costs to treat their wastewater. In terms of corporate

development activities, the creation of a single, transparent and efficient means of access to Danish health data could attract medical research to Denmark.⁹

The INNO+ Catalogue contains six main thematic areas, subdivided into a total of 21 focus areas:

1. Innovative transport, environment and urban development
 - 1.1. From waste to resource – more efficient utilisation of household, industrial and construction waste
 - 1.2. Blue jobs via green solutions
 - 1.3. An intelligent and green city with high mobility
 - 1.4. Climate adaptation in cities – global solutions for climate-resilient and sustainable cities
2. Innovative food production and bio-economy
 - 2.1. Intelligent, sustainable and efficient plant production
 - 2.2. From plant residue to high value
 - 2.3. Resource-efficient food production
 - 2.4. Denmark as a global supplier of nutritious and health-promoting food products
3. Innovative health solutions
 - 3.1. Denmark as the preferred country for early clinical testing of new medicines
 - 3.2. Patient self-management of chronic disease
 - 3.3. The efficient and safe hospital
4. Innovative production
 - 4.1. Water-efficient industrial production
 - 4.2. Pharmaceutical and biotechnological production – better, cheaper and safer processes and products
 - 4.3. The intelligent factory
 - 4.4. Advanced materials as a basis for growth and solution to societal challenges
 - 4.5. Made in Denmark - sustainable fashion and textile production
5. Innovative digital solutions
 - 5.1. A Smart Society based on the utilisation of “Big Data”
 - 5.2. Digital learning – competencies for the 21st century labour market
6. Innovative energy solutions
 - 6.1. Innovatorium for building renovation of world class standard
 - 6.2. Industrialisation of offshore wind power on an XXXL scale
 - 6.3. Integrated energy solutions – managing energy in the city intelligently and efficiently.¹⁰

Within these focus areas, 27 individual policy initiatives were defined for implementation from the start of 2013². In order to measure the effectiveness of the innovation strategy, the vision was translated into the following STI policy goals:

- The share of companies introducing innovation should be increased, such that Denmark by 2020 is among the five OECD countries with the highest share of innovative enterprises.

² Reported in ERAWATCH – Denmark but no details could be located

- Private investments into R&D should be increased, such that Denmark by 2020 is among the five OECD countries with the highest private investments into R&D as a share of GDP.
- The share of highly educated employees in the private sector should be increased, such that Denmark by 2020 is among the five OECD countries with the highest shares of highly educated employees in the private sector.¹¹

The OECD STI Outlook 2014 reports a continuation of the consultation process throughout 2013, leading to the selection of five focus areas for strategic investments in innovation in November 2013, to be pursued by partnerships addressing social challenges. The five areas selected for 2014 are: blue jobs via green solutions; intelligent, sustainable and efficient plant production; Denmark as a preferred country for early clinical testing of new medicines; water-efficient industrial production; and building renovation of world-class standard.¹²

To pursue these objectives, the Danish National Advanced Technology Foundation, the Danish Council for Technology and Innovation, and the Danish Council for Strategic Research were amalgamated into a new Foundation – the Innovation Fund Denmark (IFD).¹³ In 2015, IFD will invest almost DKK 1.6billion.

The strategy for Innovation Fund Denmark was published on 29 January 2015. The strategy formulation process commenced after the creation of Innovation Fund Denmark on 1 April 2014 from the merging of three existing bodies – the Danish Council for Strategic Research, the Danish Council for Technology and Innovation and the Danish National Advanced Technology Foundation. The strategy formulation process covered a wide range of topics: formulation of the mission, vision and objectives, definition of new investment types, restructuring of the organisation and governance, creation of a model for user-friendly interaction.¹⁴

1.1. The Act on Innovation Fund Denmark states that it:

- "... shall have the purpose of funding advances in science and technology, including advanced technology, in order thereby to boost research and facilitate innovative solutions for the benefit of growth and employment in Denmark."
- "... shall focus on funding solutions to specific societal challenges and strengthen private sector research and innovation initiatives in small and medium-sized enterprises."
- "... shall establish a flexible model for supervising and evaluating projects that have been awarded funding in order to safeguard the progress of the projects."
- "... funding application procedures shall be straightforward, flexible and reflect the complexity of each individual funding instrument and the size of each grant."¹⁵

The establishment of the Innovation Fund Denmark represents a significant shift in the approach to STI Funding, summarised in the Table¹⁶ below:

| Characteristic | Before | After |
|--------------------------|---|---|
| Organisation | Three separate entities with different target groups and different foci | A single fund with a consolidated mission, vision and objective enacted in national law |
| Investment | Funding | Investment |
| | 14 different funding instruments/ funding opportunities | Investments in Large Scale Projects, Growth Projects and Talents |
| | Strict divides between the target groups for the funding instruments and positioning within the value chain | Investments facilitate partnerships between different target groups and are diversified along the value chain |
| | More advantageous funding opportunities within certain parts of the value chain for certain institutions | Consistent financing opportunities for every type of institution along the value chain |
| Organisation/ Governance | Administrative secretariat | A fund with high level in-house professional skills in organisation |
| | Differing decision-making models for processing applications | Decision-making responsibility lodged strictly with the Board |
| | Diversified governance processes with variable processing times | Efficient, more flexible governance processes lodged with the Board |

IFD's financing policy is rooted in the prevailing legislation. It involves:

- Equal financing opportunities for all projects regardless of whether they are devoted to applied research, experimental development or demonstration and market development
- Incentivised public-private partnerships on projects between national research institutions and private-sector enterprises
- Incentivised active participation by the investment beneficiaries. For this reason, Innovation Fund Denmark finances a maximum of 75% of the project's total budget.

2. Specific Programs

The Innovation Fund Denmark is the major new authority responsible for delivering STI programs. It has only been operational for a year so, while operating principles have been clearly established, it is too early to offer comments on effectiveness. A range of programs previously delivered through other Foundations have been absorbed by this new mechanism.

The three major programs overseen by the Danish Agency for Science, Technology and Innovation, on behalf of the Ministry for Higher Education and Science, which are designed to link public sector research and industry are Collaboration between Research and Industry, Infrastructure between Research and Industry and Strategic Platforms for Innovation and Research'

A program primarily targeting SMEs, to assist them to raise their competence in innovation is the Innovation Voucher Scheme.

The National Network for Technology Transfer is a partially government funded program to assist universities to engage individually and collectively in commercialisation of their research outputs and skills.

2.1. Innovation Fund Denmark (IFD)

There are three schemes: Large Scale Projects, Growth Projects (Innobooster) and Talents.

Large Scale Projects - investments in excess of DKK 5m, including projects along the entire value chain from basic research to the market. For these projects, there are three types of calls:

- Thematic calls: Investments in projects falling under one of IFD's predefined focus areas. The themes are based on long-term strategic prioritisations by the board, and are underpinned by investment strategies specifying IFD's focus within the field
- Open calls: Investments which are not tied to a specific theme but are open to all bright ideas
- Societal innovation partnerships: Investments targeting specific societal challenges in which 5-10 partners (enterprises, national research institutions and public authorities) form an alliance.

Growth Projects - Investments of up to DKK 5m in SMEs with a viable proposition which have high development potential and which require venture capital to nurture their innovation capacity.

Talents - There are two types of investment:

- Industrial PhD/Postdoc, which, by offering postgraduate research appointments, supports the development of research capacities in promising individuals through their performance of specific R&D projects run jointly by enterprises and research institutions. The target group comprises graduates or PhDs and postdoctoral researchers capable of conducting a research project in collaboration with one or more enterprises and research institutions. The enterprise is responsible for co-financing.
- Entrepreneurial Pilot offers financial support for recent graduates with innovative entrepreneurial propositions.

Innovation Fund Denmark has defined six target research areas, which have a marked similarity to the themes developed in the INNO+ Catalogue. These are:

- Bio-resources, food and lifestyle
- Trade, service and society
- Energy, Climate and the Environment
- Production materials, digitisation and ICT
- Infrastructure, transport and construction
- Biotechnology, medicine and health.

For each research area, it will implement in-house competencies and create associated investment strategies. Distinct application processes have been developed for each of the three programs.

For Large Scale Projects, the application process has two phases:

- Phase 1: Concise expression of interest. Based on this, staff and Executive Management prepare decision-support for the Board, which decides whether to extend an invitation to apply for Phase 2.
- Phase 2: The application proper. Staff and Executive Management prepare decision support for the Board after procuring inputs from external peer reviewers. The Board then makes the final decision, with a target total processing time of 5 months.

For Innobooster, depending on the size of the funding amount applied for:

- Applications for DKK 0.5-5m: Selected applicants are invited to give a presentation before an interdisciplinary panel of staff and external peer reviewers, who jointly draw up decision-support. Executive Management makes the final decision within 2 months.
- Applications for less than DKK 0.5m: Applications are screened and assessed by IFD staff. Executive Management then makes the final decision, within 1 month.

For Talents, applications are screened by IFD staff who then prepare decision-support based on evaluations by:

- Industrial PhD Advisory Board (for both Industrial PhDs and postdoctoral candidates),
- A panel of research and industry experts (for Entrepreneurial Pilot). Based on this decision-support, Executive Management makes the final decision within 2 months.

Investments in the period 10 June 2014 to 15 June 2015 were: below:

- Bio-resources, food and lifestyle – DKK 202M, over 2-4 years
- Energy, Climate and the Environment – DKK 334M generally for 4 years
- Production materials, digitisation and ICT – DK433M over 3-5 years
- Infrastructure, transport and construction – DK 157M over 3-4 years
- Biotechnology, medicine and health – DK662M over 3-5 years.¹⁷

2.2. Collaboration between Research and Industry

<http://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/collaboration-between-research-and-industry>

The Danish Agency for Science, Technology and Innovation, on behalf of the Ministry for Higher Education and Science, manages four programs which are designed to promote cooperation and interaction between companies and knowledge institutions. These are the Innovation Networks Denmark, Innovation Agents, Model Agreements and the Innovation Incubators Scheme.¹⁸

There are 22 **innovation networks** (sometimes referred to as clusters) which offer access to a broad overview on the latest science results and innovation trends within their respective fields of expertise and provide inspiration about new developments in technology and product innovation.

The innovation networks can also assist researchers in finding new partners for collaboration on smaller or larger science or innovation projects among private companies, other researchers, technological service providers and other partners – in Denmark and abroad.

The innovation networks each have their own technical or professional focus within sectors such as the food industry, the offshore sector, the service sector, and marketing. Each network operates on a national basis, but the networks are located all over Denmark.

There are two primary target groups for innovation networks:

- 1) Companies within the network's focus area, especially small and medium-sized enterprises
- 2) Research and knowledge institutions and technological intermediaries that operate within the network's focus area.

The Innovation networks can:

- Help develop ideas into new competitive products or services
- Provide inputs and advise for solving problems with product development and innovation
- Provide access to a comprehensive network of researchers from universities, technological service providers as well as other private companies
- Provide overview of and contact to the public research and innovation promotion system
- Provide specific professional resources so relieving companies of the burden to invest in manpower or the latest technological knowledge themselves
- Be a stepping stone for an internationalisation of companies,

They are involved in:

- Initiating specific development projects within the relevant professional field of the network
- Arranging conferences, seminars, workshops on themes of interest of the members of the network
- Helping with fundraising and with the preparation of applications for funding
- Publishing newsletters and other types of information about new tendencies, research results
- Arranging export promotions and study trips abroad for Danish companies.

The innovation networks are open for all interested companies in Denmark. In some of the networks they charge a membership fee; in others the participation is free of charge. Companies finance their own participation in the Innovation Networks activities. The man hours used in the companies have to be registered and are included in total budget of the relevant network.

The Ministry of Science, Technology and Innovation finances up to half of the innovation network activities. The funding by the Ministry is used for setting up a network secretariat, matchmaking activities, and specific collaboration projects within research, education and knowledge dissemination. The networks have to obtain the other half of the funding from private companies or regional funds.

The networks are intended to function as a linchpin with all other major innovation support programs, ensuring the cohesion of the research and innovation activities within the network's focus area. In addition, strong and systematic cooperation is expected between the innovation networks and other advisers and intermediaries that are in contact with companies, including GTS (Advanced Technology Group) institutes.

Applications for innovation networks are invited every second year. New innovation networks are intended to be directed at a target group with critical mass, although no minimum or maximum amounts have been defined. Networks will typically be allocated between DKK 10-20M in government co-financing for a four-year period. The networks must be able to play a nationwide role.

The established networks are listed below. Their focus is generally evident from their title.¹⁹

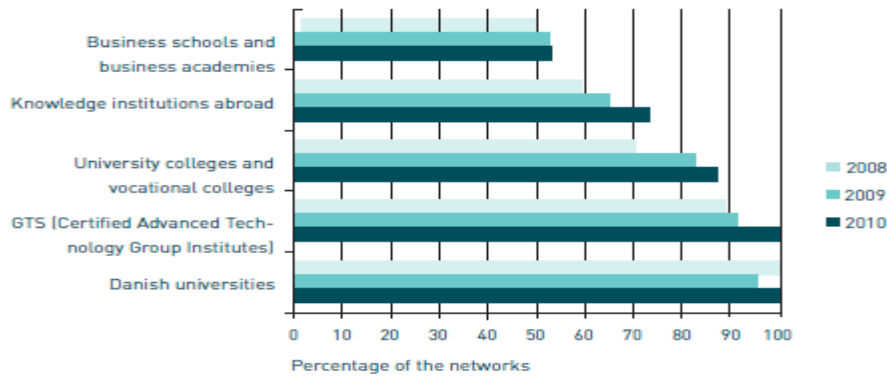
- Innovation Network AluCluster - Knowledge and technology centre for aluminium
- Innovation Network Animation Hub
- Danish Sound Technology Network
- Innovation Network for the Food Sector - FoodNetwork
- Innovation Network for Biotech - Biopeople
- The Danish ICT Innovation Network - Infinit
- Innovation Network InnoBYG - Innovation Network for Energy efficient and Sustainable construction
- Innovation Network for Environmental Technology
- Innovation Network for knowledge-based experience economy - InViO
- Innovation Network for Biomass
- Danish Lighting Innovation Network
- Innovation Network for Market, Communication and Consumption
- Innovation Network Service Platform Service Cluster Denmark
- Innonet Lifestyle Interior & Clothing Innovation Network for Lifestyle
- Plastic and Polymer Innovation Network
- Innovation Network No Age National Partnership for innovative solutions for elderly people
- Innovation Network Offshore Center Denmark
- Innovation Network RoboCluster
- The Transport Innovation Network - TINV
- Innovation Network UNIC National Partnership for the Use of new Technologies in Innovative solutions for Chronic patients
- Innovation Network for Renewable Energy VE-Net
- Innovation Network for Water National Partnership for Water in Urban Areas
- Welfare Tech - Innovation Network for Health and Welfare Technology

An evaluation²⁰ conducted in 2011 shows:

Chart 3.3. Number of companies engaged in projects with knowledge institutions as a consequence of their participation in an innovation network, 2006-2010



Chart 3.4. Percentage of networks that involve various types of knowledge institution, 2008-2010

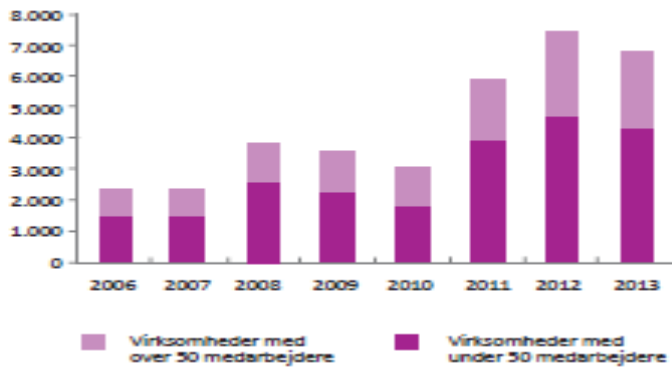


A more recent report²¹ provides the following data, in the form of charts:

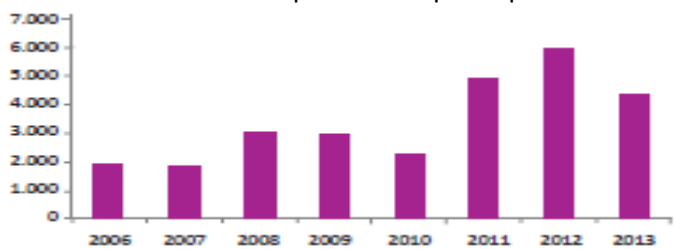
The evolution of the number of networks, which are included in performance accounts 2006-2013



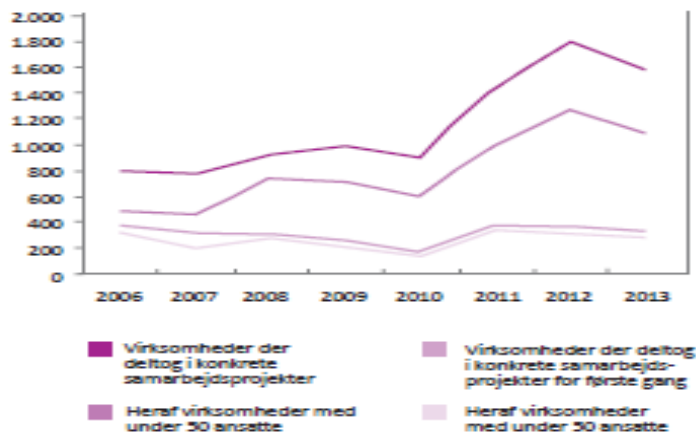
Total number of different companies that have participated in the network's activities



Number of different companies that participated in matchmaking events 2006-2013



Number of companies included in concrete cooperation projects with knowledge institutions as a result of their participation in an innovation network 2006-2013



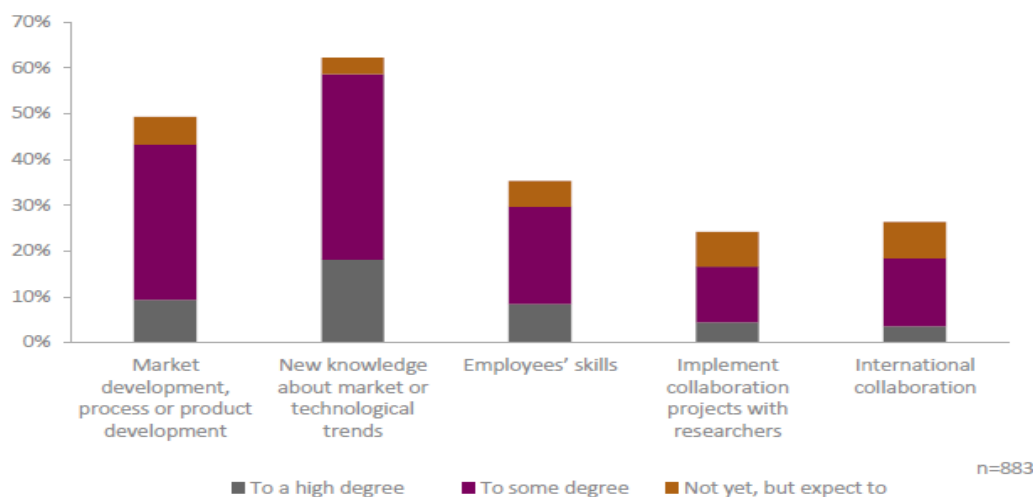
Number of companies that have developed new products, services and/or processes resulting from network participation 2007-2013



A detailed survey was made of 880 enterprises linked to 42 identified Danish clusters, of which 22 are represented by the Innovation Networks.²² The results for the two groups are not separated, but can be concluded to be at least indicative. Major conclusions are:

- clusters contributed to creating innovation in 52% of the participating enterprises
- 60 per cent of the enterprises have developed or expect to develop new ideas or concepts leading to innovation as a result of the cluster work
- an almost equally high proportion of small and large enterprises have had their innovation and competence development strengthened as a result of cluster participation
- As 2/3 of cluster participants are small enterprises with fewer than 50 employees, clusters achieve impact in almost six times as many small as large enterprises
- 42% of enterprises have developed or expect to develop new products or services as a consequence of the cluster activities
- 33% of the enterprises have developed or expect to develop new processes
- 55% of the products and services that have been developed are new to the market, whereas 37% are only new to the enterprise
- In terms of strengthening enterprise innovation competencies, the results are:

Figure 7
Impact of activities on enterprises' competencies



- 60% of the enterprises in the clusters collaborate with other enterprises and 51% collaborate with knowledge institutions
- 50% of the enterprises have found new partners through the cluster in 2013.

Innovation agents have the role of assisting small and medium-size companies to kick-start innovation and collaboration with knowledge institutions. They offer small and medium-size companies a free “innovation check-up”, which identifies innovation opportunities and challenges, and provides specific action proposals for ways of realizing such potentials. The agent also helps companies to take the first steps, e.g. by making contact with the right knowledge institution or advisory expert, or to apply to a public pool for a grant for such innovation activities.²³

Model agreements provide a practical tool for private for enterprises and public research institutions entering into research collaboration. When private enterprises and universities collaborate on research, it is advisable to have a clear contractual agreement on the joint project. To facilitate the negotiation of such contracts, The Johan Schlüter Committee has outlined five model agreements tailored for various types of research collaboration. The model agreements offer practical guidance in respect to issues such as the management of intellectual property rights, publication of research results and confidentiality on business secrets in joint research projects.²⁴

Detailed information about calls for proposals, the self-service e-portal for lodging proposals and managing grants and administration of grants are available at one site.²⁵

The **Innovation Incubator Scheme** operates through four incubators which provide professional counselling, pre-seed and seed capital for entrepreneurs and new innovative enterprises. The innovation incubators operate at the earliest stage of the investment chain, where venture capitalists and other private investors are reluctant to engage. In legal terms, the innovation incubators are private limited companies approved as operators by Ministry of Higher Education and Science following a European public procurement. Currently, the scheme is financed by a national budget grant of approximately 200 million DKK annually (about €25 million).²⁶

The innovative incubators can engage financially in three successive stages:

1) Pre-investigation – a preliminary analysis and evaluation of the technological perspectives and commercial potential of the project (due diligence). On average an amount of 80,000 DKK can be allocated for this stage.

2) Primary project funding -pre-seed funding for the initial capital injection and early stage development activities in the start-up. On behalf of the government the incubator at this stage can invest a maximum of 3.5 million DKK in the form of loans or equity, provided that a supplementary private investment is raised equalling 18% or more of the total primary investment.

3) Secondary project funding - seed funding for further development activities. On behalf of the government the incubator at this stage can invest a maximum of 2.5 million DKK in the form of loans or equity, provided that a supplementary private investment is raised equalling 60% or more of the total secondary investment.

The four Innovation Incubators are:

- Pre-Seed Innovation A/S
- Syddansk Teknologisk Innovation A/S
- CAPNOVA A/S
- Borean Innovation A/S

2.3. Infrastructure between research and industry

<http://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/infrastructure-between-research-and-industry-gts>

The Ministry of Higher Education and Science is responsible for the Infrastructure between research and industry program. This program is delivered through nine GTS (Godkendt Teknologisk Service)

Institutes in Denmark, established as the GTS-Advanced Technology Group network. The GTS network has two main functions:

- To develop and maintain the basic technological infrastructure in Denmark.
- To create technological innovation and development within Danish industry.

Their objective is to spread the most recent knowledge and state-of-the-art technology to the business community and thus further the competitiveness of the companies. Companies can buy services from the GTS-institutes or participate in collaboration projects that are co-funded.

The Minister of Higher Education and Science approves each institute for a period of 3 years. The approval is given on the basis of technological/professional performance, financial performance and organisational solidity.

The GTS institutes are independent not-for-profit organisations whose purpose is to offer knowledge, technology and consultancy, co-operation on technological and market-related innovation, testing, optimisation, 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.

All services are marketed on a commercial and competitive basis in Denmark and abroad. The government does not financially support these services. Companies can buy services from the GTS-institutes or participate in collaboration projects that are co-funded.

The core function of the GTS network is to deliver technological know-how to companies and public institutions to increase innovation and competitiveness of the Danish industry and society. This is done in close corporation with Danish and foreign universities. The GTS network develops competences, know-how, methods and technological services, which are not available in the private sector, but are strongly relevant for Danish industries. The GTS network thereby ensures that the newest knowledge and know-how is available to the Danish industries. As a result, a large proportion of Danish companies, primarily SMEs, are engaged with the Danish innovation system.

In 2013 GTS- Advanced Technology Group had:

- 4,013 employees
- Total turnover of €496.6 million (3.7 billion DKK)
- Approximately 20,000 customers

The institutes are²⁷:

- Agrotech - Institute for Agri Technology and Food Innovation focussed on the agricultural and food industry in three core areas: environmental technology, food innovation and plant innovation. In 2014, turnover was €12M, exports €1M, R&D expenditure € 8M, performance contracts €3M, 76 employees.
- Alexandra Institute - The Alexandra Institute is a privately owned, non-profit company that works with applied IT research, development and innovation. They provide knowledge, development and IT consultancy services to public and private companies and conduct collaborative projects. Examples of projects are smart cities, mobile access to health data, mobile business models and energy and sustainability. In 2014 turnover was €8M, exports €1M, R&D expenditure €5M, performance contracts €2M, 85 employees.

- Bioneer - Bioneer A/S is an independent, research-based service company within biomedicine, biomedical technology and biotechnology. Competences include production of recombinant protein, drug characterisation, validation of biomarkers and drug targets and stem cell development. In 2014, turnover was €6, exports €3M, R&D expenditure €4M, performance contracts worth €2M, 37 employees.
- DBI-Danish Institute of Fire and Security Technology is an independent, private, non-profit enterprise with a 100 year history in the field of fire safety and security, which performs R&D, provides services to private and public enterprises, and is involved in efforts to set norms and standards at national and international levels. In 2014, turnover was €19M, exports €3M, R&D expenditure €4M, performance contracts worth €1M, 152 employees.
- DELTA-Danish Electronics, Light and Acoustics, which has operated as an independent company since 1941, has core competences in electronics, microelectronics, software technology, optics and light technology, acoustic and vibration technology, and sensor systems. In 2014, turnover was €42M, exports €25M R&D expenditure €9M, performance contracts €5M, 261 employees.
- DFM-Danish Institute of Fundamental Metrology has the primary objective of supporting Danish and international industry by offering calibration and metrological know-how at the highest international level. In 2014, turnover was €4M, exports €1M, R&D expenditure €3M, performance contracts €2M, 26 employees.
- DHI-Water and Environment was established in 2000 with objectives to build competence and promote technological development in areas relevant to water and environment. Emphasis is placed on the development and dissemination of knowledge and technologies in ecology and environmental chemistry, water resources, hydraulic structures and hydrodynamics. In 2014, turnover was €111M, exports €87M, R&D expenditure €25M, performance contracts worth €5M, 1093 employees.
- DTI – Danish Technological Institute is one of the world’s largest private institutes to supply technological services such as consultancy, tests, certification and training for companies and public-sector organisations. The Institute operates in building and construction, energy and climate, life sciences, materials, production, and the Danish Meat Research Institute. The focus is on improving the ability of SMEs to exploit new technologies and management tools. Customer activities account for the majority of the institute’s turnover. In 2014, turnover was €145M, exports €45M, R&D expenditure €63M, performance contracts €16M, 1055 employees.
- FORCE Technology is a knowledge and technology-based service provider which offers development, consultancy and service within the core competencies of testing and inspection, sensors, materials, production optimization, simulation technology, human machine interaction, fluid dynamics, physical model testing, metrology and quality management. FORCE has customers in more than 60 countries and subsidiaries in Sweden, Norway, Russia, China and Singapore. In 2014, turnover was €164M, exports €89M, R&D expenditure €21M, performance contracts €7M, 1325 employees.

In 2009 a detailed evaluation was conducted,²⁸ which concluded:

“In our view, the GTS system has done well in meeting its small and large customers’ national and even international needs for technological services. However, the world is changing around it, so GTS must adapt as needs evolve.

The GTS network’s primary role is ‘de-risking’ innovation by providing a range of R&D and technical services that enable its customers to go beyond what their internal technological capabilities allow. GTS should not abandon its services work but needs to increase the R&D content in order to match the growing knowledge intensity of production. This requires a more active and united strategy across the institutes.

In Denmark, most government funding for research goes to the university system – a focus that has been increased by the recent merger of the government research institutes into that system. This leaves GTS as the institutional mechanism through which government supports innovation in industry and among other producers. It is crucial therefore that the GTS system is adequately funded and capable of providing the highest quality of relevant knowledge inputs into the productive economy.”²⁹

2.4.Strategic Platforms for Innovation and Research (SPIR)

<http://ufm.dk/en/research-and-innovation/funding-programmes-for-research-and-innovation/find-danish-funding-programmes/programmes-managed-by-innovation-fund-denmark/spir?searchterm=SPIR>

SPIR funds initiatives which seek to strengthen the link between strategic research and innovation, dissemination and possibilities for fast application of new knowledge in connection with innovation in the private and public sectors. SPIR is now managed by Innovation Fund Denmark.

The origin of SPIR lies with a 2010 initiative by the Danish Council for Strategic Research and the Danish Council for Technology and Innovation to establish a Danish model for strengthening the links between research and innovation and to create a partnering model in which private sector enterprises will be more extensively involved in both the planning and performance of research and innovation.

The program publishes annual calls which operate in two phases: a pre-qualification phase and a final phase. In the first phase, the focus is on strategy, organisation and on the description of how innovation and research are linked in the platform. The pre-qualified applicants will then have the opportunity to expand on and continue working on the application and bring in additional partners. Only the applications in the final phase will be evaluated by external peers.

The platform may comprise partners (enterprises and institutions) and participants (individuals engaged in research, development and innovation) from both public sector institutions and private sector enterprises, and from both Denmark and abroad. SPIR platforms must have an organisational model designed to promote interaction between the research and innovation actors. The platforms will be built up around the funding instruments referred to as strategic research centres and innovation networks.

A SPIR platform is a consolidated, large-scale research and innovation venture within different target areas:

2010 - energy and food

2011 - intelligent solutions for society and welfare technology

2012 - the bio economy

2013 - future production systems

2015 - big data, advanced materials and energy efficient building renovations.

Funding was provided as follows:

2010 - €9.4m (DKK70m); with co-financing €18.8m (DKK140m)

2011 - €9.4m (DKK70m); with co-financing €18.8m (DKK140m)

2012 - €10.7m (DKK79.5m); with co-financing €20.2m (DKK150m)

2013 - DKK 64 million

Assessment of a Phase I application for funding for a SPIR platform is based on the following criteria:

- the platform's vision and strategy for evolving into an internationally leading and visible research and innovation community;
- the platform's overall organisation, including the organisational, managerial and strategic cohesion between the research and innovation activities;
- the platform's and the activities' scientific/technical and commercial focus and relevance in relation to the purpose of the theme, including the scope of enterprise participation, including that of small and medium-sized enterprises;
- the managerial/scientific competencies of the platform manager(s) and/or other key individuals and the establishment of a competent management structure for the activities;
- the platform's potential significance for growth, innovation, development and welfare in Denmark in the short and long term (utility value), including expectations regarding further dissemination of knowledge to the business target group outside of the platform;
- the contribution of the activities to research training (PhD and postdoctoral);
- the interaction between public and private-sector research and innovation in the activities, and the synergy between the participating parties.

For the assessment of final applications the following assessment criteria will be applied:

- the platform's overall organisation, including the organisational, managerial and strategic cohesion between the research and innovation activities;
- the platform's and the activities' scientific/technical and commercial focus and relevance in relation to the purpose of the theme, including the scope of enterprise participation, also that of small and medium-sized enterprises;
- the managerial/scientific competencies of platform manager(s) and/or other key individuals and the establishment of a competent management structure for the activities;
- the platform's potential significance for growth, innovation, development and welfare in Denmark in the short and long term (utility value), including expectations regarding further dissemination of knowledge to the business target group outside of the platform;
- the contribution of the activities to research training (PhD and postdoctoral);
- the interaction between public and private-sector research and innovation in the activities, and the synergy between the participating parties;
- the activity's relevance, potential impact and quality of research and the links between relevance, potential impact and quality of research;

- the feasibility of the specific activities including management and organisation, timetable, milestones, resources and handling of issues of uncertainty;
- the participating parties' resource contributions (co-financing and commitment, participation in project management and other contributions in the form of facilities and know-how), including in particular co-financing from the private sector;
- the activity's connection with national strategies and position in relation to existing major research and innovation initiatives in the area (including any existing innovation networks and strategic research centres in the area);
- the activity's international dimension, including the platform's contacts with internationally renowned researchers/enterprises capable of strengthening global knowledge building and knowledge sharing in the area.

Allowed costs include labour costs (including overheads), equipment, training (including study trips) and external expertise (consultants, studies, etc.)

2.5. Innovation Voucher Scheme

<http://ufm.dk/en/research-and-innovation/funding-programmes-for-research-and-innovation/find-danish-funding-programmes/programmes-managed-by-innovation-fund-denmark/innovation-vouchers?searchterm=vouchers>

The policy measure aimed at increasing the R&D and innovation capabilities of SMEs by fostering collaboration with public research institutions and RTOs, improving knowledge transfer and by strengthening quality and relevance of public R&D.

The Innovation Voucher was introduced to inspire SMEs to utilise the opportunities and potential of knowledge institutions. At the same time, it was expected to enhance the awareness at knowledge institutions of the need for knowledge and thus secure the quality and societal relevance of public research.³⁰

The scheme was open for projects within all scientific fields. The Council of Technology and Innovation was responsible for the scheme and provided for state co-funding to be channelled directly from the Danish Agency of Science, Technology and Innovation to the research or technological partners of the project, relieving the SME from the burden of invoicing its project partner. Under the new administrative arrangements, responsibility for this scheme has now been passed to Innovation Fund Denmark.

There were two different forms of voucher:

- a *basic voucher* for a research-based business development project with a governmental co-funding level of 40%, up to a maximum of €14,000. The main focus in the basic voucher is the successful transfer of knowledge from research to SME;
- an *extended voucher* with characteristics similar to a larger scale R&D collaboration project with a state co-funding level of 25% up to a maximum of €67,000. The main focus of the extended voucher is finding new solutions to current problems. It is a prerequisite for the extended voucher projects that the participating knowledge institution itself carries out research on the field in question.

There is a limit of €2m for the project portfolio that could be funded by the Danish Council for Technology and Innovation. The SME provided 50% of the total funding and the research institution at least 25%.

The measure was organised on a 'first come, first served' basis. The proposal had to include an agreement between the research organisation and the SME, a project description, an agreement on the dissemination of research results and IPR ownership, a budget and a declaration from the research institution. The research institution is responsible for the proposed research description and the Danish Agency for Science, Technology and Innovation is responsible for evaluating the proposal and for the final decision.

The selection criteria are:

- the SME has to be a private enterprise
- the SME must have existed at least one year
- the project must not have received other public funding
- the company must be an SME with a maximum of 250 employees
- the annual turnover of the SME should be a maximum of €50m
- the SME should not have received public support over the last three years more than €0.13m (de minimum);
- for the basic voucher the SME should not have bought knowledge services for more than €6,718 over the last three years.

Eligible costs include labour costs (including overheads), travel and knowledge dissemination.

A mid-term evaluation was conducted in 2009. It concluded that the scheme generally worked as intended. The participating companies applied knowledge, which strengthens their research and development activities and provided them with an appropriate interaction with knowledge institutions. Knowledge institutions collaborated with new types of firms. Overall, the evaluation highlighted that the voucher projects created added value for both companies and knowledge institutions.

2.6. The National Network for Technology Transfer

<http://techtrans.dk/en/techtransdk/>

As of January 1st 2000 all employees at public Danish research institutions were obliged to report inventions to their institution. If the university decides to take over the rights to the invention, it must assist in seeing to it that the invention is used commercially. The knowledge institutions' task is to ensure that research results, which have a certain probability of being used commercially, will be patented. The Technology Transfer Act grants public research institutions the rights to form and own one public limited company and be co-owner of one or more public limited companies formed by other public research institutions.

The process to commercially exploit public research varies widely. It can involve licensing agreements or setting up joint ventures and partnerships to share both the risks and rewards of bringing new technologies to market. Other corporate vehicles, e.g. spin-outs, are used where the host organisation does not have the necessary will, resources or skills to develop a new technology. The raising of venture capital is frequently a means of funding the development process.

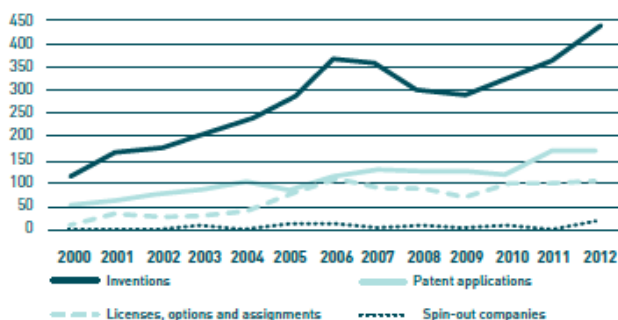
The National Network for Technology Transfer runs **techtrans.dk**. The members of the network are The TechTrans offices at the public research institution, whose role is to ensure that the institution secures attractive returns in the long term from the commercialisation of its valuable research outcomes and intellectual property. The network is an open forum for public research institutions, private business and others looking for information about the innovative collaboration between researchers and companies. The network activities supports the sharing of competences, knowledge and methods involved in technology transfer. Through courses, seminars and conferences, the network seeks to raise the collective awareness of and insight into the process of technology transfer - nationally and internationally. Techtrans.dk operates the Patent Exchange³, the only collected data base of published patents and patent applications from public Danish research institutions.

The network members are:

- Aalborg Hospital
- Aalborg University
- Aarhus University
- Copenhagen Business School
- Technical University of Denmark
- DTU Aqua
- DTU Space
- DTU Veterinary
- IT University of Copenhagen
- University of Copenhagen
- Central Jutland Region
- Roskilde University
- Danish Building Research Institute
- Statens Serum Institut
- University of Southern Denmark
- The Capital Region of Denmark

Annual surveys of public research commercialisation have been conducted since 2004. The results show a generally steady increase in the rate and value of commercialisation.³¹

Figure 1 Commercialisation Performance, 2000-2012



³ While a link to the Patent Exchange is included on the techtrans site, it is no longer active.

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