# Section 8

# The universities' interaction with society

## 1. Introduction

This section discusses how the universities interact with society in various ways. Basically, this concerns the manner in which universities disseminate their research findings to society pursuant to the 1993 Act and the objective provided by the new University Act requiring the universities to cooperate with society by

- exchanging knowledge and competencies,
- making research arrangements with other institutions of tertiary education[1], and
- participating in the public debate.

In summary the section demonstrates the following:

- From 1980 to 2000 there was a marked increase in the employment of university graduates, and the general employment profiles of the candidates changed towards a higher degree of employment in the privatesector.
- There have been considerable variations in the unemployment rates for university graduates according to fluctuations in the labour market, and although the unemployment figures are high at the moment and the labour market has stagnated, the employment among university graduates is still expected to rise over the next few years.
- There is a positive trend towards increased cooperation between the universities and the business sector.
- The cooperation between the universities and the business sector primarily concerns joint research and development projects, but research and continuing education purchased by businesses from the universities also play a role.
- Regarding participation in the public debate it appears that Danish university researchers particularly those within the social sciences to an increasing extent tend either to join the debate or to be used by the media for instance as commentators.

A recent survey of the Danish university research environments indicates which parts of society researchers consider as the forum of their research.[2]

- Within natural science, health sciences and technology, the researchers see such things as physical production and technological development (83%) and local and global health improvement as their most important contributions to society. To a minor degree they also see adjustment of society as one of their contributions (54%).
- Conversely, social science researchers see adjustment of society as one of their major contributions (87%), but rate criticism of the development of society and of public bodies highest (96%).
- Researchers within the humanities believe that their research contributes to criticising the development of society and of public bodies (89%), and to developing a purposeful cultural sphere in the daily lives of people (96%).

[1] Research arrangements between universities and other tertiary educational institutions are so new that it has not yet been possible to systematically evaluate the extent. In principle, these research arrangements concern agreements to collaborate on R&D projects, continuing education etc. that reflect the research profiles of the universities, the professions of other tertiary educations and the practical difficulties these profession must address.

[2] Bo Jacobsen, Mikkel Bo Madsen & Claude Vincent, *Danske forskningsmiljøer. En undersøgelse af universitetsforskningens aktuelle situation,* Copenhagen: Hans Reitzel, 2001, pp. 106-108.

The most direct relationship between the universities and society is, however, the training of university graduates, who through their job relations will transfer new knowledge within their specialities to the labour market.

## 2. Interaction in the knowledge society

The knowledge society requires knowledge sharing and increased cooperation in a trans-disciplinary approach between public and private knowledge institutions. As knowledge originates from many parts of society, the concept of who actively contributes knowledge must be extended, and similarly it is necessary to provide a broad definition of the ways of interacting.

The Danish knowledge system comprises a broad range of knowledge institutions:

- universities;
- governmental research institutions;
- university hospitals;
- approved technological service institutes;
- centres for tertiary educations;
- business colleges/business academies;
- adult vocational training centres;
- science parks and innovation environments that help entrepreneurs and others commercialise their research results; and
- parts of the Danish business community that produce, attract, spread and apply research-based or other sophisticated knowledge.

According to its knowledge strategy from January 2003, the aim of the Danish Government is that the Danish knowledge system is to strengthen its position as one of the most effective and competitive knowledge systems in the world, by strengthening the interaction between the knowledge institutions and the business community.

## 3. The labour market of the university graduates

### 3.1. General trends

According to section 6, in 2000 the universities awarded about 8,600 master's (candidatus) degrees, almost 3,000 of which were within the social sciences, about 2,200 within the humanities, slightly more than 1,100 within technology, almost 1,100 within natural science, slightly more than 700 within health sciences and slightly more than 300 within the veterinary and agricultural sciences. At the same time the universities conferred more than 900 PhD degrees. This is the composite potential of newly graduated masters and PhDs that the universities supplied to the labour market in 2000. The future trends seem to continue along these lines.

The primary feature of the labour market of university graduates is a very steep increase of the employment figures. From 1980 to 2000 the number of university graduates on the labour market increased from about 65,000 to more than 160,000, which gives an annual increase of more than 4,000 individuals on average. In 2002, the increase reached 5,500 because of the large number of master's degrees awarded. The figure 160,000 must be compared to the total work force of about 2.7 million people. This means that the university graduates constituted about 6% of the total work force in 2000.

Along with the higher employment figures, the employment situation for university graduates has become far more diversified. In 1980 almost 2/3 found employment in the public sector. This figure is now down to

about half. Like other educational groups – university graduates are also exposed to the effects of cyclical unemployment which in 2002 has risen to about 5 %.

Despite the low number of young people these years, the number of university graduates will continue to rise over the next few years because an increasing number of these young people enrol at university. The share is expected to reach about 14% of a cohort in 2002.

### 3.2. Educations and sectors

*Distribution of university graduates onto sectors*
Through the 1990s there has been a trend towards a change away from employing university graduates in the public sector to employing them in the private sector, not least in the private service sector.

*Figures 8.1 and 8.2 Employment of graduates 2000*
Source: Statistics Denmark, 2000.

Note: Trade etc. also refers to hotels and catering. Other services comprise business service concepts, consultancy etc. and the financial sector.

About 60% of all graduates in the humanities are employed in the public sector, but the percentage is decreasing. The same tendency applies to graduates in social sciences for whom the percentage of graduates employed in the public sector has dropped from 42% in 1992 to 37 % in 2000. In the public sector, the graduates in humanities and social sciences together constitute 55% of the number of university graduates employed. These figures should be compared to the 19% and 31%, respectively, these graduates constitute of the total work force of university graduates.

For graduates in natural science there has been a steep drop in the number of public sector employees and a rise in number of graduates employed in trade and other service industries. For the graduates in health sciences the percentage employed in the public sector has been relatively stable in recent years.

The graduates from the technological and the veterinary and agricultural educations are the groups with the lowest number of public servants. But the tendency for these groups is also to change from the public to the private sector.

*Distribution onto sector of PhDs*
The PhDs with 941 persons earning degrees in 1998 constitute a relatively small percentage of the total number of highly educated people in Denmark. The fields of natural sciences, technology and health sciences account for 75% of all the PhD degrees awarded. Within the different disciplines, the PhDs show a highly varied distribution onto sectors.

*Table 8.1. Distribution of awarded PhD degrees according to discipline*

| | Hum | Soc sc | Nat | Health | Agri/Vet | Tech | Total |
|---|---|---|---|---|---|---|---|
| **Percentage of PhD** | 8.8 % | 7.5 % | 25.29 % | 26.46 % | 8.6 % | 23.27 % | 100 % |

Source: Report from the Programme on Research Training under the Danish Research Agency 1999, *De ph.d.-uddannede 1997 og 1998 (in Danish)*

*Table 8.2: Distribution of PhDs onto sectors of the labour market in percentages, 2001*

| | Public sector | Private sector |
|---|---|---|
| Humanities | 85 % | 15 % |
| Social Sciences | 81 % | 19 % |
| Natural Sciences | 71 % | 29 % |
| Health Science | 73 % | 27 % |
| Agricultural/veterinary | 68% | 32 % |
| Technology | 43 % | 57 % |
| **Total** | **64%** | **36 %** |

As can be seen from table 8.2, most of the PhDs are employed in the public sector, mainly at the universities. This is particularly true for PhDs within the humanities and social science. The governmental research institutions also employ many of the natural science PhDs, whereas the hospitals are the largest employer of health science PhDs. The PhDs within natural science and in particular technology feature a relatively high share of the employment in the private sector.

### 3.3. Indications of the labour market projections for university graduates

for the next ten years both the projections of the number of university graduates and the projection of the need to replace employees retiring from the labour market are relatively certain.

Year 2002 was characterised by an extraordinarily high number of awarded master's degrees and a relatively low demand for labour from the public sector and parts of the private sector. The employment as a whole is, however, on the rise. From 2006, the increase in the number of master's degrees awarded will cease for a couple of years, and the need for new employees to replace those retiring will grow considerably in several sectors. From 2003, a considerable number of graduates are expected to find employment in for instance the upper secondary schools to replace those retiring. Furthermore the private service sector will employ an increasing number of new graduates.

Characteristic of the labour market for the *natural science* educations is that there is a large replacement need within the subjects mathematics/physics/chemistry (M/P/C) and to some extent biology and geography, particularly at upper secondary school level for the period 2003–2013, when many teachers will be retiring. Moreover the employment in the private sector of graduates in the fields of mathematics, physics, chemistry, computer science, statistics, economics (mathematics) and biochemistry is expected to increase.

Employment prospects for the *technological* educations – in particular within engineering – are good and the total number of engineers is increasing moderately.

*Social sciences* including public administration educations have seen a positive development of the employment situation. Over the next five to ten years, the legal profession and the university economists will have a considerable replacement need.

The *humanities* continue to be the area exhibiting the highest unemployment figures but an increasing number of the new graduates find employment in the private sector.

The most favourable employment situation is seen for the *health sciences*, for instance doctors, dentists and pharmacists, where a certain shortage in the rural areas is expected to continue in the foreseeable future.

For the educations in *agricultural and veterinary sciences* the employment prospects are good, although for instance agronomists and horticulturists are experiencing some unemployment.

## 4. Interaction between universities and the business sector

### 4.1. Collaboration on training purposes

The universities' collaboration with the business sector regarding the contents of the educational programmes and the competencies the graduates are supposed to obtain takes place at several levels:

- bachelor and master educations, primarily in the form of internships and business projects,
- the Industrial PhD Fellowship Programme, and
- continuing education, in particular the master educations for adults.

*Internships and business projects*
Short-term internships in a company have become increasingly common for university students at bachelor or master level. This collaboration provides the students with insight into the organisation and functions of a company and improves the professional profile of the student. At the same time it provides the companies with possible solutions to the concrete problems they are facing in their daily operations. Contacts are often organised by the science and information shops of the universities.

*Industrial PhD Fellowship Programme*
The intention of the new Industrial PhD Fellowship Programme is to promote research and development (R&D) in the Danish business sector by:

- training researchers that are given insight into the business-related aspects of R&D and
- setting up personal networks for knowledge exchange between companies and Danish and foreign universities and research institutions.

The Industrial PhD Initiative directs people at the level of master with the right academic qualifications, to universities and companies that have the required academic capacity to support a 3-year industrial research and educational project. Public funding covers part of the expenses of joining industrial PhD-projects. .

The PhD-student is employed by the company, and will stay partly at the company and partly at the university or the governmental research institution. The PhD-student will have at least two tutors, usually one from the university and one from the company. The industrial PhD programme is concluded with an evaluation of the PhD thesis on the same terms as an ordinary PhD thesis.

Today, there are about 250 active industrial PhD students, who constitute about 5% of the present total of 5,000 PhD students in Denmark. In 2002, 50 new industrial PhD projects were approved, 28 of them were placed at the Technical University of Denmark and the University of Copenhagen.

*Table 8.3 Industrial PhD projects approved by the Industrial PhD Fellowship Programme in 2002 divided onto main areas, 31 December 2002.*

| | Health/nat | Tech | Soc sc | Agri/vet. | Total | % |
|---|---|---|---|---|---|---|
| **Distribution of projects** | **33 %** | **9 %** | **5 %** | **3 %** | **50 %** | **100 %** |

Source: Ministry of Science, Technology and Innovation, 2003

In addition to the Industrial PhD Programme, several companies collaborate with the universities and other research institutions to establish doctoral schools as described above in section 5.

*Continuing education*
Several of the master programmes referred to in section 6 were developed jointly with external partners, for instance commercial businesses. This helps provide these educations with a clear profile and ensures that their study programmes as well as the competencies the students obtain are relevant. Most of the students are adults who enrol in these programmes while working.

### 4.2. Structure of the Danish business sector

The Danish business sector is characterised by a large number of small and medium-size enterprises. More than 2/3 of these enterprises have less than five employees, and there are only about 9,000 enterprises with more than 50 employees.

*Table 8.4 The Danish business structure*

| | No. of enterprises, 1999[3] | No. of employees, 1999 | employees with long tertiary education | % of turnover, 2001 | R&D expenses % of the value added of the industry[4] |
|---|---|---|---|---|---|
| **High-technology industries** | 1,440 | 2.5 % | 11 % | 6.1% | 18.5% |
| **Medium high-technology industries** | 4,800 | 6.4 % | 4 % | 3.4% | 6.4% |
| **Knowledge service industries** | 42,200 | 9.3 % | 24 % | 6.4% | 1.4% |
| **Others** | 187,800 | 81.8 % | 3 % | 84.1% | 0.7% |
| **Total private sector** | 236,100 | 100% | 6 % | 100% | 2.6% |

Source: Statistics Denmark, 2001 in the Governments Knowledge Strategy, January 2003.

There is a relatively low number of knowledge-based enterprises in Denmark, which gives a very high concentration of knowledge.[5] The 50 largest enterprises in terms of R&D activities account for about 50% of the sector's total R&D investments. These enterprises are primarily found within the computer, medical science, and knowledge/service and machinery industries. Less than 2,000 enterprises in Denmark employ 2/3 of all knowledge workers in the business sector.[6]

Enterprises within the high technology industry, the medium high technology industry and the knowledge/service industry together account for 16% of the total turnover and employ slightly below 12% of all employees in the Danish business sector .

[3] Rounded off to 100.
[4] Value added equals turnover less consumption of goods.
[5] Ministry for Science, Technology and Innovation, *Regeringens videnstrategi – viden i vækst. Baggrundsrapport (background report on the Government's knowledge strategy). January 2003.*
[6] Together with Statistics Denmark the Ministry of Science, Technology and Innovation has investigated the number of knowledge-intensive businesses in Denmark. In this context knowledge-intensive businesses are defined as businesses with at least five employees with a long tertiary education or a PhD degree. These employees must also constitute at least 10% of the employees of the business.

In a comparative study of the business sector's cooperation with knowledge institutions for product development purposes, Denmark generally has a high ranking[7]. 96% of the enterprises cooperate with knowledge institutions compared to for instance 80% in Norway and 6% in Australia. 17% of the enterprises cooperate with universities, while 67% cooperate with other knowledge institutions, e.g. Approved Technological Service Institutes (ATSI)[8].

The ATSIs are private, self-governing institutions that place their knowledge and competence at the disposal of the Danish business sector against payment. They play an important part generating and disseminating application-focused and technological knowledge, especially to small and medium-size enterprises. In 2001, the ATSIs cooperated with almost 24,000 small enterprises (with less than 50 employees), with almost 8,000 medium-size enterprises (between 50 and 200 employees) and with almost 4,000 large enterprises.

The ATSIs are party to centre contracts[9], i.e. binding R&D cooperation programmes between enterprises, research institutions and ATSIs .

In 1996 Aalborg University developed a new model of cooperation, the "Network Model" allowing primarily small and medium-sized companies with limited resources to gain access – without obligation – to a number of research areas at Aalborg University. In return, the university acquires knowledge of the needs and problems of industry.

### 4.3. Researchers' cooperation with the business sector

The extent of the Danish researchers' external cooperation is illustrated by for instance a survey of Danish research environments from 2002. According to this survey, nine out of ten researchers are part of collaboration projects and/or research networks extending beyond their own university.[10] Not surprisingly, the majority of these researchers have been involved in collaboration projects primarily with other universities or research institutions. In comparison 35 % of the interviewed researchers state that they are involved in collaboration projects with private enterprises.

The collaboration projects primarily concern basic research. There is, however, also a relatively high number of researchers who are involved in more application or development focused collaboration projects. In fact more than half of the researchers have been involved in collaboration projects dedicated to application-focused research (53% of the researchers), whereas slightly more than ¼ of them have been involved in development-focused collaboration projects.

Other surveys also point to the relatively high share of researchers who have been involved in collaboration projects with the business sector, for instance a survey from 1998 on commercial exploitation of research results. According to this survey almost ¼ of the publicly employed researchers are often in touch with the

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[7] Anker Lund Vinding, *Interorganizational Diffusion and Transformation of Knowledge in the Process of Product Innovation*, Department of Business Studies, Aalborg University, June 2002.

[8] In Danish: Godkendt Teknologisk Serviceinstitut (GTS)

[9] A centre contract is a legally binding agreement setting out the terms for co-operation on a strategic development or research project between private enterprises, Approved Technological Service Institutes institutes and research institutions

[10] Ebbe Krogh Graversen et al., *Dynamik og fornyelse på danske universiteter og sektorforskningsinstitutioner. En analyse af hvad der karakteriserer dynamiske og fornyende forskningsmiljøer,* Aarhus: Danish Institute for Studies in Research and Research Policy, 2002.
15 research environments, primarily universities, were selected for the survey. Although the survey is not representative, it does illustrate that it is relatively common for researchers to cooperate with society.

business sector, while about half of the researchers state that they sometimes work together with businesses,[11]

*The business sector's interaction with the universities*
Seen from a business perspective, interaction with the universities is an appreciable factor in the innovation process of many enterprises and in their accumulation of knowledge.

According to a recent questionnaire-based survey more than ¼ of Danish enterprises, with more than five employees, have interacted with knowledge institutions during the past three years.[12] Looking only at the business sector's interaction with the universities, about 14% of the Danish enterprises have been cooperating with a university during the past three years.

*Increasing interaction between the business sector and the universities*
The trend towards increasing interaction is also supported by a number of surveys of these efforts[13] [14]. Commercial cooperation today meets a far more positive attitude than previously. This is generally reflected in the visions, targets and strategies of the institutions. Also many small enterprises use researchers for various purposes, from inspiring talks to formal collaboration projects where both parties invest considerable amounts of time and money in developing new knowledge.

[11] DTI Innovation, *Erhvervsmæssig nyttiggørelse af forskningsresultater – en spørgeskemaundersøgelse om samspillet mellem danske virksomheder og forskere på højere læreanstalter*, 1998.
[12] Ministry for Science, Technology and Innovation, *Turning Science into Business* (action plan for enhanced cooperation), 2003. The analysis was carried out by the Danish Institute for Studies in Research and Research Policy on behalf of the Ministry and comprises a total of 400 businesses with more than five employees. The analysis focuses on the cooperation of these businesses with universities, governmental research institutions and Approved Technological Service Institutes. The data below from the survey comprise replies from businesses that have been cooperating with universities. Some of these businesses have also cooperated with governmental research institutions and Approved Technological Service Institutes. Consequently, in a few cases the data that have been included here from the survey also reflect the cooperation of these businesses with public knowledge institutions other than universities.
[13] Insight Consult, *Samspillet mellem erhvervsliv og videninstitutioner* (working title – not published yet), 2003.
[14] Ministry of Research, *Samarbejdsaftaler mellem universiteter og erhvervsvirksomheder,* 2000; Rectors' Conference, *Universiteter i dialog. Samarbejde mellem universiteter og erhvervslivet,* 2001.

### 4.4. The nature of the interaction – various interaction models

The collaboration projects between the business sector and the universities involve a variety of interaction models such as:

- Relationships based on direct interaction that involve personal relations between enterprise and university and where knowledge is exchanged, for instance through participation in joint research projects.
- Interaction in a wider perspective, for instance in the form of participation in conferences, studying research literature and other ways of incorporating and using research results.

Informal cooperation between universities and enterprises is the most common form.[15] About half of the enterprises have been involved in some sort of informal cooperation with a researcher (53%), while slightly less than 30 % of the businesses often or sometimes formally cooperate with researchers.

*Table 8.5. Researchers' contact to the business sector: The nature of the contact a business has had with researchers at institutions of higher education, percentage.*

| | Often or sometimes | Rarely or never | Unknown |
|---|---|---|---|
| **Informal cooperation** | 53 | 46 | 1 |
| **Formal cooperation** | 31 | 69 | 1 |
| **Researcher acted as consultant** | 27 | 72 | 2 |
| **Procurement or licensing of patent rights** | 4 | 93 | 3 |

Source: DTI Innovation, 1998.

Formal interaction models that are directly related to the innovative process of enterprises include:

- Purchase of research or development work from a university or another knowledge institution.
- Participation in joint research projects with universities or knowledge institutions.
- Purchase of license rights from a university or another knowledge institution.
- Employment of researchers from a university or another knowledge institution.
- Exchange of employees with a university or another knowledge institution.
- Employees participating in research-based continuing education at a university.

Informal interaction through which tacit knowledge is brought into the open via networks etc. plays an important role, as it forms the frames and basis for establishment of more formal forms of cooperation such as research projects etc.

For the enterprises that have taken part in the survey and that have been cooperating with a university, these relationships typically concern participation in joint research projects[16]. 70% of the enterprises have been involved in relationships of this nature. 51% of these enterprises have purchased research from a university or another knowledge institution, and a similar percentage of the enterprises have taken part in collaboration projects dedicated to building competencies through research-based continuing education.

[15] DTI Innovation, *Erhvervsmæssig nyttiggørelse af forskningsresultater – en spørgeskemaundersøgelse om samspillet mellem danske virksomheder og forskere på højere læreanstalter*, 1998.
[16] Danish Institute for Studies in Research and Research Policy, *Samspillet mellem erhvervsliv og videninstitutioner*, 2003.

Between 22% and 31% of the enterprises have been party to an interaction model that concerned exchange of employees with a university (mobility) and employment of research assistants. Only about 8% of the businesses have bought license rights from a university. 2/3 of the enterprises attach significant or decisive importance to these interaction models for their activities.

It is not surprising that large enterprises are most likely to cooperate with knowledge institutions: almost 70%, of the enterprises with more than 249 employees have interacted with universities over the past three years; whereas only ¼ of the enterprises with less than ten employees did the same.

According to enterprises that have already been cooperating with a university, the need for cooperation will increase over the next few years.

*Partners*
According to the survey, more than half of the 400 enterprises involved have been cooperating with a university over the past three years. Slightly more than 1/3 of the enterprises cooperate to some extent with the Approved Technological Service Institutes on R&D activities. Only a small number of the enterprises cooperate with governmental research institutions (18%) and even fewer still with university hospitals (7%).

*Potential for interaction*
The survey also shows, that there is a considerable potential for increasing the interaction between the Danish business sector and the universities. The need for interaction is particularly pronounced for research-based continuing education.

Respectively 18% and 16% of the enterprises have exchanged employees with a university (mobility) and participated in R&D projects. The percentages are lower for interaction in the form of purchased research, recruitment of research assistants and purchase of license rights; between 9% and 13% of the businesses have done this.

In general a higher number of large enterprises than small enterprises state that they need to interact with universities and other knowledge institutions. This pattern applies to most interaction models, such as purchase of research or exchange of employees between business and university and/or knowledge institution.

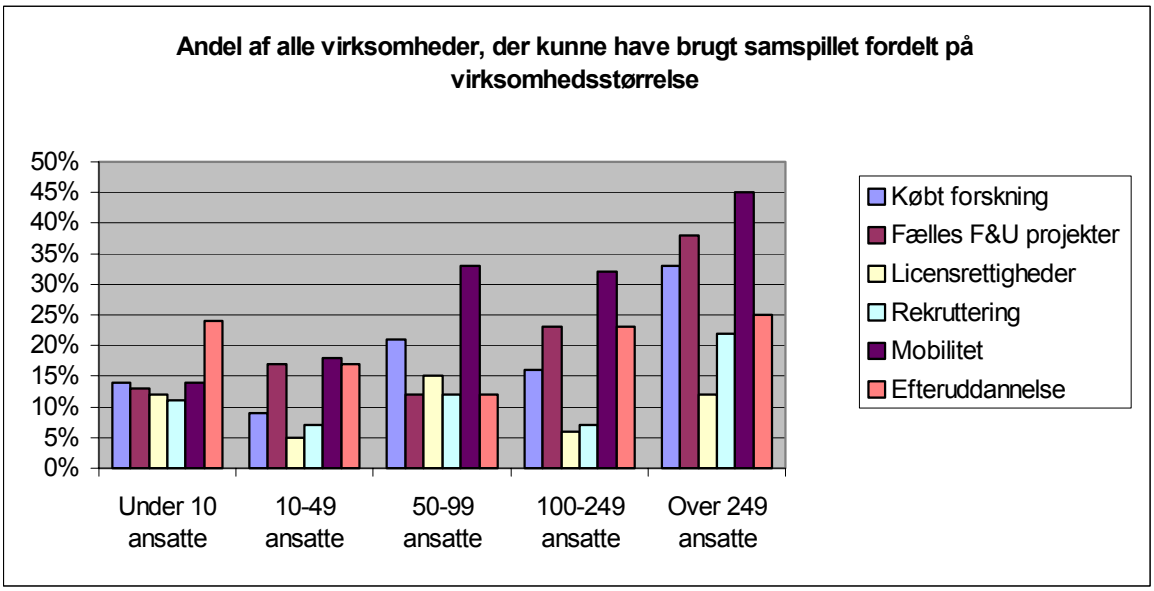


*Figure 8.3 Percentage of all companies that could have benefited from cooperating according to business size*

Source: The Ministry for Science, Technology and Innovations and the Danish Institute for Studies in Research and Research Policy, 2003.

The need for interaction varies across business segments with different research intensities. For instance more than 40% of the R&D active enterprises indicate a need to participate in R&D projects with universities compared to 10% of the enterprises without specific innovative activities.

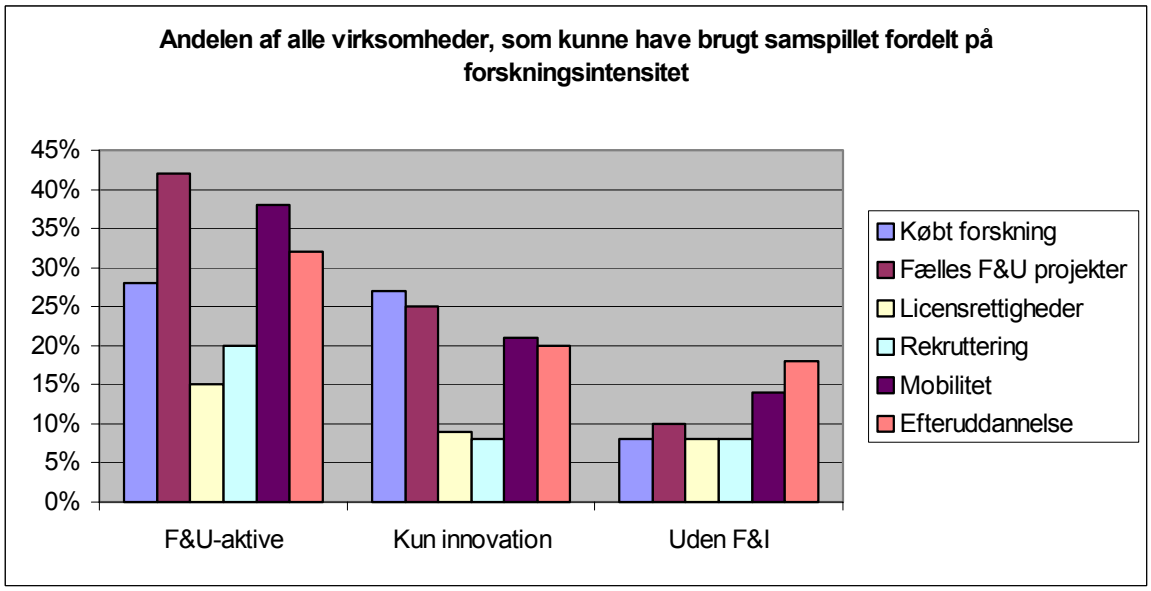


*Figure 8.4 Percentage of all companies that could have benefited from cooperating according to research intensity*

Source: The Ministry for Science, Technology and Innovations and the Danish Institute for Studies in Research and Research Policy, 2003.

*Outcome of interaction*
Most companies choose to interact with a university to increase their competitiveness and gain a competitive advantage over other businesses on the market by gaining access to technological or scientific knowledge in various ways. Knowledge that is essential to their innovation or development activities. Likewise 25 % of the enterprises state that their interaction with universities is of major or decisive importance to the strengthening of the company's competencies and level of knowledge.
The interaction of an enterprise with a university is of less importance to the development of existing products, improving the organisation and management, and improving patent options or marketing.

### 4.5. Commercialising university research

Commercialising knowledge and research results is one of several ways of transferring knowledge and technology from the world of research to the world of business. The commercialisation typically takes place by setting up new knowledge-based businesses or selling licenses and patents to existing businesses.

#### 4.5.1. Structuring commercialisation
There are several players on the Danish market for commercialisation:

- Public research institutions, including universities, governmental research institutions and university hospitals and to some extent Approved Technological Service Institutes.
- Facilitators or incubators, comprising innovation environments and science parks
- The capital market consisting of publicly funded players such as innovation environments and the Danish Investment Fund[17], and private venture companies and so-called business angles.
- Private commercialisation companies, comprising patent agencies, private sellers of licenses and others. This market is relatively new in Denmark, and new players are constantly appearing.

Below are descriptions of the first two types, viz. public research institutions, and innovation environments and science parks.

*Public research institutions*
Pursuant to the act on inventions at public research institutions (act no. 347 of 2 June 1999), the universities are to promote patenting and commercialisation of research-based inventions. The act prescribes the technical details of how to distribute rights and income from the research patents and with whom to conclude agreements in the private enterprises. The central principles of this act are:

- That public research institutions, like private businesses, can take over and exploit the right to the inventions of their employees.
- That researchers as well as institutions get a share of the income from the commercialisation of new inventions.
- That the institution has the right to make agreements for inventions when cooperation contracts are concluded for research activities making the enterprises a clear party to the contract.
- That rights are payable in shares – rather than cash – to promote the establishment of new businesses.

The Appropriation Act provided for a total of DKK 58m for the period 2000 to 2003 to build up the competencies of the institutions and to cover part of the external patent-related expenses.

[17] The Danish Investment Fund is a publicly owned financial body that is part the Danish system for promotion of trade and industry under the auspices of the Ministry of Economic and Business Affairs. The primary objective of the fund is to provide funding for promoting projects in small and medium-size enterprises. The main focus is to provide funding to innovative businesses that provide large social revenues and that are in under-funded areas of the market. The funding is both in the form of loan capital and equity capital.

Most institutions have set up internal patent policies, and by now patent rights are a natural part of the collaboration agreements that these institutions conclude with businesses. Royalties are typically shared between inventor, department and institution with a third for each.

The Danish universities do not have their own technology transfer agencies in a traditional sense, but typically, one or two legal employees handle the IPR work. In addition, some of the institutions have set up internal science and information shops or project offices to support networking with external partners. Assistance in registering patents and marketing patent rights is acquired on market terms from private patent offices, consultants, innovation environments etc.

Simultaneously new competencies have been compiled relative to patent rights and license agreements through five so-called patent consortia that act as academic networks across universities, governmental research institutions and hospitals.

Danish universities are not permitted to set up private businesses or foundations for technology transfer. Co-ownership of science parks or innovation environments requires special approval by the Folketing.

*Innovation environments and science parks*
Together the eight innovation environments and the seven science parks constitute the institutional framework of the start of new knowledge-based businesses. At the universities local initiatives are taken to encourage students to become entrepreneurs.

Legally, innovation environments are governed by the act on technology and innovation (act no. 419 of 6 June 2002) and must be approved by the Minister for Science, Technology and Innovation, based on public calls. The innovation environments comprise limited companies whose objective it is to promote cooperation between the public knowledge system, new innovative businesses, already established businesses and capital sources.

Most private investors are somewhat reluctant to invest in the early, very uncertain phases when the investments are typically less than DKK 2m which necessitates public involvement at these early stages. The innovation environments introduce the entrepreneurs to public investors at the early and uncertain stage of their evolution, and to other investors during their growth. Since 1998, the innovation environments have invested DKK 300m and attracted about DKK 615m as supplementary private investments.

The science parks, which often are located next to the university campus, primarily offer housing, administrative services and laboratory facilities to entrepreneurs and innovative businesses. Most of the Danish science parks and innovation environments are independent companies in a joint group.
These science parks are: Symbion Science Park in Copenhagen, the science park CAT (Centre for Advanced Technology) in Roskilde, the science park at Hørsholm/the Innovation Centre, the International Science Park Odense, NOVI science park in Aalborg, Agro Business Park associated with the governmental research institution the Danish Institute of Agricultural Sciences at Tjele and Science Park Aarhus.
There is no specific legislation that governs these science parks.

### 4.5.2. Extent and nature of commercialisation

The best way to estimate the resources spent on technology transfer and commercialisation is to look at the staff resources involved. Between 40 and 50 members of the academic staff at the 12 universities are involved in technology transfer, mostly on a part-time basis.

For all public research institutions, innovation environments and science parks, between 120 and 130 people are employed in management and consultancy functions, which is the equivalent of 85 to 90 man years. To this should be added an informal external network.

Since 2000 when the Danish act on inventions at public research institutions took effect, the Danish universities have submitted about 90 patent applications, but so far only a few patents have been granted, mainly in the field of biotechnology, health and medico technology. The universities report a total of about 20 license agreements of which 1/3 are concluded with newly founded businesses.

Since their establishment in 1998, the innovation environments have started 420 businesses mainly within computers, telecommunications, electronics, measuring techniques, biotechnology, and health and medico technology. As a conservative estimate based on the above, the innovation environments have resulted in 220 businesses from public research environments since 1998, corresponding to 50-70 new businesses a year.

## 5. Other models of university-society cooperation

*Hospitals and the health service*
For the universities it is natural to cooperate with hospitals in the field of health sciences. Next to universities and governmental research institutions, the hospitals and the health service together are the third largest player in Danish public research. By far most of this research is conducted under the auspices of the three university hospitals where 18 minor hospitals cooperate at regional level with the faculties of health sciences at the universities of Copenhagen, Aarhus and Southern Denmark.

The university hospitals primarily conduct health science research mainly focusing on experimental and clinical research within treatment methods, prevention/health promotion, neurology/psychiatry, genetics and biotechnology.

*Science and information shops*
There are science and information shops connected to most of the Danish universities. They primarily serve as forums where public and private organisations etc. can establish contact with students who are interested in realising projects for the organisation concerned. The science and information shops produce catalogues listing subjects and concrete projects that organisations and businesses outside the university would like one or more university students to study and report on. In this way the students may apply their research-based knowledge to concrete and practical issues for the benefit of both parties, for instance as a core experience in the education of the student. Simultaneously the parties form a network that may prove useful to both the students and the businesses, organisations and public institutions that they are in touch with through the science and information shop.

## 6. Contributions to the public debate from university researchers

University researchers are under an obligation to disseminate their findings to society. This obligation is emphasised in the 1993 University Act, and the new University Act details the role of the universities as knowledge and cultural institutions, for instance by encouraging scientific university staff to join the public debate.

In connection with the research project on Democracy and Power in Denmark[18] launched by the Danish Folketing, the contributions made by Danish researchers to the public debate were surveyed.[19] The survey

[18] In Danish: Magtudredningen

is concerned with how the media use researchers when they address different social issues. It focuses on researchers employed by universities, governmental research institutions or by the health service. These researchers are regarded as possessing both research expertise and insight, and as being politically unbiased and independent of other special interests.

According to this survey, the development during the past four decades, from 1961 to 2001, has been that the media include quotes or comments etc. from researchers in their articles three times more often today than forty years ago even when correcting for the parallel increase in the total number of articles.

The research project on Democracy and Power in Denmark reveals that university researchers have come to play a more important role in the media; and that they participate in the public debate more frequently. At the same time the project also shows that the trend is shifting towards researchers commenting on political events and other events rather than disseminating research findings as such.

[19] Erik Albæk, Peter Munk Christansen og Lise Togeby, *Eksperter i medierne. Dagspressens brug af forskere 1961-2001,* Aarhus: reports issued under the research project on Democracy and Power in Denmark, Department of Political Science, University of Aarhus, 2002.

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