

# UniDev

The Evolving Role of Academic Institutions in Innovation Systems and Development

## Developing Universities – The Evolving Role of Academic Institutions in Denmark

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# Developing Universities – The Evolving Role of Academic Institutions in Denmark

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## 1. Introduction to the Danish context

From a traditional economic point of view it may seem as a paradox that a small country (5 million inhabitants) with high wages, high taxes, a large public sector, a relatively low level of R&D activity, and a relatively low proportion of people with a higher education in science and technology has been able to stay relatively competitive and rich for decades. Especially two interrelated explanations have been put forward in recent studies of the Danish National System of Innovation (Lundvall 2002b, Christensen et al. 2005).

### 1.1. Social cohesion and the Danish welfare state model

The first explanatory factor is related to the Danish welfare state model with its long tradition for emphasizing social cohesion. A crucial ingredient in the social cohesion model has been a relatively equal income distribution obtained by comprehensive redistribution mechanisms. Another is the long tradition of equal access – meaning in principle independent of income and social status – to a relatively high level of public financed welfare state services as education, health, social services, environment, and infrastructure. The importance for creating and maintaining social cohesion by for instance bringing the majority of kids from all social groups together in a common public school system should not be underestimated. Neither should the principle of ‘free’ and equal access to health care services.

Since the beginning of the twentieth century Denmark has had strong trade unions and centre-left wing political groups with the welfare state and social cohesion as the main political agenda. A central societal institution in formulating and implementing the welfare state model has been the corporatist system of interaction between the state, the trade unions, and the employers’ organizations. This cooperation has created the so-called Danish ‘flexicurity-model’ combining a high flexibility for employers to hire and fire with relatively high degree of income security for the employees. Related to the social

cohesion model is the relatively high labor market participation rate for women in combination with an extended public supported childcare scheme since the 1960s.

However, the social cohesion model has recently been exposed to increasing political pressure from neo-liberal tendencies. This is reflected in increasing income inequalities, cuttings in the social benefits, changes in the social insurance system towards a higher proportion of private insurance and pensions, more private hospitals and more parents sending their kids to private schools. While the average unemployment rate for some years has been around five percents, groups with low formal qualification have difficulties in getting and keeping steady jobs. This is especially the case for many immigrants from outside Europe and USA. The Danish society has not been efficient in integrating these groups into the labor market.

### **1.2. Low R&D intensity but continuous incremental innovations**

A second hypothesis why Denmark has been able to maintain its high-income status has to do with continuous product -, process – and market innovations carried out by the majority of small and medium sized firms. However, this dominating sector of SMEs invests very little in R&D and has only modest direct interaction with universities. One exception from this general picture of the Danish business structure dominated by SMEs is the traditional scale intensive agro-industrial sector. This sector is today characterized by a high degree of standardization of products and processes, heavy EU-subsidies to the primary production, an efficient processing industry and a few dominating distribution channels. Another exception is the fast-growing science-based pharmaceutical industry with a high level of patent activity.

Many small countries have a business structure with specialization based on low- and medium-tech goods, but according to Maskell (2004) the Danish case has some specific features contributing to the competitiveness. Especially informal institutions like the negotiated economy, the egalitarian beliefs in society, and the smoothening of exchange of information resulting from established trust relations seem to be significant elements (Lundvall 2002b, Maskell 2004). The combination of such structures with stable macro economic conditions are important keys to understand how Danish industry has sustained relatively competitive without substantial inputs of formal R&D (Christensen et al. 2005).

Danish total R&D spending relative to GDP has more than doubled since the beginning of the 1980s (from around 1% in 1980 to approximately 2.5% of GDP in 2004). However, among the Nordic countries Finland and Sweden clearly outstrip Denmark with higher figures throughout the same period. Both these countries' R&D spending is now above 3% of GDP, while Denmark only recently (since 2001) has exceeded the OECD average. If we look at the proportion of R&D staff of the total labor force, we see the same picture. Denmark is with 2.2% (2003) above countries as Germany (1.7%) and France (1.5%) but behind Sweden (2.7%) and with Finland again at the top (2.8%) (The Danish Institute for Studies in Research and Research Policy, 2005).

*Table 1.1: Denmark's R&D spending as a proportion of GDP 1995-2005, %*

<i>Sector</i>	<i>1995</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>
<i>Private</i>	1.05	1.19	1.33	1.42	1.51	1.65	1.75	1.77	1.69	...
<i>Public</i>	0.78	0.75	0.76	0.76	0.75	0.75	0.78	0.79	0.79	0.75 <sup>1</sup>
<i>Total</i>	1.83	1.94	2.09	2.18	2.26	2.40	2.53	2.56	2.48	...

*Note: From 1998 there has been a change in the methods of data collection in order to include more R&D done by SMEs*

<sup>1</sup> Budget

*Source: The Danish Institute for Studies in Research and Research Policy (2003, 2005)*

As can be seen from Table 1.1, the public R&D spending has not increased to the same extent as the private, and for the moment, despite the decrease in 2004, it may seem more realistic that the private sector will reach the Barcelona goal of spending 2% of GDP on R&D before 2010 than that the public sector reaches the minimum 1% goal. In 2005 the public R&D spending has even decreased to 0.75 % of GDP while most other countries increased their public R&D spending.

In the last two decades the sectors of Danish industry with the greatest research requirements and -activities have been the pharmaceutical industry and the ICT/telecommunication sectors. The private research departments in these sectors cooperate closely with Danish and foreign universities, but there is an increasing tendency for Danish business to establish laboratories outside Denmark (The Danish Institute for Studies in Research and Research Policy, 2003). For instance, the pharmaceutical firm Novo Nordisk spends around half a billion Euro a year on R&D and employs globally around 3500 people in research. 40 % of Novo Nordisk's employees are based outside Denmark.

Even if the averages are at level with, or even above, EU and OECD, then the distribution of R&D expenditures is skewed. Generally, 2 percent of the firms conduct 37 % of the total R&D in Denmark in 2001 (The Danish Institute for Studies in Research and Research Policy, 2004, p.46). Since the mid-1990s the small firms have, though, increased their R&D effort, also compared to the small firm segment in the other Nordic countries.

### **1.3. Enrolment in HE, PhD and Lifelong learning**

For the last two centuries all children have attended at least seven years of primary school. Several decades ago this developed into a minimum of nine years and the large majority today spend at least twelve years in the educational system (including secondary school) ending either with a vocational education or as graduates from high school – general, technical or mercantile. On top of this an increasing share of young people attend tertiary education. In the early 1980s about 30 per cent of a birth cohort enrolled in tertiary educations (short, medium, long) but only 8 per cent enrolled in universities (long higher education). By 2000 these figures were grown to respectively 52 per cent and 18 per cent (Ministry of Science, Technology and Innovation 2003). The increase in the enrolment rate has been especially high for female students. However, the enrolment rates in universities are still low compared to many other high-income countries.

For many years all Danish students have had the right to study and have their study supported by a state grant app. 800 US\$ a month (2005) plus loans for the standardized duration for a bachelor and master study – in total 5 to 6 years. This means that all young people will be able to finance their higher education nearly without economic support from their parents or other sources. In addition to this an increasing number of bachelor and master programs have been extended in capacity, and only a few number of programs have limitations in their intake. Both the grant system and the liberal admission to higher education are now and then discussed among politicians, but restrictions have up to now only been introduced for the admission for non-European students who from 2006 will have to pay a tuition fee. For European students no tuition fee has to be paid for normal daytime bachelor and master students, only for MBA and other part-time master studies.

*Figure 1.1: Overview of the Danish tertiary educational system*

<b>Level</b>	<b>No. of institutions</b>	<b>No. of educations</b>
<b>Short tertiary education</b> <i>2 full-time equivalents incl. traineeship</i>	53 vocational schools (out of 117) licensed to provide short tertiary educations <i>Business colleges, technical colleges and business academies</i>	15 business academy educations <i>For example: computer scientist, multimedia designer and market economist</i>
<b>Medium tertiary education</b> <i>3-4 full-time equivalents incl. traineeship</i>	113 "mono disciplinary" institutions (provide only one education and without research status)	15 research related educations <ul style="list-style-type: none"> <li>• existing medium tertiary educations</li> <li>• new professional bachelor educations</li> <li>• existing academic bachelor educations located at two business colleges</li> </ul>
<b>Long tertiary education</b> <i>3+2 full-time equivalents</i>	12 universities	A wide selection of research based bachelor and master programs

Source: Ministry of Science, Technology and Innovation, 2003, p. 67

Also the number of PhD students (and degrees) has increased especially during the latest ten years reflecting an international trend towards more formal research training. However, again compared to Sweden and Finland, Denmark is still lagging behind, although the government has recently increased the PhD budget in an attempt to catch-up to the Finish level.

During the past five to ten years there has been a steady increase in the number of master educations offered within a wide range of disciplines as continuing education based on work experience of the participants. Today all Danish universities offer such master programs together with a wide palette of other activities under the heading of Open Education programs.

Denmark has a long tradition of adult education and training – including vocational training. According to various EU surveys the Danish work force is among the most active when it comes to participating in continuing education and lifelong learning activities, and the public sector has hitherto spend a higher share of GDP on life-long learning activities than most other countries (Christensen et. al. 2005).

## **2. The position of Academic Institutions in the National System of Innovation**

The Danish innovation system includes (2005) a wide grid of academic institutions: 12 Universities, 21 Governmental research institutions for specific sectors and areas, 4 University hospitals, 9 GTS Institutes<sup>1</sup>, several Centers of tertiary education (in Danish CVU) and Business academics, 7 science parks and around 8 ‘innovation milieus’.

Most of these institutions are public or semi-public. The large, but decreasing share of funding for the activities of these institutions comes from the yearly state budget. A smaller but increasing share of the institutional budgets are funding for strategic purposes, programs and projects, both from public and private sources. The vast majority of the public R&D investment is allocated to universities, see Table 2.1.

*Table 2.1: Public R&D investment divided by sectors, 2000.*

Universities	60%
Governmental research institutes	21%
University Hospitals	15%
Others (museums, libraries, centers of tertiary educations (CVUs), business academics)	4%

Source: Ministry of Science, Technology and Innovation (2003).

In the following the main focus is put on universities and to a lesser extent the governmental research institutes and the university hospital – the three groups that together take out the lion’s share of the resources.

### **2.1. Linkages and collaboration**

Concerning what areas and with whom to cooperate it is to a large extent within the decision-power of the single institution or its sub-sections - which in fact can be the individual research group or researcher – as long as it can be financed by the institution itself or financed through the linkages. Therefore the history of the institution, its traditions and the mutual benefit from linkages play an important role in how relationships are exploited.

In the Danish context this means that the existing business structure and the knowledge intensive public sector activities play an important role in forming the linkages. The agricultural sector, the pharmaceutical sector, the energy sector and not least the public

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<sup>1</sup> GTS – Danish acronym for Approved Technical Service Institutions.

hospital sector are central partners in collaboration on research and knowledge production. These sectors are dominated by large companies and in that sense a relatively few companies are responsible for a substantial part of the linkages with specific research groups within universities and governmental sector research institutions.

Besides these kinds of linkages the innovation system also includes a number of science parks typically related to a university. As well the above-mentioned linkages as spin offs from larger companies or from universities are parts of the science parks and 'innovation milieus'. Such parks and milieus can also have sectoral research institutions and GTS institutes as tenants - and even regular university research can take place on such locations.

In a small economy as the Danish the products this knowledge production is part of are sold internationally. This is today not only the case for those activities that is going on between large companies and the research institutions, but also for young and small spin-offs companies. The demand for their products and the R&D partners are very international oriented.

The firms that mainly produce for the home market or produce rather low-tech products are less involved in research and innovation linkages with the universities than the more research-intensive firms operating on the foreign and domestic markets. The GTS institutes have as a part of their mission to increase the creation of linkages between such firms and the more advanced parts of the innovation system, but up to now this has not resulted in any dramatic change in the interaction pattern. It seems as if it is a clear advantage to have employees with an academic degree situated in such firms before the actual linkages building activities starts (Christensen et al. 1999, Vinding 2002). On the other hand the part of Danish business that are only concentrating on the domestic market is gradually decreasing which means that an increasing part of business gradually is becoming more research intensive.

Weak linkages to the research system have not up to now been directly reflected in a general orientation toward the local market, but in the future a larger part of business will undoubtedly get into a more severe competition from foreign partner with knowledge as an increasingly important competitive factor. Therefore they have to become more involved in this part of the knowledge system. The success of this seems to be dependent on how fast university graduates can find employment in these firms and what their competence can offer for such firms. This implies that university and college educations are offering qualifications suited for this.

### **3. Mapping the Academic System in Denmark**

In order to map the academic system this section will present a short history of the higher education institutions, a history of the governance system, and a description of main linkages between academic institutions and other partners in society.

#### **3.1. A brief history of higher education**

The university of Copenhagen was established in 1479 as a seminary for catholic priests recognized by the pope, but with programs in law, philosophy and medicine (Ministry of Science, Technology and Innovation 2003:3). This university was during several centuries the only institution for higher education in Denmark. This changed in the end of the eighteenth century when a number of teachers colleges gradually was established in connection to the start of the general primary school, an activity that increased the demand for teacher education.

In the first half of the nineteenth century the College of Advanced Technology, now the Technical University of Denmark, was established (1829) and later in that century the Royal Veterinary and Agricultural University (1856) and the Danish University of Pharmaceutical Science (1892) were established. This was followed in the first half of the twentieth century of the two business schools and the University of Aarhus (1928). Finally in the second half of this century the universities of Odense (1966), Roskilde (1972) and Aalborg (1974), and the Danish University of Education were founded in 2000 by merging a number of smaller institutions. Both Roskilde University Center and Aalborg University introduced from the very beginning the so-called Problem Based Learning model (PBL) as their overall pedagogical teaching model. Currently in total 12 universities are functioning today.

The teachers colleges were in the twentieth century followed by a number of colleges for the education of different kinds of professionals within the area of pedagogy and pre-school teachers, and a gradual transformation of the training of health personnel from in-house vocational to institutionalized education. Including the teachers colleges this group of institutions counted more than one hundred before a number of mergers began. In addition to this a number of engineering colleges existed and a number of high schools within business and technology started to offer short-term higher education of one to two years within their specific fields.

This increase in the number of academic institutions has within the university sector up to now only been followed by a small number of mergers. One between the University of Odense and a small business school in the southern part of Jutland to the University of Southern Denmark (1998) and another the earlier mentioned University of Education (2000). Within the college sector the Ministry of Education has through the last ten years urged the institutions concerned with professional fields to merger and a number of mergers have diminished the number of these types of institutions rather dramatically. Recently, the Minister of Science, Technology and Innovation has launched the idea of further mergers within the university sector. The outcome of the ongoing negotiations seems to be a kind of 'moderate' solution with in total 8-9 universities.

A large number of relationships on the individual level exist between specific groups of researchers and teachers related to similar programs. The amount of linkages on the institutional level is considerable lower and is normally used to secure that institutions with small research resources are supported by institutions with more research resources to enhance the quality of education within the 'poor' institution. The relatively small number of linkages within this field have also been fluctuating and might not have had any significant importance except a possible increase of the quality of the education within professional.

### **3.2 The development of university governance system**

*From a collegial governance system...*

Since the Reformation in 1536 universities in Denmark have been state institutions, but with a high degree of autonomy. This means that a collegial governance system based on the professors through a senate has ruled the university. From 1968 the students demanded more influence on decision making within the universities, and in the beginning of the 1970s the governance structure that functioned the next couples of decades passed the parliament. In this act the university senate consisted of a share of 50% professors, 25% students, and 25% technical administrative staff. Their constituencies within the university elected their members of the senate, and the same constituencies in the same proportions elected the rector. During the first half of the 1970s faculties each including a number of departments, with faculty councils were implemented in all the universities. These councils had the same constellation as the senate and had the decisive power on budgets, plans, and academic matters, and they elected a dean for the faculty. In the departments the entire staff of researchers, teachers, technical administrative staff, and a number of elected students governed the department and elected the head of the department.

For all master study programs a study board consisting of equal representation of teachers and students were elected, and these boards decided upon curricula, course programs, and other matters concerning teaching and education. This was done under an ordinance for each master program made by the Ministry of Education that on a national level defined the general goals of the specific master education. In this way the governance of study programs to some extent was divided between the Ministry and the study board. At the same time it is important to notice that neither boards nor universities were - and still not are - allowed to start new master or bachelor programs without the permission from the ministry, and the ministry has always had the power to assess the quality of existing programs.

During the 1980s and 1990s the ways of allocating resources to university education changed in a number of steps. For many years resources were allocated according to a formula that took into account the number of students and the salaries for the number of permanent research and teaching positions. In the changed allocation system money to the universities was distributed according to the number of bachelors and masters that graduated. In this way the mechanism for allocation of means for education changed from an input criteria to an output criteria. This change was closely connected to general new principles of allocation of state funds to its institutions, and the change for the universities

was to some extent part of the national governments experiments with these new principles.

More than once did individual professors, some political parties and different societal organizations complain especially about the influence of students and technical administrative staff on research and administrative decisions in universities, and in 1992 the Parliament passed the centre-rights government's new act on university governance. In this act the most important change was that rector, deans, heads of departments, and heads of study formed a more traditional hierarchy and got a more specific leadership mandate. But the election system was continued, and the most important change in governance was the abolishment of a number of committees and the handing over of operative management to the individual leader.

#### *To a hierarchical top-down system*

This system was also criticized from different sides. The most often heard critique was that this democratic system was too slow in its decision-making processes. Even if this was never proven the government anyhow, in 2003, put a new and different act on university governance in operation. In this act the senate and the faculty boards were abolished and instead a number of advisory academic councils were established. A university board with a majority of external members from business, cultural institutions, and foreign universities, formally got most of the power that hitherto had been located in the senate. Furthermore, the rector, the deans and the heads of departments are appointed, not elected. Rector is appointed by the board, deans by the rector, and heads of departments by the dean. The academic council decides only on strictly academic matters. The individual managers on the different levels decide on all other areas. The only governance structure that has not been changed concerns the study boards.

The governance structure as it looks today is formally more autonomous than the former structures. The universities are not any longer formally an integrated part of the state administration, but are defined as kind of firms with a governing board where the external majority on vacancies appoints new members for the board, and the economic and financial responsibility is placed entirely in the board. On the other hand, the universities are still mainly financed by public means, and the government and the minister still have a number of mechanisms to control specific fields and the power to start evaluations into specific universities on subjects of interest. At the same time the system for allocation of resources for education has during the years been more detailed. The allocation of resources for research has in the same period slowly developed from a lump sum based partly on traditions and partly on the mechanisms for allocation educational funding towards a system based on strategic and political priorities.

Along with the new governance structure came a new 'resource allocation device' in the form of a formal contract between the ministry and the individual university. The contract normally runs for a period of four years and it specifies a number of goals concerning external resources, research publications, international, national and regional cooperation, number of graduates, PhD production, and a number of improvement of more administrative and organizational kind. Combined with this most universities have started

to form and publish strategies that relate the more specific goals in the contract to more long-term goals and missions of the university.

These developments are part of a kind of new public management development in the entire state governance. This makes according to the proponents of such systems the universities and their management capacity more in line with their dynamic environment in general, but also with a national government that demand more flexibility of its institutions and a research funding system that is increasingly geared towards strategic research programs allocated from the ministry's chair. This is also reflected in the structural development of the national research funding system, where the traditionally discipline directed national research councils have been merged and changed in the direction of more broad areas and programs and away from disciplines and projects.

To finish the description of the national governance system two additional elements should be mentioned. One is the standing Research Committee in the Parliament that debates most legislation on higher education and matters concerning research. The other element is the current structure of the national government where two ministries are responsible for education. The Ministry of Science, Technology and Innovation is responsible for the universities, and the Ministry of Education is responsible for primary and secondary education and for that part of tertiary education that is outside the resort of the existing 12 universities.

### **3.3 Linkages between Academic institutions and other partners in society**

#### *Linkages within the educational system*

As mentioned above, the main body of the educational system from primary education to PhD is public with an overall responsibility of the Ministry of Education. This is the case, even when as in primary and lower secondary schools 15% of the children attend private schools. The rules and regulation for private schools and public schools are identical. Within the educational sector the formal linkages between the state level and each of the sub-sectors seems to be more frequent and dominating than linkages between de different sectors (for instance between the primary and the secondary school sector or the upper secondary school and the universities). This is also the case for the linkages between the state owned institutions for vocational training and the other parts of the educational system. But increasingly additional agreements are made directly between individual institutions on different levels and sectors within the Danish educational system. Most clearly this is seen between university colleges and universities in relation to how shorter and longer higher education can be combined for students who starts in the university colleges but wants to continue on post-graduate university programs.

#### *Linkages between higher education and business and public administration*

The increase in numbers of university graduates with jobs in business and public administration has in itself created important linkages between higher education and these sectors in society. What can be noticed is a much more even relationship between higher education and society. Higher education and academia are not any longer to the same extent seen as institutions with an unbridgeable distance to society, and the knowledge level present within the knowledge and research intensive business sector is increasingly

comparable with universities. At least this seems to be the fact in the large knowledge based firms and in the knowledge based part of public institutions. So even if this is only a part of the business sector and public administration it results both in an increasing understanding between those sectors and an increasing critique from business and the public sector, when they find things not well enough conducted within university. At the same time it has dramatically increased the involvement of firms and institutions as providers of cases, projects and traineeships for university students.

#### *Life-long learning*

Another kind of linkages between higher education institutions, private firms and public institutions has evolved during the last ten years where an increasing number of employees have participated in part-time further education, mainly on the master level (MBA and similar). Some students finance these education activities themselves, but do often get reduction in their working hours. Other students get part of their tuition fee paid by their employer and others are encouraged strongly by their employer to take part in such kinds of education. As a linkage this development is not only increasing the competences of experienced employees, at the same time it gives the higher education institutions a closer connection to the everyday life in business and public administration. In time it might also increase the function of alumni organizations that up to now has been nearly completely absent in Denmark compared to the active role these organizations play in many other countries.

#### *Linkages within research*

Linkages within research have been established many decades ago. Establishing the first mono-faculty universities in the middle of the nineteenth century can be seen as a result of needs expressed by agriculture and industry. Not at least agriculture has as a strong historical development force in society from the very start of the cooperative movement and until recently been among the most impressive builder of linkages to research. On the one hand, the relative weight of these traditionally strong research linkages related to agriculture seem to decrease in the Danish case concurrently with the increasing outsourcing of processing of agricultural products and the decrease in numbers of farmers. On the other hand, has the increasing focus on both organic farming, GMOs, functional foods, animal cloning, pesticides, pharmaceutical and animal deceases in a sense revitalized the traditional research area and strengthened the relations to especially the chemical industry and the pharmaceutical industry. The research linkages that have increased the most during the last decades are between large research-intensive firms and university research. Especially the growing pharmaceutical industry and the ICT industry have developed strong research linkages to the universities but other industries are gradually following the same track.

The linkage between SMEs and university research activities is currently not very strong. Recently, several initiatives have been taken from the government, the industry itself and the universities to try to strengthen the collaboration between the universities and the SMEs, but there seems still to be a long way ahead. Instead knowledge diffusion to the SMEs has primarily been the responsibility of a variety of technological service institutions, including the earlier mentioned GTS institutes. These institutions direct their

activities toward all sectors within the economy and have to a large degree functioned as intermediate for new knowledge produced in universities and internationally to be used in the SMEs. They have also functioned to some extent as institutions diffusing knowledge to different kind of public (municipal) institutions. Most of these institutions were established by the state and partly financed by public support for basic activities. During the last decade these institutions have received reduced basic funding from the government and have had to earn more money in the market. Consequently a number of structural changes within the sector have followed.

#### *Technology transfer institutions within the universities*

The role of the universities in knowledge and technology transfer has increased. From institutions engaged in teaching and research – eventually in co-operation with other research institutions, the so-called ‘third function’ on knowledge diffusion and transfer has become an important target. This development has slowly and rather organically obtained increasing importance within the individual university and especially with an emphasis on the technical knowledge. From a start this was not any joint or state furthered development, but it emerged through different research groups and milieus in specific departments. This has led to a situation where all Danish universities have established Technology Transfer Offices, Patent Offices, Network Centers, Incubators, Knowledge ambassadors, etc. – all different kinds of organizational structures and institutions that services knowledge diffusion and technology transfer activities. Today these activities are explicitly included in the University Act and the activity contracts that universities have to make with the Ministry.

## **4. The Danish debate on the role and development of academic institutions**

During the last five years the academic institutions in Denmark have been a subject for debate both among the political parties in parliament and among several societal institutions such as employers associations, trade unions, and professional associations, but also among people directly involved in university activities and in creating linkages between universities and other partners in society. The reason for this has both been the global and international development and internal changes in the national innovation systems. Such debates flare up for different reasons and have been initiated by different organizations. Debates on different topics within this field to some extent circle around efficiency, quality and dynamic within individual institutions, groups of institutions, types of linkages and the entire knowledge producing and diffusion system. The debates can, because of its inter-linkages, be divided into several sets of clusters. In this paper the following division will be used: financial problems, types of knowledge production and diffusion, the future types of academic workforce, and the way universities are governed and how the future total set up of the tertiary education system should look like.

### **4.1. Money makes the World go round**

One of the arguments within the discussion of the future competitiveness of the Danish society in an increasingly competitive world takes its starting point in how firms in the future will be able to develop new and innovative products and to sell these. This debate

has a national perspective that relates to the specific Danish industry structure with many small and medium sized firms and a large part of the entire production as rather low tech. Furthermore, it has an international perspective that relates to the European Union and its goals on global competitiveness.

The present government has committed itself to follow the Bologna agreement meaning that the total national R&D spending should make at least 3% of GDP in 2010. This is a goal that has a broad support among political parties, societal organizations and universities. It is at the same time a policy in accordance to EU ambitions and is in that respect often seen as a kind of national contribution to European competitiveness.

A debate on this subject has started because it has been a little difficult for many observers to see how the government will live up to its own ambition of 1% public R&D spending. Several university rectors have complained that when they look into the yearly national budget proposed by the government and when they look into the state funding of their own institutions the only thing they see is budget cuts. So instead of a yearly increase in the state funded research, a decrease, or at least stagnating allocations, during the last couple of years seems to them to be a more accurate picture of the situation. Confronted with this the Minister of Science promises that next year an increase will be seen, and the financing goal will be met in a few years.

Anyhow, critics express their scepticism. The reason for this is that the government for the last four years successfully has followed a policy of no tax increases of any kind. At the same time the expenditures for health and other social areas have been increasing. In addition to this the coalition that forms the political majority in parliament is kept together on policies that to some extent point in another direction than increasing state funding of research. This can be one of the arguments for the scepticism within the universities. Another worry expressed by those who fears about the future development is that the way to fulfill the financial ambition on research could be done through even more severe cuts in the funding of university education than what already has been seen during the last couple of years. The minister promises that this will not be the case, but this debate hardly stops before the targeted percentage for research spending is met through additional funding.

Summarizing, the debates on the funding of research, teaching and service concerns 1) how the total national budget within these fields develops, 2) how the allocation of resources between different scientific fields such as natural science, humanities, social science evolves, and how the mechanisms that create public funding for areas, programs and projects changes. Concerning mechanisms – one of the most important changes seems to be an increased use of co-financing where public funding follows funding from private sources.

#### **4.2 Research and research linkages**

Both in the internal university debates, on the national political level, and among societal organizations with interest in research a debate is running on what areas to allocate those scarce means directed toward research. This debate can at the same time be seen as

related to a global, a national and regional dimension as well as to different disciplines, areas and objectives. One way to explain why this debate is going on, and has done so for several years, is through the fact that the national resources used for research - including what the private sector is using within this field - are, with a population of only five million, very limited seen in a global perspective. This brings about an argument that a small nation has to concentrate its research activities to become excellent in knowledge production.

This debate on concentration runs in different direction. One concerns the contradiction between being on a world-class level within specific areas of basic research, and the counter argument raises the question if this in reality will support national business, social and cultural needs. This can be seen as a debate in a certain perspective of mode 1 versus mode 2 research (Gibbons et. al. 1994). In this perspective this debate relates to another debate where the government seems to be in favor of universities and other research institutions directing their activities more directly toward producing results that can be useful specifically for the national and local business. To make things even more complicated this debate also includes two other contradicting views. One is that more emphasis should be put on hard sciences to make it possible to compete at the global level. The other is that soft sciences are not only more needed for the further development of the Danish welfare state, it is also one of the means to how the country has competed with success through its specific social organization. Into this debates points of view on the future national business structure with its weight on service and creative industries and the increased out-sourcing of traditional industrial and technical areas seem at present to gain in importance.

As mentioned this debate has been going on in different versions for a number of years, and no formalized policy neither at the national level nor in the individual institutions has been decided upon. This can perhaps be explained through the fact that no stable and strong coalition has up to now been formed on a united strategy pointing at one specific type of concentration. In all political coalitions there seems to be proponents for several different kinds of concentration. Anyhow, a look into the more 'unstructured' development within the research funding landscape during the last decade might show a slow but steady move away from the humanities and the social sciences and toward the natural sciences and technology. This is a movement that has been possible because of the gradual decoupling of the funding streams for research and education. But a more explicit policy on how much and what kind of concentration seems not to be on the agenda in the short run and is not much echoed in national debates on the development of research.

This means that the linkages that are being established toward global research centers, global companies, national research centers, domestic firms and public institutions and regional partners to a large extent has been a result of a natural development of local research interests and results. National and international institutions, such as EU institutions, can be supportive in these processes, and so can the universities themselves, but the important players are the research groups themselves and in some cases firms and

other kinds of organizations raising demands and offering support. Concentration in the form of research relations has in this way been part of a rather organic development.

### **4.3 Debates on higher education**

The number of programs that offer free admission is increased, and only a few studies such as medicine are strongly restricted. Despite this the share of university students measured toward the entire population is lower than in many other countries, and the government is constantly complaining that the young people are starting their university studies too late. According to the government this harms the national economy.

The rather free admission also for individuals of other European nationalities has several times fuelled a debate on the possibility of restrictions. This has been the case because for instance, medical studies receive a large share of Swedish and Norwegian students who are able to follow programs where Danish is the language of instruction. This has got some politicians to demand that they should not be allowed to study in Denmark without paying, but the government has rejected such ideas as violation rules and regulations within the EU. More success have those parts of the political majority in parliament had who has supported restrictions for the admission of non-European students. From 2006 they have to pay a tuition fee to be allowed into a Danish higher education.

A debate which to some extent is pulling in another, more globalized direction centers around how it should be possible by a focused use of extra resources, to have a small proportion of students that in the future as graduates will be able to compete and participate in the knowledge production at the absolute highest level. This is a debate between elite and mass education that has gained momentum during a year or so. The debate includes positions that can be seen as rather similar to some of the research policy positions. One is for free and broad admission as has been a Danish tradition, the other is for reallocating resources in order to concentrate on a small number of programs that have shown great strength in an international perspective and can be seen as vital to the national competitiveness. Several arguments have been presented in this debate - from master programs that clearly see themselves as candidates for such an honor to rectors who claim that if the government not continuously cut the budgets for university education, then excellence in education would on a broad scale be a goal that is within reach in the present structure.

In another perspective a debate flourish concerning the direction of university education. This is a debate that can be seen as trying to raise and fulfill goals in a quite opposite direction. The question raised here is how much weight should be put on making university bachelors, masters and PhDs competent within innovation and entrepreneurship. One of the arguments for this is that it might create more successful start-ups of new firms by university graduates and at the same time make bachelors and masters more useful for small and medium sized firms. Many universities are experimenting within this field, and the debate is more concentrated on how this could be done than if it should be done.

#### **4.4 Internal governance structures and external linkages structures**

As explained earlier in this paper both the internal structures in university governance and the overall set up of the higher education system have been through processes of change in the most recent decades. This has not happened without debates between different partners in society and among politicians. At the moment these debates have calmed down, but they tend to flair up now and then. One is the debate about the conditions for internal governance in universities especially when the ministry interferes into what the universities see as their internal affairs. Another debate is of a more inter-institutional nature and concentrates on mergers and new linkages between university colleges and between universities and university colleges.

The basic fuel for the debate on university governance is the contradiction between what in the governments language could be called institutional autonomy, and the many direct and indirect governance mechanisms that still and perhaps increasingly are in the hand of the Ministry of Science, Technology and Innovation. Even when the universities are not any longer seen as traditional state institutions a detailed state control still prevails. From the period of genuine collegial governance the framework that has been set up by the government has in Denmark always been rather narrow. At the same time all universities have national teams of external second examiners that participate in most exams in university and are appointed by the ministry. Such possibilities for inspection have not been changed as a result of the universities formally have got more autonomy.

Years ago such control methods did not create much debate. The universities were rather unaffected by the external state control. The daily operations and decision-making took place in an organic way that was normal when it concerns the development and planning of teaching and research, and the funding for the larger part was a lump sum. These activities were not in every day life affected by the state regulation. If any real problems were recognized this was often negotiated on a national scale between the ministry and representatives from the study-boards, deans or in institution matters by the Danish Conference of Rectors. This could now and then lead to public debates, but they mostly concerned the specific problem more than matters of governance structures.

One explanation on why the debate has turned more towards governance structures and has become more intense could be divided into three factors. One is that the dynamic both relates to an increase in the number of new demands that confront universities, and at the same time a situation where systematic budget cuts makes state governance more visible inside the universities. Secondly the discrepancy between the formal autonomy and the actual governance makes it increasingly difficult for the universities to live up to internal as well as external expectations. And thirdly the new autonomy is followed by a demand for the universities to show more systematic management. This means that not only leaders are appointed by their boss, it is also expected that leaders on each level uses managerial methods that often internally are felt as rather mechanistic in a type of organization that has been used to a more organic way of handling things. Therefore the debate that takes place on an everyday basis in all universities now and then is reflected in the media and results in discussions on principles and how they are implemented in practice.

The reason why the debate within and between the non-university higher education institutions, which are in fact governed by the Ministry of Education, is different from the university discussion is connected to two other factors. One is the formalization of the educational structure within these institutions in order to increase the level of graduation to professional bachelor degrees. The other is the need for critical mass, which forces a large number of small institutions to merger and to form university colleges. One difficulty in this process is the rather loose framework the Ministry of Education has set for this process, something that seems to be new for these type of institutions. At the same time it is a precondition that university colleges education in some ways are connected to research, although not research based as in universities, and the university college institutions are not given state means for research. Therefore some kind of linkage to universities is seen a way to solve this ambition of a research connection.

The debate within this field has for a large part been related to a question about who should merger with whom and what kind of governance structure should such a new university college work for. The process started with more than one hundred institutions, and according to the Minister of Education it should end with less than ten large institutions. This has resulted in a number of different structures and with different kinds of linkages to universities. Some have formed rather loose mergers containing institutions with very different areas of education (nursing, teachers education, business education), while others have either formed more homogeneous or more centralized institutions. Some mergers include linkages to a university others do not. At the same time the first break ups in such new constructions have already been seen.

## **5. The road ahead**

The increasing interaction between universities and other actors in the innovation system (small and large firms, high-tech and low-tech firms, technological service institutes, hospitals, consultancy and other knowledge intensive business services (KIBS), public agencies, other educational institutes, etc.) involve a variety of forms from joint labs, spin-off, licensing, research contracts, mobility of researchers, co-publications, conferences, exhibitions and specialized media, informal contracts with professional network to flow of graduates. Most countries – including Denmark - have implemented multifaceted strategies to stimulate collaboration between universities and other actors in the innovation system. However, it is not an easy task to design and implement mutual beneficial collaboration between actors with different missions, culture, resources, power structure, and knowledge base (Arocena et al. 2004). There are massive variations among technological fields and sectors in their capabilities and opportunities to create and maintain linkages with universities and other research institutions. For less research-intensive firms and institutions it might not even be relevant to engage in such direct collaboration. Seen from the perspective of the universities and other academic institutions they face a complex mix of challenges in order to fill out their ‘new and bigger shoes’ in the modern learning economy. In this concluding section we only list a few of these interrelated challenges.

### *Globalization and restructuring of the production system*

Historically, a substantial part of the national academic institutions has been linked directly to the national production system. Most clearly this is reflected in the mono-faculty universities (for instance agriculture and pharmaceutical) and in the set up of sector specific governmental research institutes, but of course also in many other areas as law, business and engineering. The ongoing globalization and restructuring of manufacturing and services is one of the most important (and difficult) challenges for the contemporary national academic institutions. If for instance the future software industry mainly is to be located in India or China is it then relevant to continue educating Danish IT-specialists? Or if most of the manufacturing is outsourced where should the production engineers go? Or if the internationalization and mergers within KIBS continue will they all end up in London or Beijing? Multinationals set up and close down R&D departments according to contemporary national strongholds. Multinationals have for instance during the latest ten years established R&D departments within mobile communication and pharmaceuticals in Denmark, but recently some of the mobile research units have been closed or reduced. At the same time Danish research-intensive firms establish R&D units outside Denmark and to an increasing degree collaborate with foreign universities and research institutes. How can or should the academic institutions react to this?

One small country strategy could be a specialization strategy where a substantial part of the scarce resources is allocated to a few specific areas. To identify these and not least to agree on the selection is a challenge in itself. Non the less, it seems as many countries – including Denmark - try to implement such a specialization strategy and it also seems as if there is a common understanding that areas within ICT, nanotechnology, biotech and pharmaceuticals should be among the selected based on expectations about future key technologies and related growth industries.

In the Danish case another specialization (or maybe diversification) strategy could be to further strengthen the linkages between the academic institutions and public administration, the health care sector, the alternative energy sector, and the environmental industry – areas where the Danish Innovation System still has some international strongholds.

### *Increased internationalization of knowledge production and knowledge diffusion*

Concurrently with the increasing globalization and restructuring of manufacturing and services follows an increasing internationalization of knowledge production and knowledge diffusion. One important part of this has to do – as mentioned above - with the MNCs' restructuring of R&D activities and the outsourcing of high-skilled jobs. However, it also affects the academic institutions more directly in the form of increased focus on international research collaboration, more international staff and student mobility, and a growing focus on international publishing. In that way universities and research institutions have to balance between increasing demands towards international engagements on the one hand and on the other commitments to collaborate with domestic firms and other actors in the national innovation system. In countries where the domestic production structure is dominated by SMEs within low-tech industries that do not invest

much in R&D and have no or very little tradition to collaborate with universities and other research institutions this dilemma is more manifest (Arocena et al. 2004).

Furthermore, the increasing internationalization of the knowledge production system is forcefully stimulated by national and international R&D and innovation policies. In the Danish context various EU policies – for instance the different generations of framework programs – have had substantial influence on the national policies and the academic institutions' responses to these new funding possibilities. The increasing demand for forming Networks of Excellence spurs in the same direction.

#### *Increased marketization of public sector activities*

Since the 1980s there has been a general shift in the public service philosophy towards more and more marketization (Peters & Olssen, 2005). This tendency has also made its entry into the academic institutions and its relations to other actors in the innovation system. It is echoed in several ways. Firstly, it is reflected in the increased policy focus on the production of so-called 'useful knowledge' primarily defined as knowledge with a direct economic benefit for the private sector. This is valid both for the ongoing 'modernization' and tuning of study programs and for allocation of public research funds. Secondly, the marketization philosophy also prevails in the increasing dependency on external funding. On the one hand this may stimulate research collaboration between the academic institutions and external partners. On the other hand, there is a risk that an increasing dependency may favor short-term research within a few selected areas at the expense of more long-term research within a broader range of disciplines and thus maybe emptying the key source for collaboration in the long run. Thirdly, the earlier mentioned shift in the allocation mechanism from input criteria to output criteria drives in the same direction.

#### *Increased commodification of knowledge<sup>2</sup>*

The enhanced possibilities for universities and research institutions to take out patents have revitalized the classical dilemma between on the one hand a broad and easy access to public financed research and on the other private appropriation as one of the basic incentives to innovate. But more important is maybe that the increasing tendency to treat information and knowledge as commodities introduces a basic contradiction in the learning economy. On the one hand firms and now also universities try to capture knowledge economies through intellectual property rights. On the other hand knowledge is socially produced in groups and networks, which may be destroyed or damaged when knowledge is treated as a commodity. Furthermore, the commodification of knowledge is accompanied by increasing costs for developing and maintaining an adequate knowledge infrastructure including various transaction costs following the commodification process and protection of property rights.

Most European countries have recently implemented equivalents to the American Bayh-Dole Act hoping for future revenues from patents taken out by universities. In the Danish case, a new patent law was implemented in 2000 (L347) aiming to increase the

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<sup>2</sup> An earlier and more elaborated version of this section is published in Arocena et al (2004).

commercialization of public research. The new law has given the public research institutions the possibility to take over the rights to an invention done by a public researcher on condition of paying a 'fair' compensation. Furthermore, L347 gave the public research institutions an obligation to work actively for putting the research to commercial use. It is of course too early to evaluate the long-term effects, but a recent evaluation (Danish Ministry of Science, Technology and Innovation, 2004) confirms that setting up the necessary institutional infrastructure related to IPR is both a costly, risky and lengthy learning process.

It is an important question if the changing IPR regime in public research will influence the internal and external collaboration patterns in the long run. Will the university management allocate more resources to areas with higher probability to patent? Will the demand for secrecy influence the interaction between colleagues, students and external partners?

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