



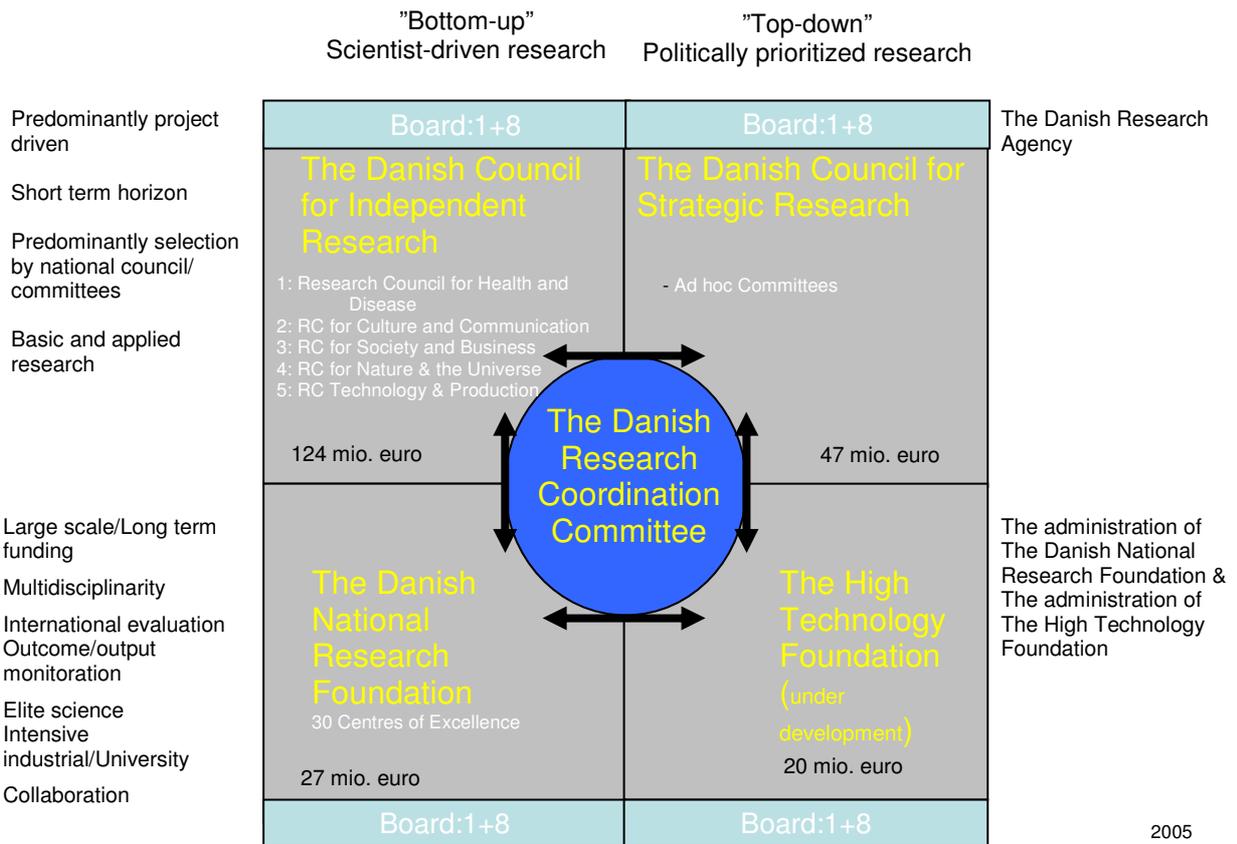
DANMARKS
GRUNDFORSKNINGSFOND
DANISH NATIONAL RESEARCH FOUNDATION

Research and Development in Denmark

Working Paper

2005

Brief overview of the Danish Research Advisory and Counselling System 2005



2005

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1. Research and Development in Denmark

This document serves to provide an overall outline of the research financing and research performing system in Denmark. It is structured under the following 3 main headings:

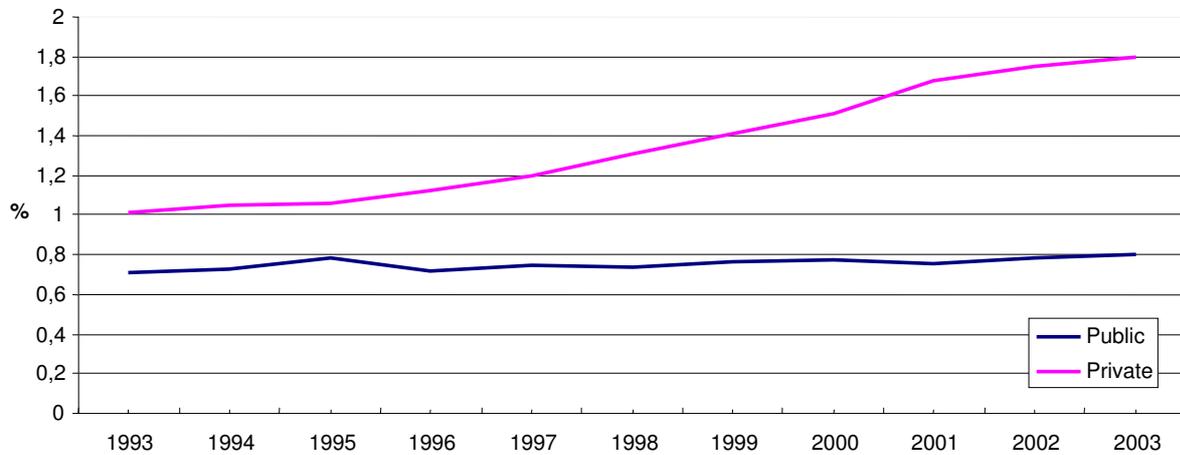
- Financing of the Danish research and development effort
- Research performing institutions in Denmark
- Description of the second tier for resource allocation to research in Denmark – The research counselling system

The focus of the report is thus on financial resources available for research and development (R&D) activities the distributing actors and the different types of research performing institutions in Denmark.

The report is based on the latest statistics available on research and development from 2003. Statistics on research and development in Denmark is compiled at the *Danish Centre for Studies in Research and Research Policy* (Dansk Center for Forskningsanalyse) under the Ministry of Science Technology and Innovation. The institute's analyses are based on the OECD definition of R&D. All the figures in this report are quoted from the latest published statistics from the *Danish Centre for Studies in Research and Research Policy*, and the *Danish Rector's Conference* of the Danish Universities.

1.1 Financing of the Danish R&D effort

Figure 1: R&D Expenditures in percent of GDP, 1993-2003



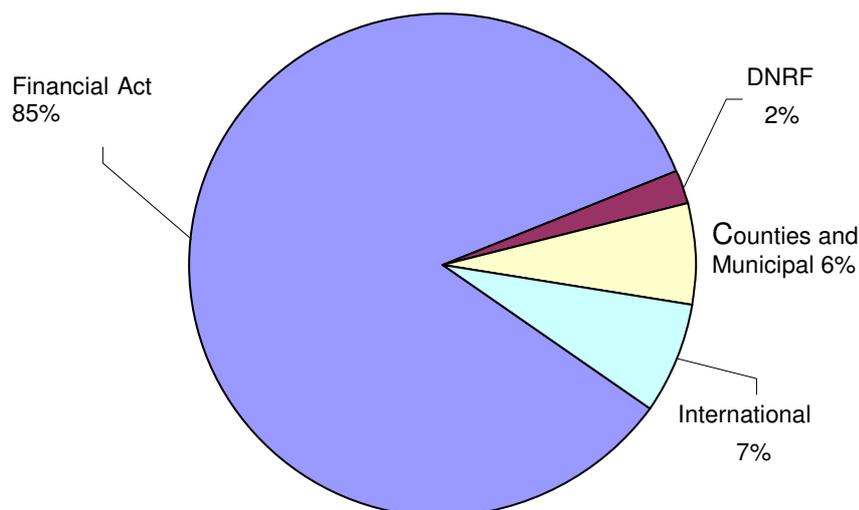
Source: Dansk Center for Forskningsanalyse: Forskningsstatistik 2003, p 28

Figure 1 shows the development of R&D expenditures in percent of GDP during the past 10 years for the private and public sectors respectively. Most of the rise in R&D expenditure was caused by increased private investment, primarily in the late 1990's and in the latest couple of years, whereas public expenditure has been fairly stable at a lower level. The Danish expenditures to Research and Development (R&D) have increased from 35 billion in 2002 to 36,5 billion in 2003, according to the latest statistics. This has caused a rise in the total Danish R&D effort with approximately 4% in 2003. The 36,5 billion amounts to 2,61% of Denmark's GDP 2003. This key figure has increased 0,09% from 2002, which is promising for Denmark's fulfilment of the Barcelona Agreement, stating that all EU states should spend a minimum of 3% of GDP on R&D by 2010.

The public sector's effort has increased 3% to 11,2 billion DKK from 2002-2003. This means that the R&D in public institutions now amounts to around 0,8% of GDP. Private R&D has in 2003 amounted to 25,2 billion DKK which gives a nominal increase of almost 4% compared to 2002. This is the lowest nominal increase since 1993, most years the rise has been the double or more. Many other EU countries experience the same weakness in the R&D effort in the private sector. Measured in relation to the Danish GDP, the private sectors effort is still strong though, and has risen from 1,75% in 2002 to 1,8% in 2003. With these numbers, the Barcelona Agreement about the private sector financing 2/3 of the total R&D seems within reach.

1.1.1 Public R&D expenditures

Figure 2: Public Expenditure on R&D distributed on Financial Source, 2003

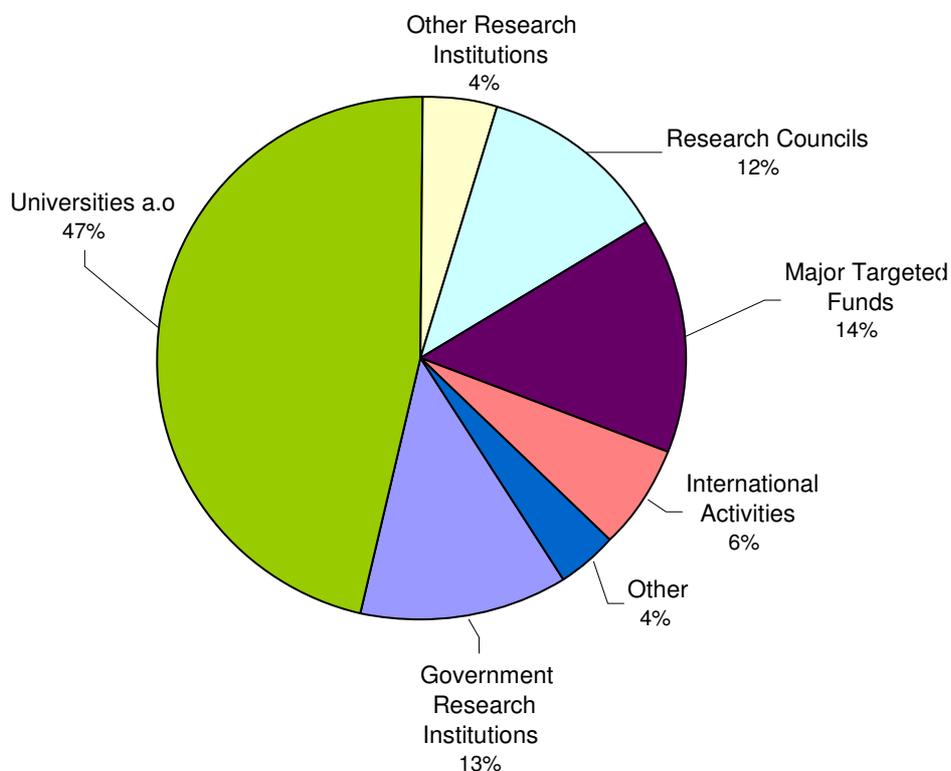


Source: Dansk Center for Forskningsanalyse: Offentligt Forskningsbudget 2003, p.8

Figure 2 shows the percentage distribution of the total public R&D expenditures of 11,2 billion DKK. The vast majority of the public expenditures on R&D (85%, or 9,5 billion) are granted through the Financial Act, while the rest is provided through international sources: the EU framework programmes, the Council of Nordic ministers, counties and municipalities, the Danish National Research Foundation, and the Growth Foundation. Noticeable in this context it is a relatively modest contribution from the Danish National Research Foundation (DNRF), showing its share in 2003 of about 260 million DKK or 2% of total public R&D expenditure in Denmark. Yet, the Danish National Research Foundation has had a strong impact on research development in Denmark (please see the report *Evaluation of the Danish National Research Foundation's centres of excellence* written by an international panel, June 2003.)

The 85% of public R&D expenditures coming from the Financial Act are furthermore distributed through the various ministries. It is worth noting that the Ministry of Science Technology and Innovation is the most research heavy ministry receiving 59% of the R&D grants of the Financial Act in 2003. Its importance is partly due to the fact that the Universities belong to the competence of the Ministry.

Figure 3: Sectoral Distribution of R&D Grants from the Financial Act, 2003

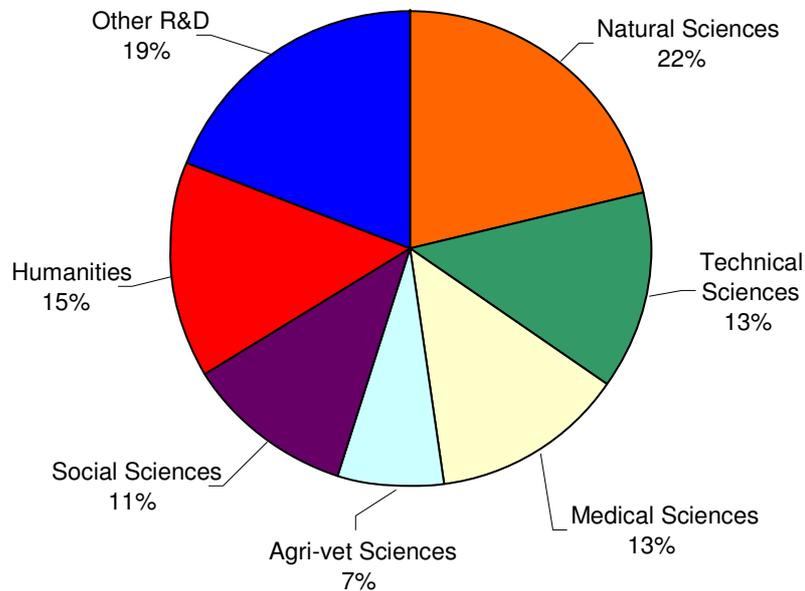


Source: Dansk Center for Forskningsanalyse: Offentligt Forskningsbudget 2003, p.25

Figure 3 shows the breakdown of the 9,2 billion DKK R&D grants from the Financial Act 2003. The universities and institutions of higher education administer about 4,3 billion DKK, the government research institutions approximately 1,2 billion DKK, while the Research Councils receive about 1,1 billion DKK. The three sectors together receive 72% of the R&D grants of the Financial Act.

Not all 9,2 billion DKK of the Financial Act's R&D grants relate to basic research. It is estimated that about 60-65% or about 6 billion DKK are spent on what may be classified as basic research, including research at the universities, while the rest is categorised as applied research or development activities.

Figure 4: Distribution of Financial Act Grants for Basic Research according to Scientific Area, 2003



Source: Dansk Center for Forskningsanalyse: Offentligt Forskningsbudget 2003, p.32

Figure 4 shows the breakdown of these approximately 6 billion DKK for basic research by main scientific area. The largest scientific area in terms of Financial Act grants is the natural sciences followed by the humanities. Taken over the latest 8 years, the humanities' share has increased with an average annual growth rate of 3%, whereas financial resources for the natural sciences have remained unchanged. The technical, health, and social sciences receive an equal share of 12-13%. R&D in other areas accounts for 19% and covers mainly expenditures for Ph.D.-training, research libraries, and interdisciplinary research projects.

1.1.2 Private R&D expenditures

The majority (86%) R&D expenditures in the private sector take the form of investments within own enterprise. Of the external investment the main part is being invested in other companies, leaving only a small share of private investments at government research institutes and institutions of higher education.

1.2 Research performing institutions in Denmark

The largest research performing institutions in Denmark are the universities and other institutions of higher education under the Ministry of Science Technology and Innovation (12 in all). In addition, there are a substantial number of research institutions under this ministry and several other ministries, entitled government research institutions (23 in all). Finally, research is performed in private enterprises. The following is a presentation of the research performing institutions and the organisation of research in Denmark.

1.2.1 *Universities*

All universities in Denmark are self-governing, public institutions under the Ministry of Science Technology and Innovation. The Danish University Act of 2003¹ specifies that a university has the responsibility of carrying out research and provide higher education at the highest scholarly level within its subject area. The university is to ensure a balanced interaction between research and education, to make strategic choices, and priorities, ensure continuous development of research and education, and to transfer knowledge about new scientific methods and results to society at large. The university should interact and cooperate with society and contribute to developing international collaborations. Each university decides for itself which study programmes it will provide. The Minister of Science, Technology and Innovation shall approve the offered programmes of the Universities. Moreover, the Minister can enact rules concerning educational programmes and the access to the study programmes, whereas the universities for themselves decide which research they wish to pursue.

With the University Act of 2003, the management of the universities has been changed. The universities used to have senates, faculty councils, departmental boards, and Rectors, Deans and heads of institutes elected collegially. Today, the managerial structure is more similar to that of other public research institutions.

According to this governing structure, the university structure consists of a Board, Rector, one or more academic councils, the Deans of faculties, and the departments (in Danish: Institutes). The Board is the supreme body of the university, which safeguards the interests of the institution and establishes guidelines

¹ The following is a rendering of the University Act of May 28, 2003. The Act is not translated into English, thus the DNRF is alone responsible for the reading and rendering of the document.

for its long-term activities and development. Thus, the Board sanctions the organisation of the institution, its budget and proposals for statutes. Furthermore, the Board appoints the Rector.

The Board is composed of external members and members representing the scientific and technical-administrative staff, Ph.D.-students, and students. The external members outnumber the members representing the staff. Furthermore, the chairman of the Board is to be appointed among the external members.

A Rector heads each University. (S)he used to be elected for a four-year period from among professors and associate professors in full-time positions and by staff and students of the institution. According to the new structure, the Board of the university appoints the Rector. The Rector should be a recognized researcher with experience in research management and knowledge of education and interaction between the university and society.

The university sets up one or more academic councils for the university or for each of the main study areas (faculties). The academic councils advise the Rector about the internal distribution of financial resources, and strategic research areas, etc. The council recommend to the Rector in composing panels for the evaluation of candidates for scientific positions and is responsible for awarding scientific degrees (doctoral and Ph.D). Members of the academic council are elected by and among scientific staff, the Ph.D-students, and the students. The Rector or the Dean of the relevant study area (faculty) chairs the academic council(s).

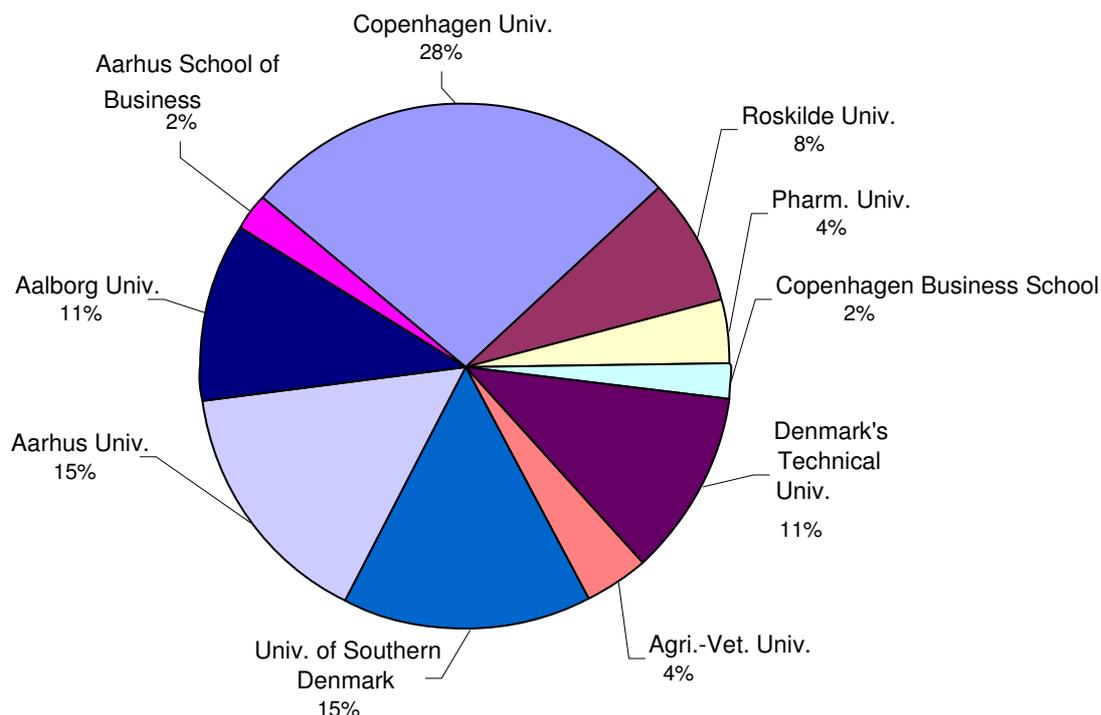
At institutions with several faculties a Dean is appointed for each faculty. The Dean is responsible for the management of the faculty, ensures a correspondence between research and education as well as warrants quality of research and education. The Rector appoints the Dean. The Dean should be a recognized researcher and be experienced within and knowledgeable of higher education, management, and interaction between the university and society.

Research and related activities at universities are normally placed within departments or usually designated “institutes” that may comprise several departments. The head of the institute is responsible for the day-to-day management of the institute, including planning and allocation of assignments. The scientific staff of the institute’s conduct research within the areas strategically set by the university, but can be instructed to perform specific tasks by the head of institute. The Dean of the faculty appoints the head of institute. The head of the institute should be a recognized researcher and have experience in teaching.

Statistics about the universities

The individual university institutions are provided with basic grants for research activities directly allocated by the Ministry of Science Technology and Innovation according to the Financial Act. The Danish university institutions received about 4,3 billion DKK in 2003, equivalent of 47% of the R&D grant of the Financial Act, cf. figure 3.

Figure 5: Relative R&D Expenditure distribution between the 10 largest Danish Universities, 2003



Source: Dansk Center for Forskningsanalyse: Forskningsstatistik 2003, tabel 17 (www.forskningsanalyse.dk/OF2003/Tabeller/Oversigt.htm)

Figure 5 shows the relative distribution of R&D expenditures between the 10 largest universities, including external financing. The total expenditure amounts to 6,9 billion DKK for all 10 institutions in 2003.

Figure 6: Location of Danish Universities

Source: Dansk Center for Forskningsanalyse: Forskningsstatistik 2003, tabel 17

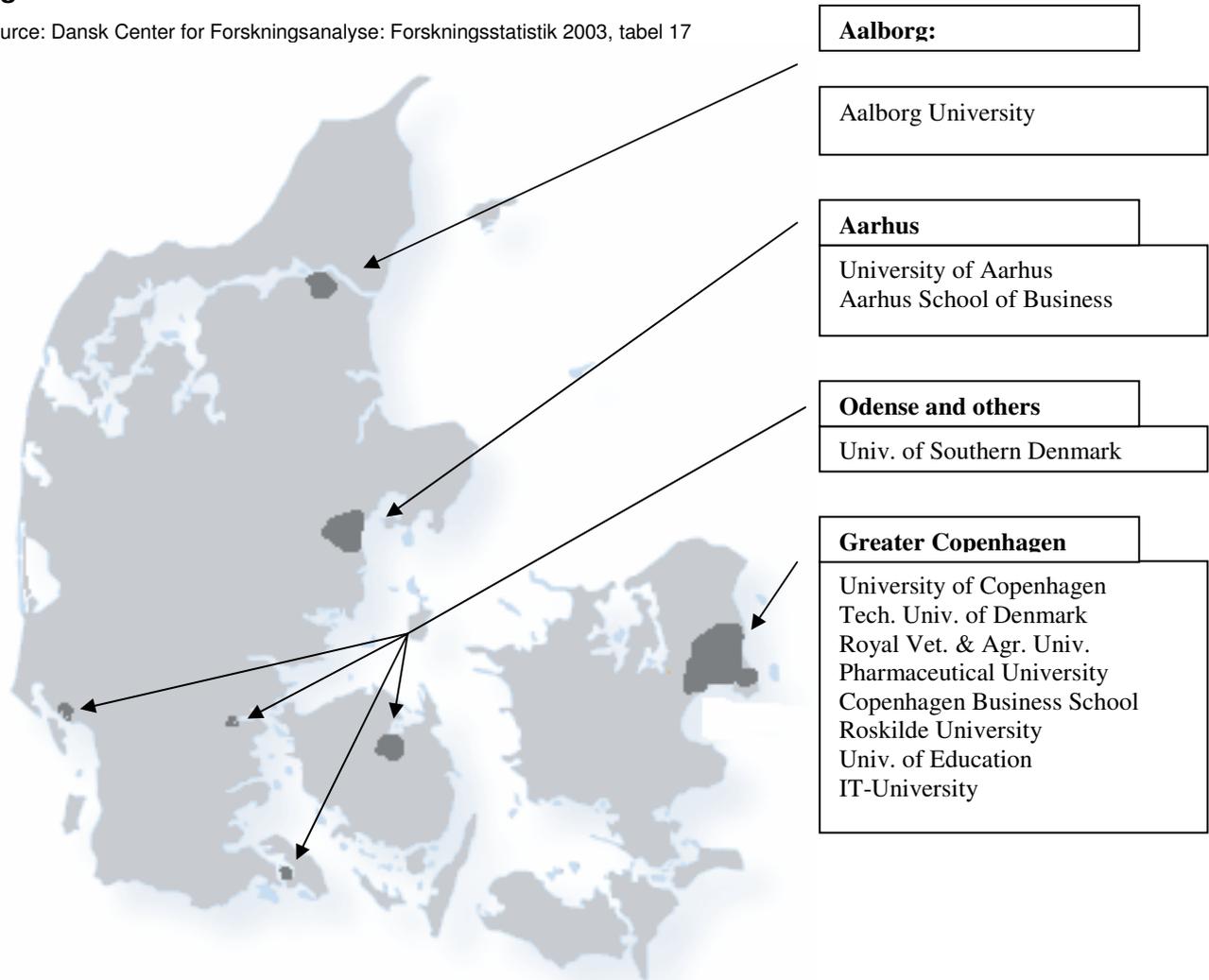
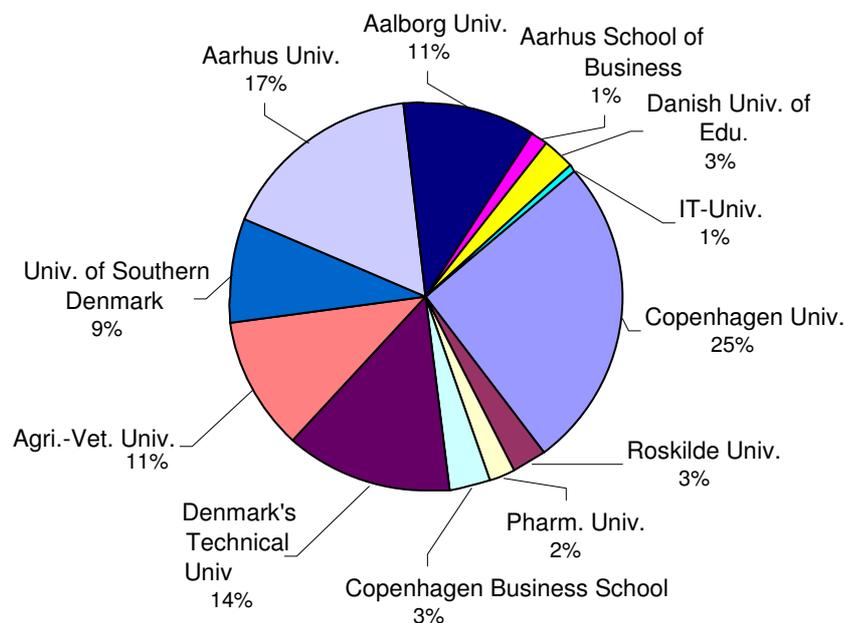


Figure 6 shows the location of the 12 Danish universities, the main part being located in the greater Copenhagen area.

Another way of illustrating the size of the 10 largest universities is to rank them by the distribution of R&D Full Time Employees (FTE) among them. This measurement, FTE, is defined as a full time employed person's work in one year.

Figure 7: R&D FTE at Danish Universities and Institutions of Higher Education, 2003

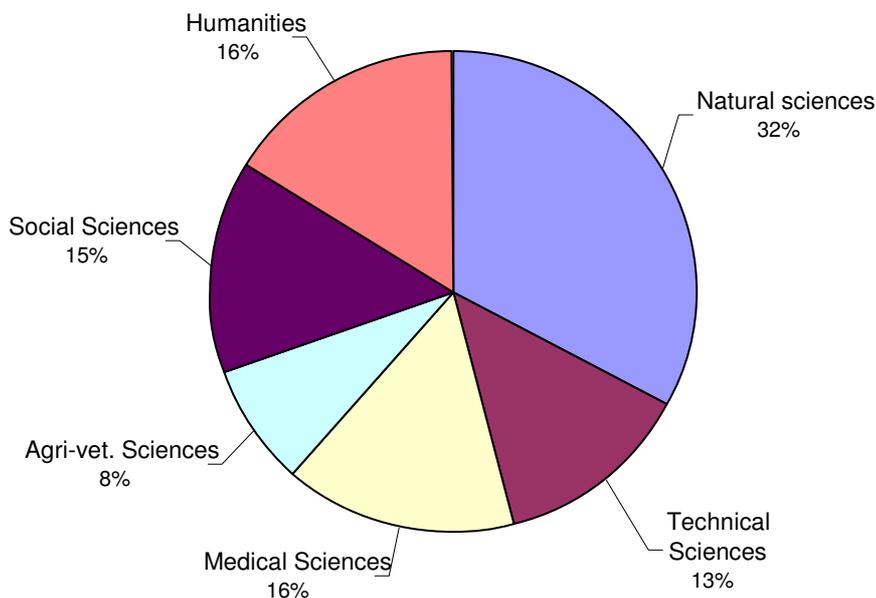


Source: Dansk Center for Forskningsanalyse: Forskningsstatistik 2003, tabel 11 (www.forskningsanalyse.dk/OF2003/Tabeller/Oversigt.htm)

Figure 7 shows that the 7 institutions (the Danish University of Education excluded) in the greater Copenhagen area together comprise almost 2/3 of the R&D FTE of Danish universities and institutions of higher education. Seen in another way, more than 2/3 of the R&D FTE is distributed on the four largest institutions: the Copenhagen University, Aarhus University, Technical University of Denmark and the Royal Veterinary and Agricultural University (RVAU).

R&D FTE at institutions of higher education amount to 57% of the total of 14.386 R&D FTE for all public sectors. At the 10 largest universities the distribution of R&D FTE between scientific personnel, Ph.D.-students, and technical and administrative personnel are as 2:1:1. However, if focusing on the different categories of employment it seems that there are major variations between the individual institutions. For example the share of full professorships in proportion to the total number of all scientific FTE including Ph.D.-students ranges between 4% (IT-University) and 14% (Copenhagen Business School) at the various universities.

Figure 8: R&D FTE at Institutions of Higher Education, 2003



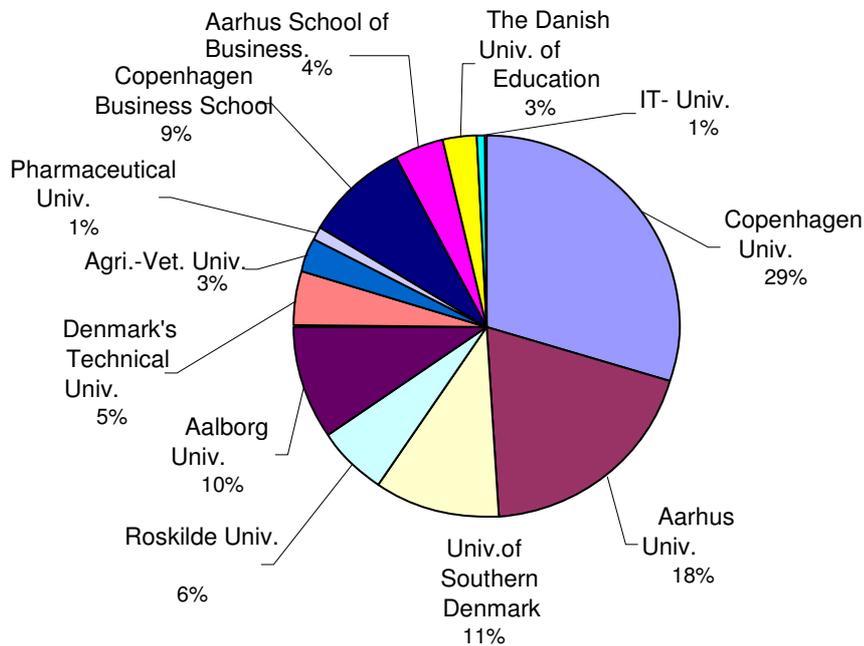
Source: Dansk Center for Forskningsanalyse: Forskningsstatistik 2003, tabel 11 (www.forskningsanalyse.dk/OF2003/Tabeller/Oversigt.htm)

In **figure 8** the R&D FTE's at institutions of higher education are distributed according to main scientific areas. It shows that 1/3 of the R&D FTE are in the natural sciences, another 1/3 in the humanities and social sciences, while the last 1/3 were related to medical, technical and agricultural-veterinary sciences. This covers differences in the distribution of FTE between the scientific and the technical-administrative personnel. The humanities and the social sciences are relatively scientific personnel intensive while the medical, agricultural-veterinary, and the natural sciences use more technical-administrative FTE due to the nature of the research activities.

All Ph.D. students in Denmark must be enrolled at a university, even if they have their major affiliation with and carry out their research at another type of institution, e.g. a government research institution. The annual number of Ph.D.-degrees has risen steadily from 1995 (699 degrees) to 2003 (989 degrees).

According to the Ministry of Science Technology and Innovation, there were 3536 ongoing Ph.D.-studies in Denmark in 2003. They were distributed as follows: 21% in the medical sciences, 15 % in the technical sciences, 28% in the natural sciences, 14% in the humanities, 14% in the social sciences, and 9% in the agricultural-veterinary sciences.

Figure 9: Bachelor and Master Students enrolled at Danish Universities, 2003



Source: Universitetsuddannelser i tal, Ministry of Science Technology and Innovation, 2003

Figure 9 shows the distribution of Bachelor and Master students enrolled at the respective Danish Universities, which more or less reflects the relative sizes of the institutions. However, if this picture is compared to figure 7, which shows the R&D FTE at the Danish universities and institutions of higher education, it becomes clear that the Copenhagen University, the two Business Schools, and Roskilde University have more students in relation to R&D FTE, whereas the Technical University of Denmark and RVAU have relatively fewer students seen in relation to R&D FTE.

The number of enrolled Bachelor and Master students totally amounts to around approximately 110.000 of which approximately 2/3 are in the humanities and the social sciences. If one compares this to the resources in terms of R&D personnel at the universities, one sees that only about 30% of the R&D FTE fall within these two areas. The teaching load in the agricultural-veterinary sciences and the natural sciences seems to be of a somewhat different character. These two branches hold a relative share of R&D FTE, which is 2 to 3 times higher than what their total share of student should logically merit up to, when compared to the relative share of R&D FTE held by the social sciences and the humanities.

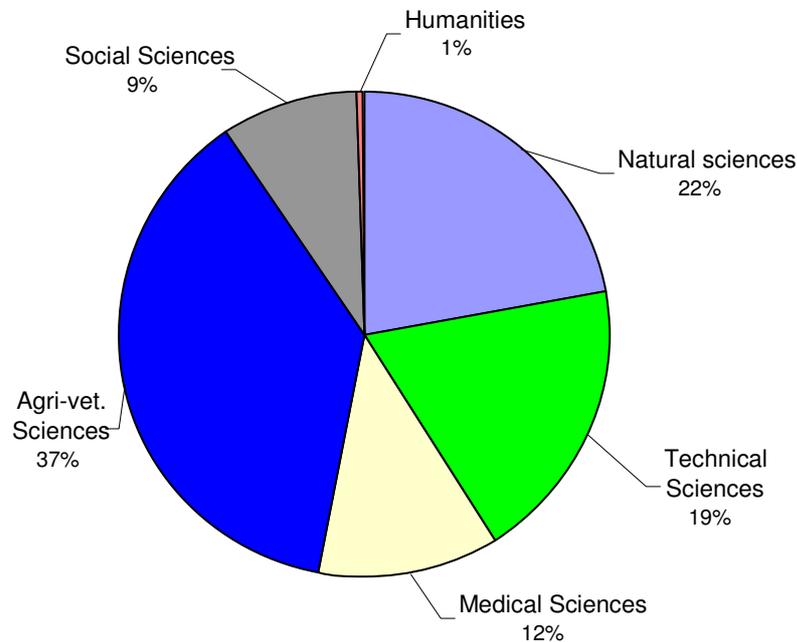
1.2.2 Government research institutions

Government research originated from a need for task performance (including research activities) which is not fulfilled by either universities or private enterprises. These needs are addressed primarily by public authorities, and most often by ministries. Government research institutions engage in research and development and conduct such task performance in their respective expertise areas. They provide input to both political and administrative processes as well as to the development of knowledge and public awareness and debate in the concerned task area.

The government research institutions are typically financed through basic grants from the Financial Act. The Danish government research institutions received 13% of the R&D grants of the Financial Act in 2003, approximately 1,2 billion DKK, cf. figure 3. However, the total budget of the government research institutions amounted to 2,2 billion DKK, other finance sources being the National Research Councils, other public funds and programmes, counties and municipalities, enterprises, organisations and trusts, plus international resources.

Approximately 20% of the total R&D FTE of all public sectors are held by government research institutions, whereas, for comparison, the institutions of higher education have 57% R&D FTE.

Figure 10: R&D FTE at Government Research Institutions according to Scientific Area, 2003



Source: Center for Forskningsanalyse: Offentligt Forskningsbudget 2003, Tabel 27a (www.forskningsanalyse.dk/OF2003/Tabeller/Oversigt.htm)

Figure 10 shows that most of the R&D FTE at government research institutions is in the areas of natural sciences and agricultural-veterinary sciences, while the relative share of R&D FTE in the social sciences and the humanities at government research institutions is comparatively small in Denmark. The R&D FTE at government research institutions in the natural and technical sciences account for half of the total R&D FTE at government research institutions. This is quite similar in size to the percentage of R&D FTE within the same areas at the institutions of higher education. On the other hand, R&D FTE at government research institutions in the area of agricultural-veterinary are markedly over-represented with a share of 34% as compared to 8% at the institutions of higher education conversely, medical and social sciences and particularly the humanities are under-represented, cf. figure 10.

1.2.3 *Private enterprises/research labs*

The private sector accounts for 60% of the total R&D FTE with 21.022 R&D FTE as compared to the 14.386 R&D FTE of the public sector. Hence the distribution between public and private R&D FTE is roughly 1:1½. The public sector's R&D expenditures comprise less than half of the R&D expenditures of the private

sector, cf. figure 1. R&D FTE in the areas of medico/health and IT/communications² account for more than 50% of the total R&D FTE in private enterprises in the private sector.

1.3 The second tier for resource allocation to research

Denmark has a two-tier system for resource allocation to research. One tier of this system is the basic grants from the Financial Act allocated by the different ministries directly to the institutions. The other tier comprises resource allocation from the National Research Councils, strategic research programmes, and R&D funds from the individual ministries. Denmark also has a few private funds, which are part of this second tier. Amongst these is The Danish National Research Foundation.

Scientists get resources from the second tier predominantly through competition. Grants are given for shorter periods of time, partly on the basis of project proposals, partly by tender for research activities specified by the granting institutions. Grants may be given predominately to individual scientists or to research groups. The basic institutional grants in Denmark today are so limited that they do not provide sufficient support for conducting top-level research. Therefore in Denmark at present most scientists, who wish to conduct research on an international level, are forced to seek funding from the second tier in the two-tier system, where competition is fierce.

1.3.1 The structure of the second tier for resource allocation to research

In January 2004 the act L 142 came into force concerning the second tier of allocation of resources to scientific research. The research advisory and counselling system now consists of the following main bodies:

- Danish Council for Research Policy (Danmarks Forskningspolitiske Råd) – advisory board to government only

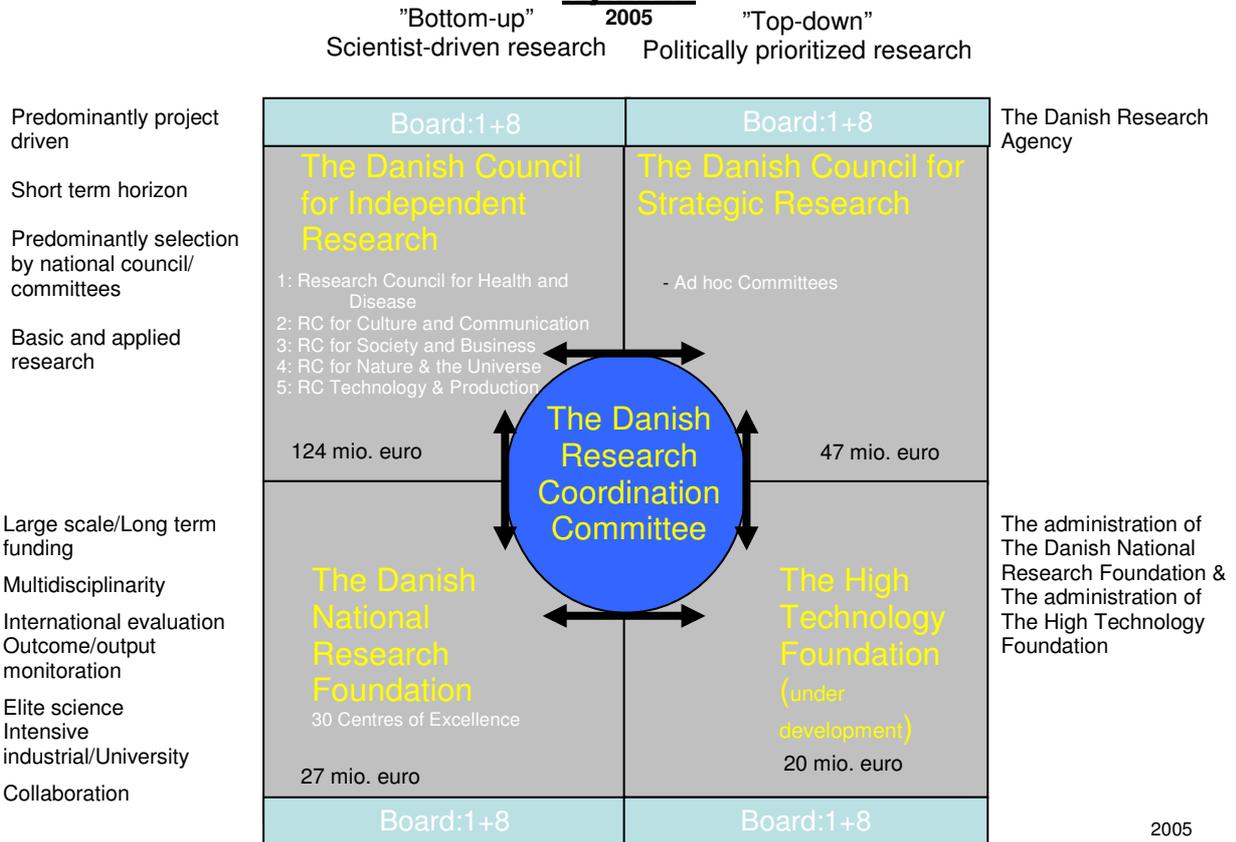
- The Danish Council for Independent Research (Det Frie Forskningsråd)
- The Danish Council for Strategic Research Council (Det Strategiske Forskningsråd)
- The Danish National Research Foundation (Danmarks Grundforskningsfond)
- The Danish National High Technology Foundation (Højteknologifonden)

The activities of these 4 bodies are coordinated by:

- The Danish Research Coordination Committee (Koordinations Udvalget for Forskning KUF)

² The other resource areas being: Foodstuffs, furniture/clothing, construction/housing, transport, energy/environment and other industry.

**Figure 11 The second tier:
The Danish Research Advisory and Counselling
System**



The Danish Research Counseling system is driven either based on the so called "bottom-up" principle - the Danish Councils for Independent Research and the Danish National Research Foundation - or by top-down, politically prioritized subjects - the Danish Council for Strategic Research and the High Technology Foundation.

1.3.2 *The Danish Research Council for Independent Research*

The Danish Research Council for independent Research is headed by a board consisting of 8 scientifically qualified members and 1 chairman of the board appointed by the minister. The Danish Research Council for Independent Research is the governing body of 5 research councils named:

- Research Council for Health and Disease
- Research Council for Culture and Communication
- Research Council for Society and Business
- Research Council for Nature & the Universe
- Research Council for Technology & Production

Each of these councils consists of 15-20 members, which are recognized researchers, appointed by the Minister of Science Technology and Innovation in their personal capacity after a public vacancy announcement. According to the statute, members are appointed in a way that ensures the broadest possible professional coverage and the most thorough research competence in each single research council within its specific area of scientific competence. Besides the financial support the councils may provide advice to Parliament, the Ministry of Science Technology and Innovation, other ministries, and other public bodies, either on request, or by their own initiative. Depending on the economic size of the research proposals the councils may occasionally use external peer reviews in their assessments and decisions.

1.3.3 *The Danish Council for Strategic Research*

The Danish Council for Strategic Research is headed by a board of 8 members of which the majority is recruited from private enterprises. The chairman is appointed by the minister. The council's main objective is to ensure the implementation of research in politically prioritized areas. The board does not in and by itself have competence to give grants. Therefore it works through ad hoc programme committees for each politically chosen programme. The committees are closed again after the assignment is completed. Currently the following committees exist:

- Programme committee for food articles and health
- Programme committee for energy and environment
- Programme committee for nanoscience and technology, biotechnology, and IT (NABIIT)
- Programme committee for non-ionising radiation
- Programme committee for welfare research

1.3.4 The Danish National Research Foundation

The Danish National Research Foundation was established in October 1991 with a capital of 2 billion DKK and the purpose of funding unique basic research from humanities to technological sciences at the highest international level.

In accordance with the Act of the Foundation, a Board of Trustees consisting of 9 nine scientifically qualified members is responsible for all decisions by the Foundation. The Minister for Science, Technology and Innovation appoints all trustees in their personal capacities. The Act on the Foundation was changed for the first time in 1998. The latest revision of the Act on the Foundation took place in 2003.

The Government has with the provision of the capital of 2 billion DKK enabled the Foundation to spend an annual amount of about 230-265 million DKK on research activities predominantly in the form of Centres of excellence. In addition parliament has allocated an annual amount of about 40 million DKK since 2005. Thus, since 1993 the Foundation has established about a total of 60 centres of excellence with a total expenditure of about 2,3 billion DKK until now and a further commitment up to the year 2010 of about 0,7 billion DKK. With the new Act of 2003 the Foundation can fund research until the end of 2013. The funds are distributed in open competition. The Board of the Foundation bases all final decisions on international peer reviews.

For further details about the Danish National Research Foundation and reflections on its aim and scope please see the report: “the Danish National Research Foundation’s strategy for Danish centres of excellence”-

1.3.5 The Danish High Technology Foundation

The Danish High Technology Foundation is currently under establishment (April 2005). The board comprises 8 members and a chairman of which only 3 are scientist and the remaining including the chair are recruited from industry and private enterprises. The minister appoints each member. The High Technology Foundation is a government initiative aimed at research, development, and innovation initiatives in politically prioritized areas such as biotechnology and information technology.

1.3.6 The Danish Research Coordination Committee

The Danish Research Coordination Committee (KUF) has to ensure the best possible coordination between the 4 bodies as shown in figure 11: The Danish Council for Independent Research, the Danish Council for Strategic Research, The High Technology Foundation, and the Danish National Research Foundation.

Moreover KUF has the final decision on the distribution of new grants from parliament to research training activities. Finally the committee aims at strengthening and coordinating Denmark's international research activities and make efforts to advance research activities related to the Faroe Islands and Greenland.

1.3.7 *Private funds*

Only four major funds from the private sector will be mentioned in the following.

The Velux Foundation comprises two foundations: *The Villum Kann Rasmussen Foundation* supports scientific activities, especially within the technical, natural, agricultural-veterinary, and industrial sciences. *The Velux Foundation* supports a broad range of scientific and public beneficial purposes. Research in projects related to museums and cultural history is given high priority, however health sciences also receive many donations from this Foundation. Since the establishment of the Foundations in 1971 about 40% of the grants have been for scientific activities mainly in the health sciences and the technical sciences. For 2003 a total of 127 million DKK was granted from the two Foundations.

The Novo Nordisk Foundation is a private commercial foundation. The foundation was established in its presents form and organisation in 1989. One of the objectives of the foundation is to support scientific, humanitarian, and social purposes. The support is given to health and natural science purposes. Annual stock returns of approximately 86 million DKK were granted for scientific purposes in 2003.

The Carlsberg Foundation was established in 1876 and has as its objective to contribute to Danish basic research. One of the main objectives is to advance and support the natural sciences plus mathematics and philosophy, the humanities and the social sciences. Within this objective the total grants from the Carlsberg Foundation amounted to about 143 million DKK in 2003.

The Lundbeck Foundation is a private commercial foundation established in 1954. One of the foundation's objectives is to support research of high quality. In 2003 the foundation granted 85 million DKK, where 90% were granted to research in the areas of health and natural sciences. From 2005 this foundation has decided to initiate centres of excellence within the broad theme of neuroscience applying the same model as that advanced by the Danish National Research Foundation.