Blue Sky II

Specialized R&D Surveys: Design and Application

By Peter S. Mortensen and Carter Bloch

Abstract

The OECD has in recent years promoted specialized surveys on biotechnology, based on the need for more detailed information and indicators within this area. This same need is present in other areas, and the demand for more detailed, specialized indicators can be expected to increase in the future.

While specialized surveys in many cases can be undertaken by universities and other organizations, there are a number of benefits from linking these surveys to national R&D statistics. For example, R&D surveys can be used to determine target populations for specialized surveys, and these surveys can often be integrated with general surveys, either directly or through a linking of data.

This paper discusses a supplement to the Danish R&D survey on research areas and two specialized surveys conducted in Denmark, one on R&D within information and communication technologies, and the other on R&D activities that are related to Greenland. Both the supplement and the surveys offer a number of insights in terms of their methodology that can be applied to other areas. Furthermore, the data can be used to develop a number of specialized indicators of use both for research and policy making.

Biographical note

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1. Introduction

All OECD-countries conduct R&D surveys which cover to varying degrees the suggested indicators in the guidelines of the OECD Frascati Manual. Apart from these general R&D-indicators there is a continuous demand for more detailed information on R&D-related and innovation-related indicators, either on an ad hoc basis or in a more continuous form. An example is indicators for R&D in biotechnology; here the OECD has promoted a specialized survey by developing common definitions and a core questionnaire (OECD, 2005c).

The background for the demand of more detailed and specialized R&D-indicators is the need for better information for policy making. Also, more narrow industry or professional motives can be sources of the demand for specialized R&D-indicators.

In Denmark – and likely in many other countries – the demand for more detailed and specialized R&D-indicators has increased markedly during the last years. The demand in the different countries may be fairly similar, but experience from the biotech field indicates that harmonized international actions may be difficult to implement into new harmonized indicators. It is, however, crucial that the guidelines of the Frascati Manual and other recommendations are followed, also when specialized R&D-surveys are only conducted nationally.

One way to ensure that international guidelines are followed is to let the institute responsible for the national R&D-surveys also conduct the specialized survey. There are some important advantages in letting the national producer conduct the survey:

- The international guidelines are followed.
- The national producer can use their knowledge on R&D measurement and may have access to experts on measurement problems and on the topic for the specialized survey.
- The national producer has experience in collecting information on R&D and has an authority that ensures a high response rate, even in a voluntary survey.

More advantages may be achieved if the specialized R&D-survey can make use of information collected in the national R&D-survey. This could be

- through a filter question, identifying relevant enterprises or institutions, such as "*Did your enterprise conduct Biotech-R&D in 200X?*"
- by reusing the general information on the enterprises
- as a control of the information given in the specialized R&D-survey.

In a number of countries including Denmark it happens that others than the national producer of the R&D-statistics conduct specialized R&D-surveys. It may be universities or other public research institutions that are conducting the survey, or a commercial actor, such as consultancy firms, public opinion bureaus or R&D-service firms. In these cases the quality of the specialized R&D-survey may be endangered, both in relation to response rate,

relevance and validity of the information sampled. A basic problem is when R&D is not defined according to the Frascati Manual.

Funding of new specialized R&D-surveys will often be through one-time appropriations. This means a clear focus on whether the specialized R&D-survey is giving value for money by providing indicators of relevance and usefulness. An indicator of this is whether the survey is refunded.

This paper discusses a supplement to the Danish R&D-statistics on research areas (biotech, ICT, energy etc.) and two specialized surveys that have been conducted in Denmark, one on R&D within information and communication technologies (ICT), and the other on R&D activities that are related to Greenland. Both the supplement and the surveys offer a number of insights in terms of their methodology that can be applied to other areas. Furthermore, the data can be used to develop a number of specialized indicators of use both for research and policy.

The ICT R&D survey covers ICT R&D activities in all sectors, thereby allowing a matching of R&D in firms and public research institutions, with a number of insights for policy. Within the business enterprise sector, non-ICT sectors are also surveyed, providing information on which non-ICT firms conduct ICT R&D and in what ICT research areas.

The Greenlandic-related R&D survey is conducted biannually and the Danish part is integrated with the general Danish R&D survey, isolating R&D activities that are related to Greenland and also whether these activities take place in Greenland.

In the following, the methodologies of the two specialized R&D-surveys are described along with the question on research areas in the national R&D-survey. All three methodologies may be used in other areas. It is also described which types of indicators and insights these surveys have provided and their impact on policy making in Denmark.

2. Research areas as specialized R&D surveys

Since the 80’s the national Danish R&D surveys have included questions on research areas in all sectors – the business sector, higher education, governmental and non-profit research institutions. The respondents are asked which of a number of research areas that they have conducted R&D in, and also to estimate the proportion of the total R&D of the unit, conducted in each of the research areas. The areas have been revised on a number of occasions, lately by including nanotechnology, but we try to limit the changes to ensure comparability over time. The number of research areas is higher in the public sectors, as there has been a political interest in indicators on more (detailed) research areas. Efforts have been made, however, to maintain a good correspondence between the research areas in the business sector and the public sector to ensure comparability. In the business sector the following 15 research areas are included in the questionnaire for 2005:

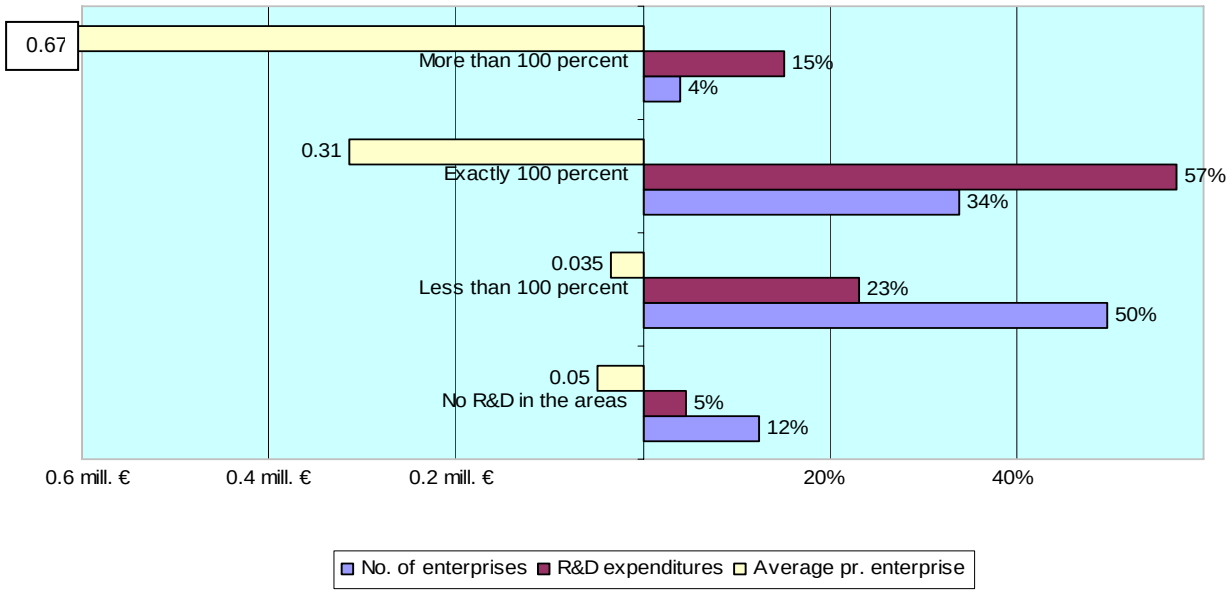
Table 2.1. Research areas in the business sector, Denmark, 2005.

Materials	Nanotechnology	Defence-related technology
Building and construction	Food	Management/organisational R&D
Health-related R&D	Energy	ICT, Integrated software
GMO-technology	Environments	ICT, Stand-alone software
Biotechnology	Elderly care	ICT, Hardware

By studying the 15 research areas it is clear that there is a certain amount of overlap between some of the areas. The respondents are reminded that there might be such an overlap and that this means that the total of the proportions of R&D in the research areas may be above or below 100 percent. Statistics from the R&D-survey in the business sector in 2003 tells that (see Figure 2.1)

- Just 4 percent of the R&D-reporting enterprises have a total sum of proportions above 100 percent, while they account for 15 percent of the total R&D-expenditure (R&D pr. enterprise: 0.67 Mill €).
- 34 percent have assigned all their R&D-activities (exactly 100 percent) to the research areas and they account for 57 percent of the total R&D-expenditure (R&D pr. enterprise: 0.31 Mill €).
- Half of the enterprises have assigned some, but not all their R&D to the research areas, but only accounting for 23 percent of the total R&D expenditure (R&D pr. enterprise: 0.035 Mill €).

Figure 2.1. Proportion of enterprises, proportion of R&D-expenditure and average R&D-expenditure by proportions of R&D in research areas, Denmark, 2003

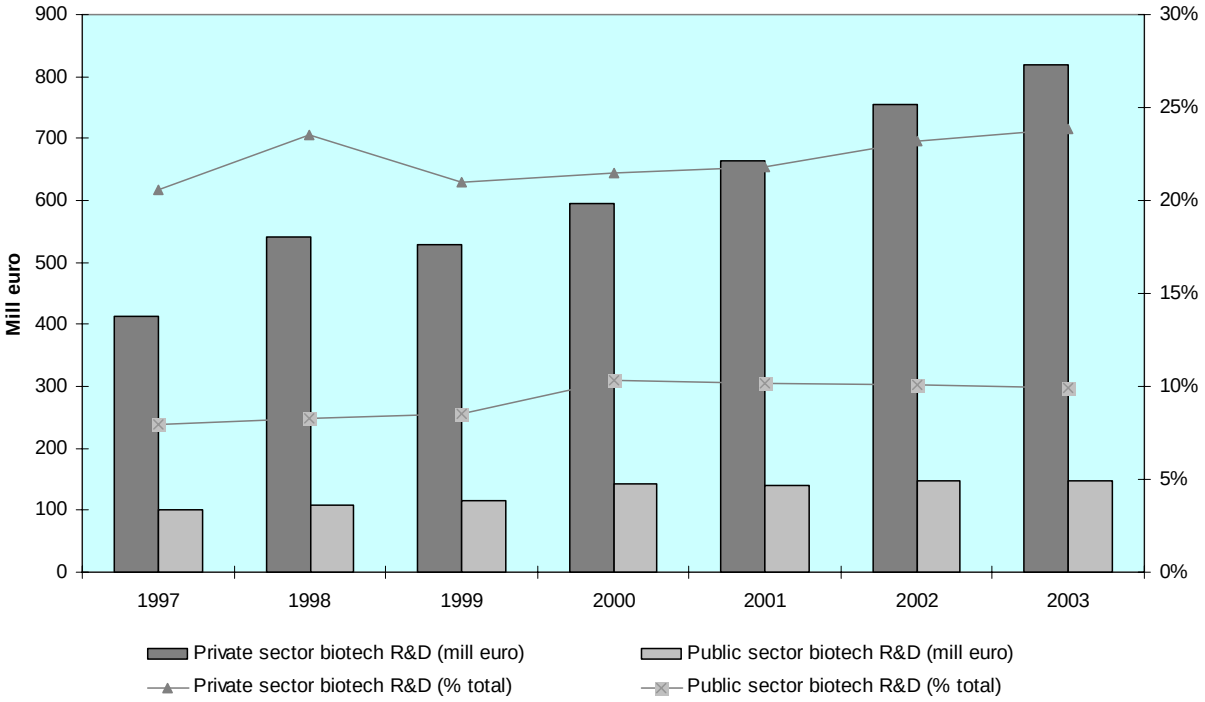


- Around 12 percent assign none of their R&D to the research areas, and they account for less than 5 percent of the total R&D-expenditure (R&D pr. enterprise: 0.05 Mill €).

Combined with more detailed analyses we conclude that the R&D-expenditures of each research area are valid estimates of the R&D-activities in the areas.

The question on research areas makes it possible to construct indicators of R&D within specific areas. In the absence of a biotech R&D-survey in Denmark, the question has been used to capture activity within biotechnology and to form an approximation of biotech R&D in Denmark (see Mortensen, 2002 and Bloch, 2004, 2006). Figure 2.2 shows the estimates of private and public biotech R&D expenditures in Denmark for 1997-2003 based on data for firms' and public research institutions' (PRI) research areas. These figures – and also figures on the other research areas – have been of great interest for policy makers, and we are often asked about more details and about other research areas, that are not included in the survey.

Figure 2.2. Private and public sector biotech R&D expenditures, Denmark, 1997-2003. Mill euro.



The question on research areas has another important application. As mentioned above, this question can be very useful as a tool for identifying firms and PRI-units across a wide range of industries and main fields of science with R&D in a specific research area. In the next part we will describe how this information was used within ICT as an indicator of R&D-performing enterprises outside the ICT-industries and ICT-FOS (Field-of-Sciences).

3. ICT-R&D

Information and communication technology has become a key technology in the last decades. The importance of ICT creates a need for greater knowledge on its characteristics and development. There is now extensive data on ICT usage both in firms and households[1]. However, there exists little specialized data on R&D activity within ICTs. Only aggregated data is available on levels of R&D in the ICT business sector (manufacturing and services)[2]. This stands in stark contrast to the now widespread collection of data on for example biotechnology activities (van Beuzenkom and Arundel, 2006).

In 2002 the Danish Ministry of Science, Technology and Innovation appointed an expert group to examine the status of ICT research in Denmark and formulate a research strategy for the ICT sector. The group provided a number of recommendations. However, to aid in the implementation of these strategies, it was found that a systematic examination of R&D within ICTs was needed.

The Danish ICT R&D Survey 2003[3], conducted by the Danish Centre for Studies in Research and Research Policy, seeks to collect data on ICT R&D throughout the economy. The survey thus includes firms both within ICT-related industries and in a variety of other industries, and public research institutions (PRI) from a broad range of academic fields.

The overall objective of the Danish ICT R&D survey is to map ICT R&D in the business and public sectors and describe the linkages between them for use in ICT policymaking. Among the issues that guided the design of the survey were: where does ICT R&D take place? What types of research are conducted within ICT, and in what areas? What types of linkages are there between actors? Which factors hinder ICT R&D and which areas are seen as most important for future research? And to what degree do PRIs commercialize their ICT research?

To assist in the design of the survey, a reference group was formed consisting of experts within ICT from business and the public sector and representatives from us and the Ministry of Science, Technology and Innovation.

In defining information and communication technology, the group chose a fairly broad formulation in order to capture all ICT-related R&D[4]:

ICT comprises information technologies, communication technologies and related electronics. The area of ICTs consists of the group of technologies for the storage,

[1] Such as Eurostat's harmonized survey of ICT-usage in firms and households. see Eurostat (2006).
[2] See e.g. the OECD Key ICT Indicators 2005.
[3] Publications, see www.forskningsanalyse.dk/ikt.htm
[4] For comparison, the guiding principles for the OECD's definition of the ICT sector:
"The list of ICT sector activities was decided on the basis of the following set of principles.
For manufacturing industries, the products of a candidate industry: must be intended to fulfill the function of information processing and communication including transmission and display, or must use electronic processing to detect, measure and/or record physical phenomena or to control a physical process.
For services industries, the products of a candidate industry: must be intended to enable the function of information processing and communication by electronic means." (OECD, 2005b, p. 30)

processing, transmission and interpretation of information, also including the use, understanding and impact of these technologies.

ICT R&D includes both the development of technologies within ICT, and R&D that concerns the application, significance, comprehension and consequences of ICTs. ICT R&D does not include R&D where ICTs are solely used as a support activity or tool; ICT must be the object of the R&D activity.

A central element in the survey methodology was the classification of types of ICT R&D. ICT R&D was classified along two dimensions, in terms of its use and in terms of research areas. Three main groups were identified according to its use:

- *Hardware*, including hardware used for communication and used for data processing
- *Stand-alone software*, both standardized and customized software
- *Integrated software*, involving software that is embedded in other products

In all 12 research sub-areas were identified by the reference group for ICT R&D:

- *Database and software tools*
- *Data storage and network management*
- *Instruments*
- *Security systems*
- *Business systems*
- *Process control*
- *Communication systems*
- *Microelectronics*
- *Image technology*
- *Language technology*
- *Usability*
- *Games*

In addition, questionnaires for private and public sectors were made as equivalent as possible, in order to aid in comparison. Furthermore, all firms and PRIs were also included in the general R&D surveys, in order to allow a link with standard R&D data. The survey was originally intended as ad hoc, but has since been planned to be held every two years.

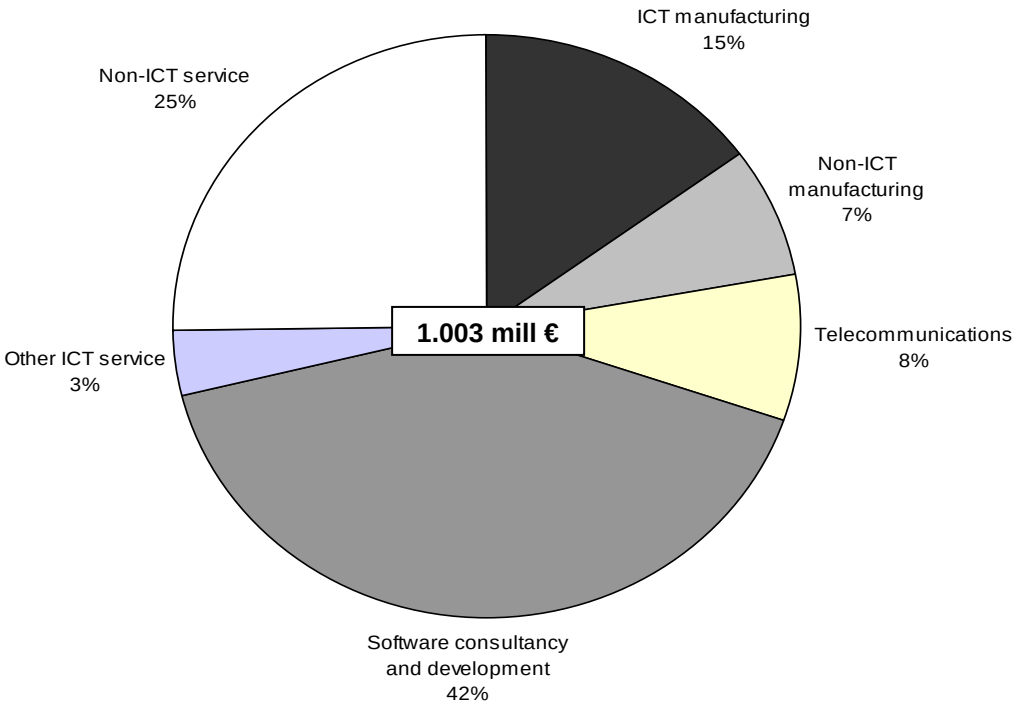
An important issue in conducting specialized R&D surveys is determining the population and sample for the survey. Sampling the entire population of firms may likely be too costly and put too much burden on the sector. On the other hand, many technologies, such as ICT and biotechnology, are pervasive and may span a wide range of industries, making the identification of relevant firms difficult. The Danish ICT survey made use of the question on research areas from the national R&D survey in enterprises and PRIs mentioned in Part 2. The estimates of the share of the respondents R&D within each area could even be used as a control. This data combined with information on industry or field of science were used to form a population of firms and PRIs that potentially had ICT-related R&D.

Figure 3.1 shows a breakdown of business ICT R&D by industry. In all, around 400 enterprises conducted ICT R&D in Denmark in 2003. This includes enterprises from a wide

range of industries, also in low-tech industries within manufacturing and services. 10 percent of the enterprises are from non-ICT manufacturing industries and 12 percent from non-ICT services. In all, almost one third of business ICT R&D is conducted in non-ICT industries. This gives an indication of the pervasiveness of ICT in terms of its development and application.

A very high share of ICT R&D is in services, around three quarters. This is very atypical in international comparison, where R&D in the ICT sector for most OECD countries is predominantly in manufacturing[5].

Figure 3.1 Business ICT R&D by industry, Denmark, 2003.

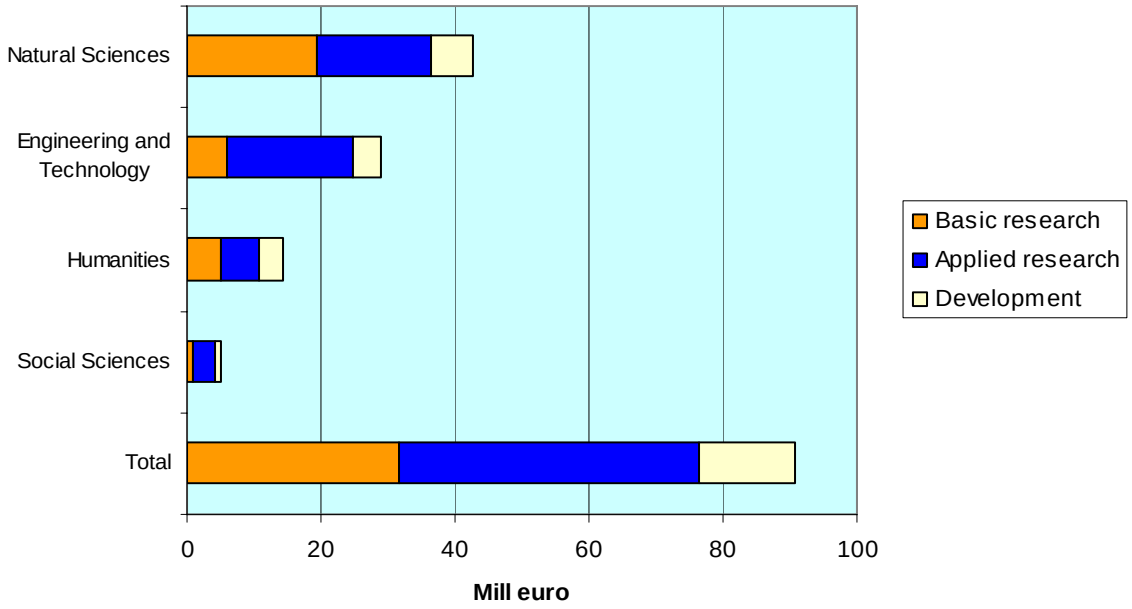


Over 40% of R&D expenditures are in *Software consultancy and development*, with over half of ICT R&D active firms. This industry thus comprises the most significant industry for Danish ICT activity. Second largest in terms of R&D expenditures is *Financial intermediation*, where enterprises in banking and insurance account for over 20 percent of ICT R&D expenditures in 2003.

Overall, about two thirds of all firms with ICT R&D have less than 50 employees. This may be important for policy considerations, in order to ensure that policy measures address the needs of smaller firms.

[5] See OECD Key ICT Indicators 2005.

Figure 3.2. Public sector ICT R&D by field of science, Denmark, 2003. Mill euro.



The public sector survey covers the Higher education (HES), Government (GOV) and Private non-profit (PNP) sectors. However, almost all public ICT R&D was conducted in the Higher education sector[6]. In all 48 academic departments or institutes reported that they conducted R&D in ICTs. These institutes are quite diverse and are found in five out of six main fields of science: Natural sciences, Engineering and Technology, Medical Sciences, Social Sciences and Humanities[7]. Figure 3.2 shows the R&D expenditures by academic field and type of R&D.

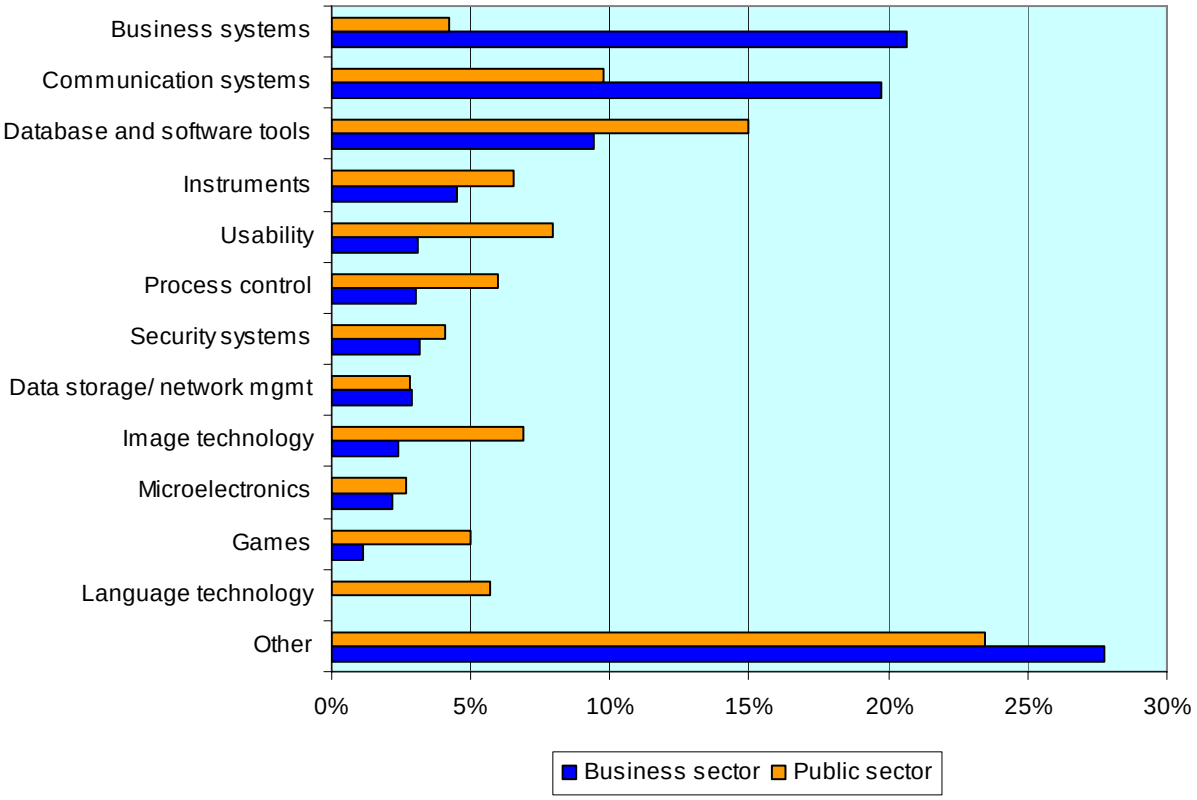
The largest share of public ICT R&D expenditures is in Natural Sciences, followed by Engineering and Technology. There are roughly the same number of institutes in Natural sciences, Engineering and Technology, and Humanities.

Figure 3.3 shows ICT R&D distributed according to research sub-area. ICT R&D in the private sector is focused on three areas: *Business Systems*, *Communication Systems* and *Database/Software Tools*. Substantially less R&D is devoted to the other areas. Public sector ICT R&D is in contrast much more evenly spread over the 12 areas. The three largest areas for the public sector are *Database/Software Tools* (Natural Sciences), *Communication Systems* (Engineering/Technology), and *Usability*.

One interpretation of these results is that there may be a potentially large mismatch between private and public sector R&D in ICTs. A primary focus area of many firms, *Business Systems*, receives little attention in the public sector. This may hinder interaction between the two sectors.

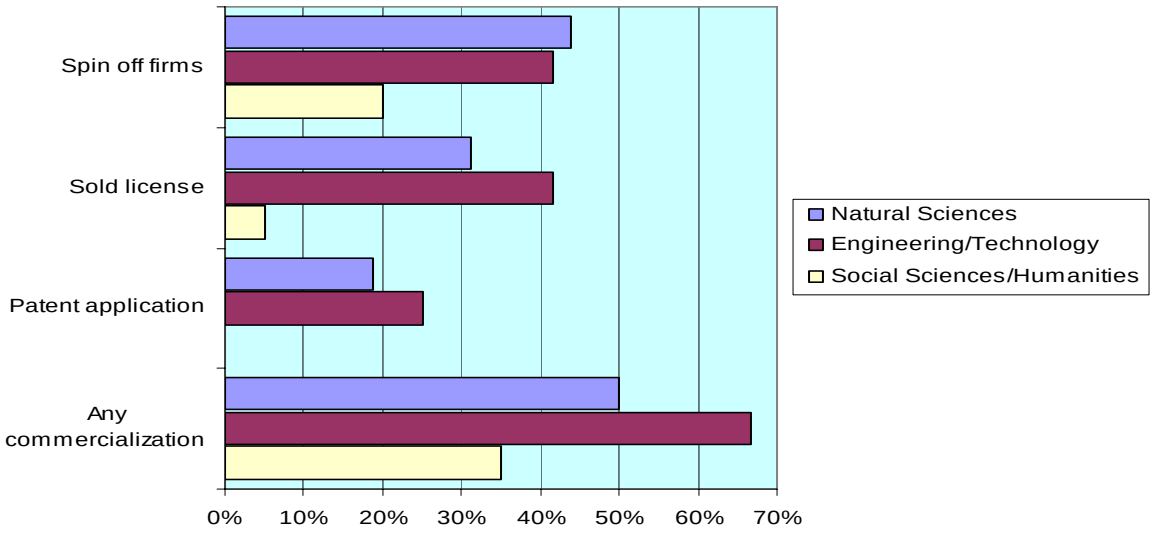
[6] In all two institutes within GOV and none from PNP reported R&D within ICT.
[7] Due to the small number of institutes within Medical Sciences with ICT R&D, Medical Sciences is combined with Natural Sciences in this paper.

Figure 3.3. ICT R&D by research sub-area, Denmark, 2003.



PRIs were asked whether they had commercialized their ICT research results over the period 2001 to 2003, such as through patenting, licensing or spin off firms, see Figure 3.4.

Figure 3.4. Commercialization of public research within ICT, Denmark, 2003.



A fairly large share of PRIs actively commercialized their research, particularly those in Natural Sciences and Engineering and Technology. Among institutions in these fields of science, around 25 % had applied for patents for 2001-2003, over a third had sold licenses and over 40 % had established spin-off firms based on their ICT research.

The ICT R&D survey has drawn increased attention to ICT research in Denmark and has generated a number of indicators that identify the strengths and weaknesses of Danish ICT R&D in the public and business enterprise sectors. These indicators have provided a valuable input for policy decision, such as the allocation of resources from the Danish High Technology Fund. This public fund finances R&D projects in both the public and private sectors, with a focus on ICT, biotechnology and nanotechnology.

4. Greenlandic-related R&D

While the object of the foregoing specialized R&D-surveys was research areas, this second type of specialized R&D-survey covers geographical areas. It is, however, a special type of geographical area that is the object for the measurement of R&D-activities, namely remote or backward areas with much R&D-activity performed by universities, research institutions and enterprises from outside the area. The case from Denmark is Greenland, but other cases could be the outback of Australia, the Polar areas of Canada, some small island in the Atlantic or Pacific Sea.

Greenland is a former Danish colony, where Greenland Home Rule was introduced in 1979. Since then Greenland has not, statistically seen, been a part of Denmark, and no R&D-surveys were introduced in Greenland in spite of the development in Denmark. The relevance of Greenlandic R&D-statistics was also limited in the first years after the formation of the Home Rule, as most R&D-activity in Greenland was conducted by Danish and foreign institutions.

After the foundation of Greenland University, *Ilisimatusarfik*, in the 80's and Greenland Institute of Natural Resources, *Pinngortitaleriffik*, in the 90's, both with increasing R&D-activities, the demand for a measurement of the total amount of R&D-activity was growing. However, the R&D-activities were still dominated by Danish and foreign institutions, so indicators of Greenlandic R&D-activities (expenditures, type, field of sciences etc.) would be insufficient without these institutions included.

The Commission for Scientific Research in Greenland has produced yearly lists of projects funded by them, and The Nordic Ministerial Council was instrumental in bringing about a report of all research activities in Greenland (TemaNord 1997:610). In 1998, a committee was formed by the Greenlandic and Danish authorities to analyse the

Greenlandic R&D activities in both parts of The National Community and to provide advice for the future. This committee needed more exact information on the R&D-activities and asked for quantitative information for the period 1995-1998. This ad hoc statistic should include all R&D-activities related to Greenland, no matter who performed it or where the activity was performed. R&D-activities in the Greenlandic business sector were, however, not included. The Danish Institute for Studies in Research and Research Policy conducted this survey by sending questionnaires to Greenlandic and Danish institutions pointed at as potential performers of Greenlandic-related R&D-activities by the committee.

From the experience of this first survey and our general knowledge on R&D-statistics, The Danish Institute for Studies in Research and Research Policy developed in 2001 a new system for collecting information on all Greenlandic-related R&D, independent of the performer. This system was partly integrated with the national Danish R&D-surveys and follows the guidelines of the Frascati Manual. The reporting units included Greenlandic higher education, research institutions and business enterprises, Danish higher education and research institutions, and R&D performed by foreign research-teams in Greenland. The Danish institutions reported two kind of Greenlandic-related R&D-activities: Those being performed in Greenland and those performed in Denmark. Greenlandic-related R&D-activities by Danish enterprises were only reported, if the Danish enterprise had affiliates or if the Danish group had a subsidiary company in Greenland.

The new survey on all Greenlandic-related R&D was conducted for the first time in 2001 with 2000 as reference year. The survey has been repeated for the reference years 2002 and 2004.

The collecting and processing of the statistics has been funded by The Greenlandic Home Rule and the Danish Polar Centre. It is expected that the statistics will be collected and published every two years. However, Danish institutions with many Greenlandic-related R&D-activities have been given the possibility to report every year.

Since 2002 there have been three sectors included in the statistics: Greenlandic institutions (HES, GOV), Greenlandic enterprises and Danish public and non-profit research institutions (HES, GOV, PNP).

The questionnaire for the Greenlandic institutions is a simplified version of the questionnaire used by the same sectors in Denmark. Danish units having declared themselves as performers of Greenlandic-related R&D in a former survey receive the Greenlandic R&D-questionnaire automatically. Newcomers are identified by a screening question (*Conducted Greenlandic-related R&D in 200X?*). In 2004, the sample included 12 Greenlandic institutions and 47 Danish public and non-profit research institutions. Greenlandic enterprises are identified in the Greenlandic business register (GER), run by Statistics Greenland. Enterprises with at least 5 employees in relevant industries[8] form the population, from which a sample is drawn. In 2004 the population included 364 enterprises

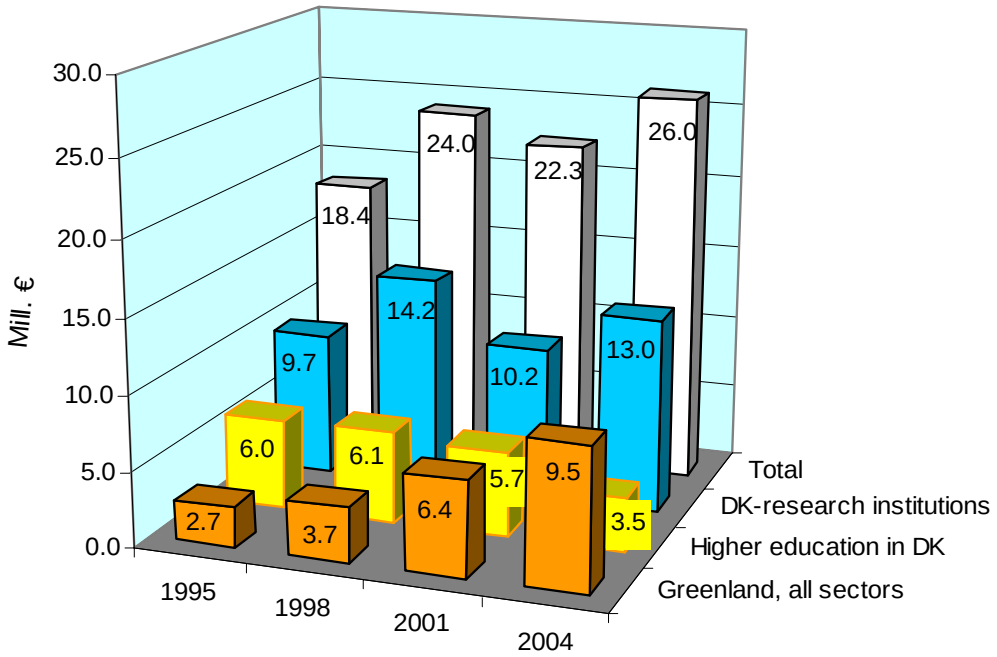
[8] The following two-digit NACE-classes are included: 01-05, 11-41, 51-52, 60-67, 70.3, 72-74, 92.2

and the sample 102. The enterprises in the sample receive a simplified version of the questionnaire used in the Danish R&D-survey for the business sector.

The questionnaire and the processing of the data meets the guidelines of the Frascati Manual fully, with the exception that for Danish institutions it includes all Greenlandic-related R&D and classifies these R&D-activities in those being performed in Greenland and those being performed in Denmark. The information sampled includes the R&D-expenditures and their funding, the human resources (head counts and full-time equivalents) categorized in researchers, PhD-students and technicians/administrative personnel and information on the kind of R&D-activities (type of R&D, field of science/industry, research area and a NABS-like code).

Some results from the period 1995-2004 are presented below to give an impression of the information sampled. In Figure 4.1 the total Greenlandic-related R&D expenditures are broken down in the Danish HES-sector, the Danish GOV-sector and the Greenlandic units. Greenlandic performers have increased their activities markedly, partly due to the business sector, while the Danish HES-sector is markedly down in 2004. The GOV-sector has peaks in 1998 and 2004 – and so has the total expenditures.

Figure 4.1. Greenlandic-related R&D expenditures by sector, 1995-2004. Mill. euro, current prices.



In Figure 4.2 the proportion of the total Greenlandic-related R&D expenditures is calculated for Greenlandic units, for the part of the activities of the Danish units performed in Greenland and performed in Denmark. The Greenlandic share has increased from 15 to 36 percent from 1995 to 2004, while the activities in Greenland by Danish institutions have been halved. In all, close to 50 percent of the R&D-activities are now performed in Greenland.

Figure 4.2. Proportion of Greenlandic-related R&D expenditure by place of performance and affiliation, 1995-2004.

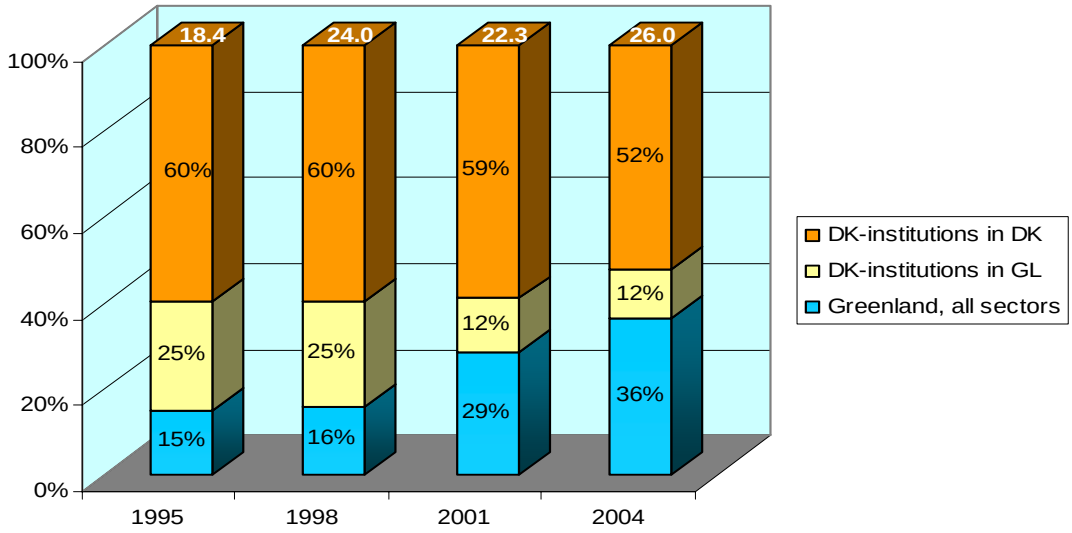
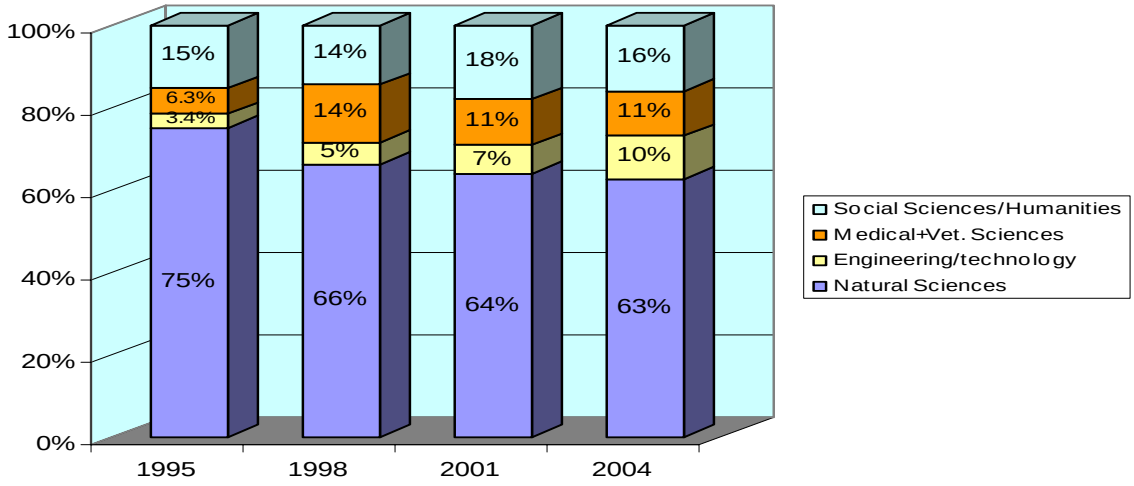


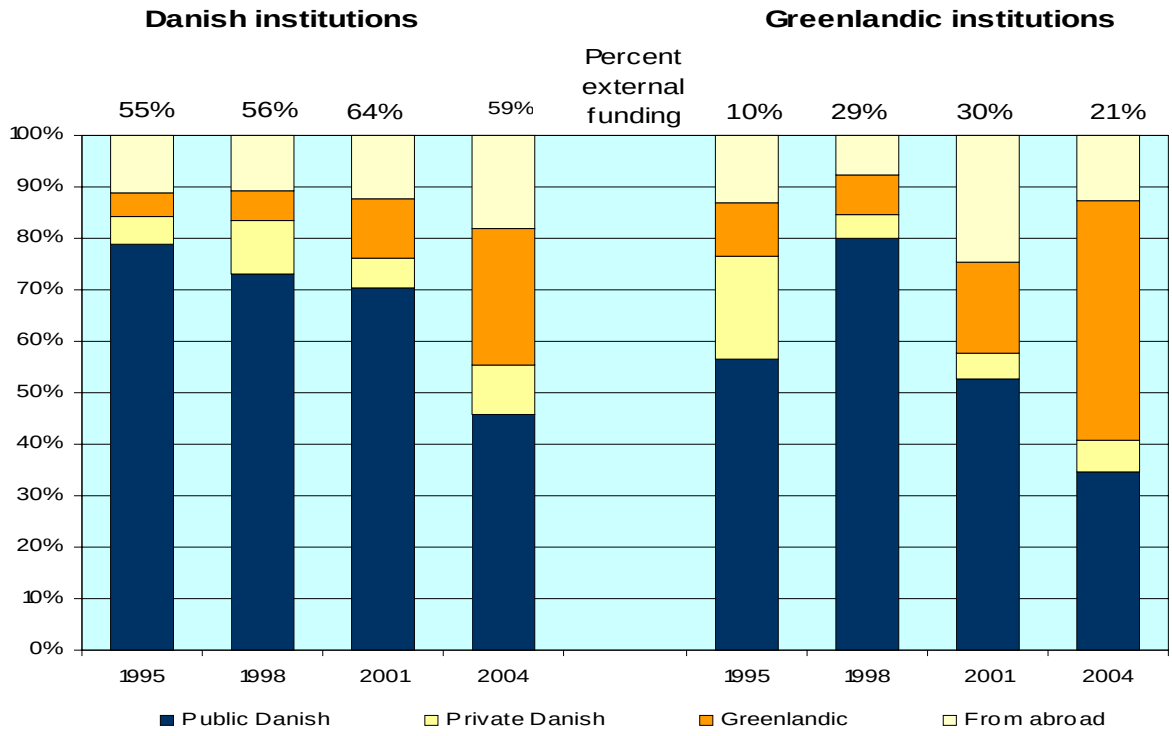
Figure 4.3. Proportion of Greenlandic-related R&D personnel by field of science, 1995-2004.



The distribution of R&D personnel by main fields of science is illustrated in Figure 4.3. The Natural Sciences are dominating, but the proportion of personnel has decreased from

75 to 63 percent, while the proportion of personnel has tripled in Engineering and Technology (including BES) and doubled in Medical and Veterinarian Sciences.

Figure 4.4. External funding of Greenlandic-related R&D by source and area, 1995-2004.



The funding of Greenlandic-related R&D is described in Figure 4.4. More than half of the activities of Danish institutions are financed by external funds, while the Greenlandic institutions only rely on 21 percent in 2004, a decline from 30 in 1998-2001. The sources of funds have changed during the last decade, with public Danish funding relatively declining and Greenlandic funding increasing, both for Danish and Greenlandic institutions.

As a supplement to the indicators collected now, indicators on cooperation and communications, especially for the R&D-activities of the Greenlandic institutions would be of relevance, because networking is of extreme importance for the insurance of the quality of the R&D-activities – and this theme is also on the political agenda.

The effect of introducing and continuously producing Greenlandic-related R&D-statistics has been very visible. There is now a clear focus on the development in the amount and kind of R&D performed, and especially the decline in the Danish share and the Danish financing of the Greenlandic-related R&D and also the increase in the activities of the Greenlandic institutions. Policy makers have had to take a stand on these issues, and two times in the last 5 years new earmarked funding has been added to the Greenlandic-related R&D-

expenditures. Some of the funding has been granted through the common Greenlandic-Danish research council, including the funding of Greenlandic PhD-students. Also, policy makers, the researchers themselves as well as the media have been using the indicators to discuss new priorities.

It is our evaluation that without these new statistical indicators on the Greenlandic-related R&D-activities the level of Danish activities would most probably have been lower due to general cuts in the budgets - and the Greenlandic activities would probably not have been upgraded as quickly as has been the case. The newly published statistics are therefore expected to – together with the coming polar years 2007/08 – help in furthering funding to relevant Greenlandic-related R&D-activities.

4. Conclusions

This paper discusses the design and application of specialized R&D surveys, examining two particular surveys conducted by the Danish Centre for Studies in Research and Research Policy: the Danish ICT R&D survey and the survey on Greenlandic-related R&D. Also, a question on research areas is discussed.

The ICT R&D survey generates a number of useful indicators. The sector composition of ICT R&D gives an indication of the strengths and weaknesses in ICT-related industries and on new ICT applications in other industries. In addition, the classification of types of ICT R&D provides a detailed picture of which areas research is conducted within. Coverage of both the public and the business enterprise sector also make it possible to match ICT R&D activities in the two sectors. These indicators provide valuable input for policymakers, both in supporting business R&D and in determining focus areas for public research.

A valuable tool for identifying the population for the ICT survey is a question included in the general R&D survey on research areas. Information from this question is also useful in its own right, and can be used to generate fairly reliable indicators of R&D activity within individual research areas.

The Greenlandic-related survey produces a number of indicators that identify both the R&D activity that takes place in the region and Danish R&D activity that is oriented towards Greenland. These indicators have been important both in tracking the development of research activity in this region and also in drawing attention to the need for policy measures to foster growth in R&D activity.

References

Bloch, C., 2004. Biotechnology in Denmark: A Preliminary Report, Working Paper 2004/1, The Danish Centre for Studies in Research and Research Policy.

Bloch, C., 2005. IKT Forskning I Danmark – En kortlægning af forskning og udviklingsarbejde inden for informations- og kommunikationsteknologier (in Danish), Report 2005/2, The Danish Centre for Studies in Research and Research Policy.

Bloch, C., 2006. Biotechnology in Denmark 2005, Working Paper 2006/4, The Danish Centre for Studies in Research and Research Policy.

Bloch, C. and Mortensen, P.S., 2006. Mapping R&D in information and communication technologies – methodology and results of the Danish ICT R&D survey 2003, Working paper 2006/5, The Danish Centre for Studies in Research and Research Policy.

Danish Ministry of Science, Technology and Innovation, 2002a, Oplæg til dansk it-forskningsstrategi (in Danish).

Danish Ministry of Science, Technology and Innovation, 2002b, IT Research and Development in Denmark.

Eurostat, 2006, Methodology Manual for Statistics on the Information Society, Eurostat, Luxembourg.

Greiffenberg, T; Mortensen, P.S. & Poppel, B, 2002. Forskningsstatistik for Grønland 1995-2000 (in Danish), The Danish Institute for Studies in Research and Research Policy, Aarhus.

Mortensen,P.S, 2002. *Developments in R&D in biotechnology* in Focus on biotechnology - Issues related to R&D in biotechnology - Denmark in a comparative perspective Report 2002/2; (ed.) N. Mejlgaard & K. Siune, The Danish Institute for Studies in Research and Research Policy, Aarhus.

Mortensen, P.S, 2006. Grønlandsrelateret Forskning og udvikling 2003-2004 (in Danish), The Danish Centre for Studies in Research and Research Policy, Denmark.

OECD, 2002, *Proposed Standard Practice for Surveys for Research and Experimental Development, Frascati Manual 2002*, OECD, Paris.

OECD, 2005a, OECD Information Technology Outlook 2004, OECD, Paris.

OECD, 2005b, Guide to Measuring the Information Society, OECD, Paris.

OECD, 2005c. A Framework for Biotechnology Statistics, OECD, Paris.

TemaNord, 1997. Forskningsaktiviteter på Færøerne og Grønland (in Danish). Tema1997:610, København (in Danish)

van Beuzekom, B. and Arundel, A., 2006, OECD Biotechnology Statistics 2006, OECD, Paris.