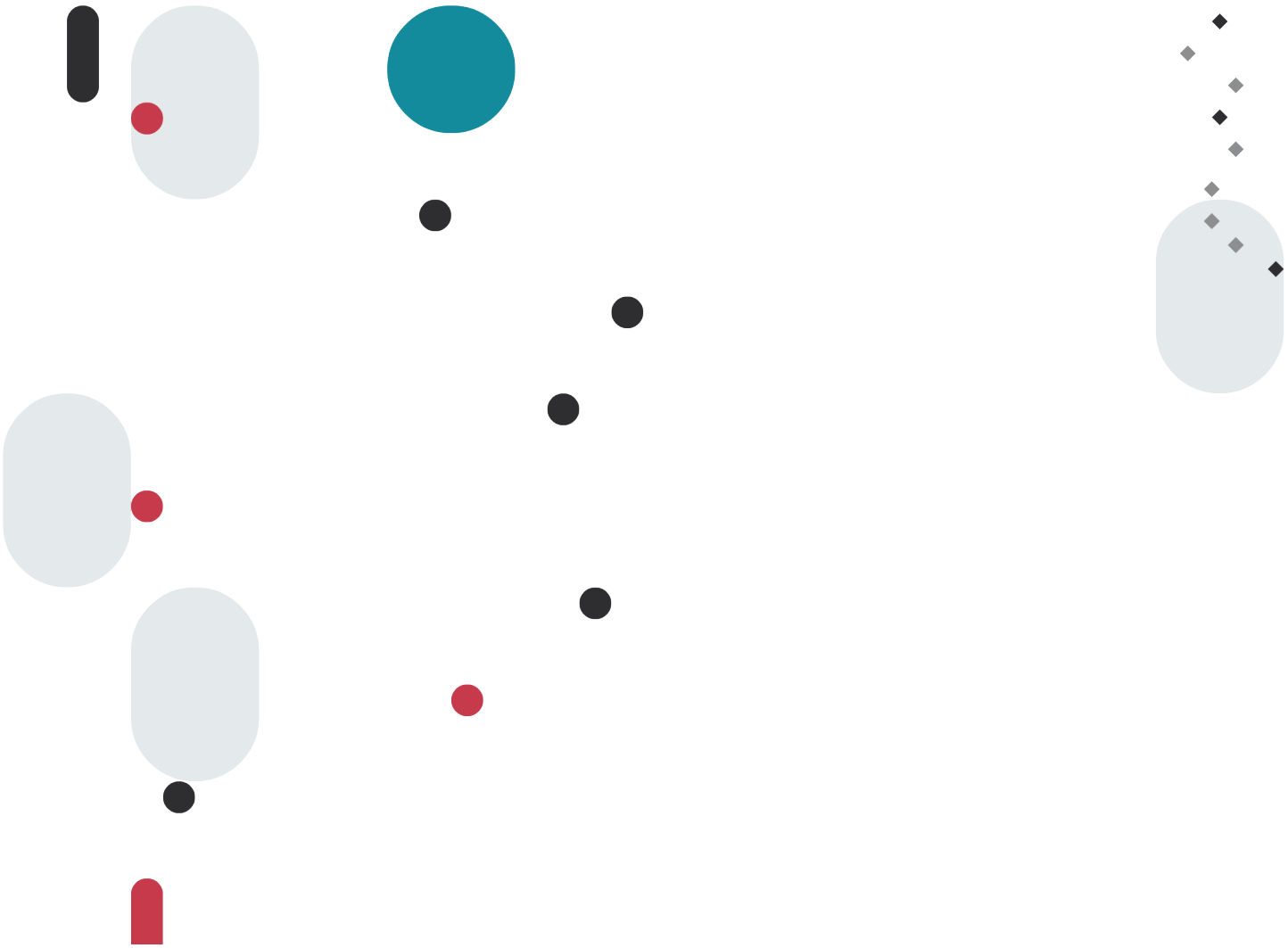

Centres of Excellence in the Nordic countries

A comparative study of research excellence policy and excellence centre schemes in Denmark, Finland, Norway and Sweden

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Preface

The PEAC project – with the full title: *coping with globalization: how do Policies to promote Excellence Affect the research Community* – aims at improving the knowledge base for research and innovation policy for the formation of centres of excellence. The project is sponsored by the Research Council of Norway (via the FORFI programme, project number 212206).

This working paper presents the first results of the project. The paper is authored by the PEAC project team: Liv Langfeldt (project leader, NIFU), Dag Aksnes (NIFU), Mats Benner (Lund University), Siri Brorstad Borlaug (University of Oslo/NIFU), Hanne Foss Hansen (University of Copenhagen), Egil Kallerud (NIFU), Ernst Kristiansen (SINTEF), Antti Pelkonen (VTT, Finland) and Gunnar Sivertsen (NIFU).

Oslo, January 2012

Taran Thune
Head of Research

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Executive summary

This working paper presents the results of the initial mapping studies for a larger project (PEAC)[1] aimed at improving the knowledge base for research and innovation policy for the formation of centres of excellence. The excellence policies and centres' profiles are mapped and compared across Denmark, Finland, Norway and Sweden. The results are preliminary; the mapping will be used as input for comparative case studies of the impact of centres of excellence (CoE) schemes in the four countries. Hence, this working paper presents a considerable amount of data, but only a limited amount of overall analysis and conclusions.

Findings

CoE schemes are introduced based on different opportunities and arguments. The Nordic countries have followed different paths to the introduction of centres of excellence. In the beginning of the 1990s, Denmark was the first Nordic country with a competitive funding scheme for centres of excellence. The Danish path to CoEs can be understood as an entrepreneurial policy process that succeeded because of its good timing: it matched the availability of funds from the privatisation of a public life-insurance company. Finland followed a few years later and established its CoE scheme in 1994. Since the 1980s multiple research policy working groups/reports had argued for a more selective research policy and for the introduction of centres or 'top-level units'. In the 1990s this thinking coincided with an economic recession and a government decision to respond to that recession with increased public funding for research, and efforts to enhance international research competitiveness. In Norway, the excellence policy emerged late and more slowly. The need for a concentration of resources to promote excellence was balanced against conflicting distributive – and more egalitarian – policy objectives. When a CoE scheme was finally introduced in 2001, part of the argument was that such schemes had already been introduced – with success – in a large number of countries. Another scheme using centres for research to drive innovation was also added in 2006, and was later adapted by creating yet another scheme for environmentally-friendly energy research centres within the context of 2008 climate agreement. Over the last decade CoE schemes have become a sizable and entrenched part of Norwegian research funding policy, but a shift towards more traditional, responsive mode project support has taken place during the last couple of years. In Sweden, the public CoE schemes were introduced despite some hesitance from the funding agencies, partly as a response to competition from initiatives by private foundations. The Swedish government was in favour of more competitive funding and pushed for excellence schemes. The first excellence centre scheme was introduced in 2001, and several more schemes were established from 2005 on. However, a change in policy direction is underway in Sweden; the policy-makers are more in favour of individual support, and the future of the various CoE schemes may be uncertain.

[1] Acronym for «coping with globalization: how do Policies to promote Excellence Affect the research Community?" PEAC is sponsored by the RCN FORFI programme.

The schemes encompass scientific, economic and broader social objectives. Whereas the paths taken to introduce excellence centres schemes differ, there is much similarity in their overall policy objectives. The PEAC project's scope includes three main types of excellence centre schemes, categorised according to their aims: those with mainly scientific objectives, mainly economic/innovation objectives or mainly broader social objectives. Apart from Finland, all the studied countries have centre schemes in all three categories. Norway has three schemes with different objectives and target groups: one regular CoE scheme (SFF) aimed at promoting scientific excellence, (SFI) aimed at research for innovation and more economic objectives, and a third scheme (FME) which is thematically defined and focused on environmentally-friendly energy research and aimed at solving specific challenges. Denmark has a similar range of schemes to Norway, with one large scheme with scientific objectives, and two other major public centre schemes, one aimed at research for innovation with more economic objectives (SPIR) and another for strategic research (Strategic Research Centres). Sweden has multiple schemes: one with scientific excellence as the overall objective (the Linnaeus Environments); another focused on economic rationales and innovation (the VINN Excellence Centres); and, several schemes with multiple objectives. These diverse Swedish schemes include: the FAS-Centres (scientific excellence and social challenges/strategic objectives); the Berzelii Centres (scientific excellence and economic rationales/innovation); and, the Strategic Research Centres (social challenges/strategic objectives and economic rationales/innovation). Finland has one regular CoE scheme, which is aimed at scientific excellence, and the SHOK scheme ('Strategic Centres of Science, Technology and Innovation') aimed at innovation and economic rationales.

Scientific objectives include international visibility and competitiveness, resource concentration, researcher recruitment and restructuring the research system. In studying the CoE schemes with scientific excellence as their overall objective, we find that their aims are formulated and emphasised in a variety of ways. In Denmark, the key objectives include creating critical mass for high quality and international competiveness, and to enable top researchers to deliver ground-breaking research. In Norway, the objectives include international visibility and attractiveness, strengthening internationalisation of research, promoting researcher recruitment and restructuring the organisation and management of university research. In Finland, the objectives include fostering creative and efficient research environments, in order to reach the top international level and promote scientific breakthroughs, as well as the development of the research system so research organisations improve their own profile in terms of international visibility and competitiveness. In Sweden the objectives include attaining high international standards, enabling resource concentration (by supporting research environments instead of individuals), and reducing the burden of writing many applications/administrating multiple funds for the same research by enabling longer-term and larger grants.

CoEs receive funding of between €0.5 and €1.4 million per year, as well as considerable additional funding. The amount of money allocated is an important indication of the potential impact of a research policy scheme. There are notable differences between countries in the size and terms of the excellence schemes, but the variations identified are smaller than might have been expected. Looking at excellence schemes focused on scientific objectives, the average annual funding per centre varies between €0.5 million for the Finnish CoEs and €1.4 million for the Norwegian CoEs (based on the scheme funding only, not the total budgets of the centres). The total annual funding provided varies from €27 million in the Swedish Linnaeus scheme to €43 million in the Danish CoE scheme. According at these figures, the potential impact should be somewhat higher in Denmark and Norway (due to larger schemes and/or larger average grants) than in Finland and Sweden (smaller grants). On the other hand, if the centres attract large amounts of additional external funding, as well as co-funding by their host institution and partners, these variations in national funding from excellence schemes may be of limited importance. The number of centres may be an alternative indicator for impact. The

number of centres funded by the schemes is 88 in Sweden, 75 in Finland[2], 71 in Denmark and 53 in Norway. In addition, NordForsk has funded 22 Nordic Centres of Excellence (NCoEs).

CoEs account for 2.5 to 6.1 per cent of national governments' R&D expenditures. The total annual funding for the excellence schemes, as share of the national government's total expenditure on R&D, varies from 2.5 per cent in Norway to 6.1 per cent in Finland. However, if we exclude the Finnish SHOK scheme from calculations, the figure for total Finnish funding is drastically reduced, and the share of national governmental R&D expenditure spent on the CoE schemes' varies far less between the four countries (from 1.4 per cent in Finland to 3.6 per cent in Denmark). The SHOK-scheme is much larger than any other scheme for which we have information, with total annual funding of €99 million and average funding at €16.5 million per centre per year; it also differs from the CoEs in other important respects, as SHOK centres are consortia comprising companies and research institutions/universities, not centres hosted by research institutions.

A few universities host a large number of CoEs. The majority of the excellence centres are hosted by universities. In total, 248 of the 287 centres are hosted by a university. In Sweden, all host institutions are higher education institutions. In Finland, all but three CoEs are hosted by universities. In Denmark 6 out of 12 host institutions are non-universities, but these institutions only host 8 of the 71 Danish centres. Norway has the highest number of host institutions (20) and a lower number of centres, and hence a more distributed centre profile than the other three countries. Nonetheless, a large proportion of the Norwegian centres are hosted by five universities, so the distributed profile is largely due to centres outside the universities. In all countries there are one or two universities that host a large number of centres. The University of Helsinki (FI) hosts 33 centres, the University of Copenhagen (DK) hosts 25 centres, Lund University (SE) hosts 21 centres, the University of Oslo and NTNU (NO) host 9 each. In addition, Norway has a research institute (SINTEF) which hosts a considerable number (six) of the centres, indeed, it hosts one more centre than the University of Bergen. Not surprisingly, the host institution profile varies by the type of centre. The universities host nearly all the centres funded by the 'scientific' schemes (95 per cent), while centres at research institutes are mainly funded by the innovation/economic schemes or strategic schemes. Schemes with an innovation/economic objectives have the largest proportion of non-university hosts (29 per cent of centres hosted in the institute sector).

Biomedicine and engineering dominate CoE activities. When the centres are categorised based on their research areas we find some similarities, as well as some particular national profiles. The two largest categories in all countries are Biomedicine/Health Sciences, and Engineering/ICT/Materials Sciences. Sweden has the highest proportion of centres within the Biomedicine/Health Sciences area, whereas Norway has the highest proportion of centres within Engineering and Materials Sciences. Norway also has a higher share of centres with a Geosciences and Agriculture focus. Finland has a higher proportion of centres within the Humanities than the other countries. Denmark has a slightly higher share of centres within Physics/Mathematics and Chemistry.

A lack of gender balance is apparent in CoEs. In all four countries, a large majority of the centres are led by men. Finland has the highest proportion of female leaders (19 per cent), Denmark the lowest with 7 per cent. In total across the four countries, only 12 per cent of centre leaders are female. Comparing the proportion of female centre leaders with the overall percentage of female professors in each of the four countries, suggests that this share of female centre leaders is far below what could be expected. The highest proportion of female centre leaders are in centres within agriculture, biology and the humanities, with 21 to 38 per cent; this indicates that, to some extent, the proportion of female leaders is higher in areas with more female researchers. We also find a lower proportion of female leaders at centres funded under schemes aimed at innovation and economic rationales (only 7 per cent). These are schemes dominated by engineering and technology, with low percentages of female professors.

[2] Only CoEs are included for Finland, we have not mapped the SHOKs. Of the 75 CoE, 25 terminated before 2010. For the other countries only today's centre are included in the figures (see centre mapping, Chapter 3).

Host institutions score high on competiveness criteria. We have studied the general competitiveness of the CoE host institutions, measured by bibliometric indicators and their performance on attracting research funds under EU FP7:

- The large majority (89 per cent) of the centres included in the analysis are based at universities which obtained a citation index above the world average for the relevant field(s). The exception is centres focused on biomedicine, where the average citation index of CoE host universities is at the world average. Including all fields, the Danish host institutions score highest, with an average citation index of 1.34 (1.00 indicating the world average), and 94 per cent of Danish centres are hosted by universities that score above the world average. The Finnish host institutions score lowest, with an average citation index at 1.08, and 75 per cent of centres hosted by universities that score above the world average.
- The CoE host institutions also dominate the ERC grants; only 6 out of 189 ERC grants cannot be traced to an institution with an excellence centre. Moreover, there is high correlation between the number of approved ERC grants and the number of centres at the host institutions. For most universities with ERC grants, these grants are a significant part of their funding from EU FP7, providing close to 50 per cent of total funding for both Stockholm University and the University of Helsinki.
- In conclusion, the CoE host institutions score high on competiveness criteria. The data indicates both that the excellence centres are hosted by institutions among the leading/strongest in the relevant fields, and that they are part of interrelated processes of cumulative advantage when it comes to international research funding.

Issues for further studies – priorities of the PEAC project

The preliminary findings point to several important topics for further analyses:

- *The total size of the centres and cumulative advantages offered.* What is the relationship between the amount of funding from an excellence scheme and the total size of the centres established? Is it the funding, the excellence status or other factors that enable the centres to attract additional resources? More specifically, how do the excellence centres relate to, and benefit from, other excellence schemes, including their possibilities of being funded by multiple schemes in parallel or subsequently? Interrelated processes of cumulative advantages will be an important topic for the PEAC case studies.
- *Differences between excellence schemes.* Schemes have different objectives and so should impact on the research community in different ways. To what extent does it make a difference for the researchers whether they are funded by a scheme aimed at scientific excellence, by a scheme with innovation objectives, or a scheme aimed at solving societal challenges?
- *Differences between research fields.* Different research fields have different needs and different possibilities for acquiring additional funding. Hence, the excellence schemes are likely to have different kinds of importance and impact in different research fields. Differences between fields will be an important topic for the further studies.
- *Gender balance.* The gender distribution of centre leaders varies by the kind of excellence scheme and research area. More detailed studies are needed to understand the schemes' effects on the gender equality.

1 Introduction

The main objective of the PEAC project is to develop a better knowledge base for research and innovation policy for the formation of centres of excellence. This working paper reports the results from the first stage of the project – a comparative study of excellence policy and instruments in the Nordic countries. The excellence policies and centre profiles for Denmark, Finland, Norway and Sweden are mapped and compared.

Chapter 2 analyses the origin of policies for research excellence in the Nordic countries. We have studied how the main policies and instruments developed, and how the policies differ in terms of objectives and emphases. Furthermore, the various excellence schemes and the resources allocated to them are mapped, and we discuss the schemes' relative importance in terms of overall national research funding.

Chapter 3 presents the results of mapping 11 excellence centres in the four countries. The centre types and their scope, locations/host institutions and research areas benefiting from excellence schemes, are analysed. The mapping was based on information about the centres available via the funding agencies' and centres' web pages.

Chapter 4 combines the data from the centre mapping with available comparative statistics on host institutions' general competitiveness, in terms of attracting international research funds (under FP7) and their scores on bibliometric indicators. The overall question addressed is the extent to which centres are allocated to institutions which are among the leading/strongest in their relevant fields.

2 Policy origin and objectives – national policy profiles

2.1 Excellence policy in the Nordic countries – policy origin, discussions and objectives

The emergence of 'centres of excellence' in the Nordic countries over a period of two decades is part of broader international developments. Policies for research excellence have been developed and implemented in a large number of countries, including a large variety of what has been called 'research excellence initiatives' (REIs) (Orr et al. 2011). These are seen as a relatively recent part of broader changes in the structures for funding public research and research institutions. REIs may be seen as encompassing a wide variety of initiatives and schemes, but schemes for forming and funding 'centres of excellence' are often a key or main type of REI used (op.cit., pp. 7-8). REIs have emerged as a novel 'specific model of funding research', focussing on 'rewarding and fostering exceptional quality in research and research-related activities' (p. 2). REIs are seen to differ from two existent models of funding, institutional (block) funding and project funding respectively, while overlapping with and sharing some characteristics of both. REI funding is different to block funding and similar to project funding in being competitive and goal-oriented, but differs from project funding by providing more extensive and long-term funding. A central *institutional* aspect of REI funding is that 'it is the overarching central objective of re-structuring the research landscape, which makes this funding form different' (p. 6). Hence, REIs have a *systemic* scope that is usually absent from project funding. More specifically, systemic changes are sought in terms of enhancing the international competitiveness of domestic research: a common denominator of programme descriptions for all REIs is the objective of assuring national scientific competitiveness, through enhanced international excellence, visibility and attractiveness for the best national research institutions and/or research groups. Thus, REIs often require up-scaling of research efforts and extended networking between institutions, disciplines and actors.

These characteristics may be seen to apply, to greater or lesser extent, to all or most of the CoE schemes that have emerged in the Nordic countries, and are now sizable parts of these countries' national research landscapes and research funding instruments. This chapter provides an overview of schemes for centres of excellence, in various forms, in four Nordic countries. While many similarities between CoE schemes across these countries are apparent, it must also be acknowledged that the role and design of these schemes are largely determined by their systemic context, that is, their position in the wider national portfolio of funding instruments and policy incentives, and the national research systems more generally. To provide some information on the broader national context of policy instruments, the mappings of specific schemes for centres of excellence are presented alongside a selection of adjoining schemes to support and stimulate excellence in research.

The origin of the Nordic CoE policies

The Nordic countries have followed different paths to the introduction of excellence centres. In this chapter these different stories are told (Section 2.2 to 2.5). Below are some overall observations.

In the early 1990s, Denmark was the first Nordic country with a competitive funding scheme for centres of excellence. The background was that proceeds from the privatisation of a public life-insurance company were used to establish a separate research foundation, to strengthen basic research. This foundation introduced CoEs as its main research funding instrument. In sum, the Danish path to CoEs can be understood as an entrepreneurial policy process that succeeded because of good timing, i.e. it coincided with the availability of funds.

Finland followed Denmark a few years later, establishing its CoE scheme in 1994. Since the 1980s there had been increased emphasis on research evaluation and achieving international quality in Finland. Multiple research policy working groups/evaluation reports had suggested the introduction of a more selective research policy and centres or 'top-level units'. In the 1990s this coincided with a recession and the government's decision to respond to the economic downturn with increased public funding for research, as well as a policy line to increase competitive research funding and a general emphasis on international competitiveness. The CoE scheme was originally established without any separate funding, and only gave the units the status of a CoE. After a couple of years, additional government funding was allocated to the Academy of Finland, to be distributed to the CoE host institutions. The Finnish CoE scheme generated some resistance and criticism. The scheme was criticised as involving too high a number of centres, so the funding per centre was too low. As a consequence, the number of centres has been reduced in the latest selection process – which has also been criticised. Moreover, there has been criticism of the selection process: many applications get top scores, but only a smaller proportion are awarded funding. The basis for selecting the winners among those with top scores is unclear, it is claimed. Moreover, it has been argued that the groups that are not awarded CoEs are then stigmatised as 'losers', whereas the reasons for why they are not selected are not transparent.

In Norway, the excellence policy emerged later and more slowly. The need for a concentration of resources to promote excellence was balanced against conflicting distributive – and more egalitarian – policy objectives. Hence, the first developments in excellence policy during the 1980s and the first half of the 1990s took place as much in spite of, as in response to, official research policy. When a CoE scheme was finally introduced in 2001, part of the argument was that such schemes had already been introduced – with success – in a large number of countries. When they were established, excellence schemes gained wide support and saw less resistance than could have been expected, and the schemes are now strongly embedded in Norwegian research policy. Nonetheless, the criticism has been raised that single researchers and small groups now have inferior funding opportunities. Partly in response to this, Norwegian responsive mode funding is now being strengthened.

In Sweden, the public CoE schemes were introduced despite some hesitance among the funding agencies, and partly as a response to competition from initiatives taken by private foundations. The government was in favour of more competitive funding and pushed for excellence schemes. At the same time, the universities were increasingly dependent on external funding. Moreover, the large research units were successful in arguing that they needed more resource concentration to establish scientific leadership and excellence. Simultaneously, the research councils did not have a strong position in the research system and tried to find new niches. The first CoE scheme was introduced in 2001, and several more schemes were established from 2005 on. Sweden also experienced criticism of the selection processes – related to possible conflicts of interests and a lack of transparency. Moreover, the uneven distribution of centres between the universities has hampered support for the schemes and leads to considerable scepticism. The schemes have been found to disadvantage some groups, in particular women. At present there is a policy shift underway in Sweden; policy-makers are more in favour of individual support, and the future of the various centre schemes may be uncertain.

Policy objectives

Whereas the paths taken in establishing excellence centre schemes differ, there is much similarity in their policy objectives. Both similarities and differences are found in the countries' portfolios of excellence schemes and the particular objectives for the schemes.

Excellence centre schemes may be categorised according to their aims: mainly scientific objectives, mainly economic/innovation objectives or mainly broader, social objectives (see Chapter 3). According to these categories, the portfolios of excellence schemes found in each country vary somewhat. *Norway* has three schemes with different objectives and target groups, all managed by one single organisation: one regular CoE scheme (SFF) aimed at promoting scientific excellence; another scheme (SFI) aimed at research for innovation and more economic objectives; and, a third scheme (FME) which is thematically limited to environmentally-friendly energy research and aimed at solving specific challenges. *Denmark* has a similar range of schemes to Norway, with one large scheme with scientific objectives, and two other major public centre schemes, one aimed at research for innovation with more economic objectives (SPIR) and another for strategic research (Strategic Research Centres).*Finland* has one long-run CoE scheme, aimed at scientific excellence. So far, there is no other Finnish centre scheme. There is however the SHOK scheme, which comes close to being an excellence centre scheme. This scheme – described as offering cooperation platforms for innovative companies and spearhead research – is aimed at innovation and international economic competiveness. *Sweden* has several schemes with multiple objectives. The Linnaeus Environments have scientific excellence as their main objective. The FAS-Centres are aimed at both scientific excellence and social challenges/strategic objectives. The VINN Excellence Centres are aimed at economic rationales and innovation (but as all the schemes studied, includes also scientific quality among the assessment criteria). The Berzelii Centres are similarly aimed at scientific excellence as well as economic rationales and innovation. The Strategic Research Centres are aimed at social challenges/strategic objectives, as well as economic rationales and innovation. In addition to the regular centre schemes, Denmark and Sweden also have national schemes, providing university grants to enhance international competitiveness (the UNIK initiative in Denmark and Strategic Research Areas (SFO) in Sweden, see Table 2.1).

Denmark has a similar range of schemes to Norway, with one large scheme with scientific objectives, and two other major public centre schemes, one aimed at research for innovation with more economic objectives (SPIR) and another for strategic research (Strategic Research Centres).

Studying the regular CoE schemes and looking beyond their main objectives of scientific excellence, we also find some variation in what the countries emphasise.

In Denmark, where the CoE scheme is run by a separate foundation for basic research, the key objectives include creating critical mass for high quality and international competiveness, and enabling top researchers to deliver ground-breaking research. While a turn towards a more elitist profile for research funding was part of the scheme's aims, after the first allocation of centre funding in Denmark, criticisms were made that the result was a more egalitarian distribution than intended. Interestingly, those criticisms are quite the opposite of what has been seen in Norway and Sweden (but similar to the first criticism in Finland).

In Norway, the more general objectives of the CoE (SFF) scheme – apart from scientific excellence as such – include: international visibility and attractiveness; strengthening internationalisation of Norwegian research; promoting researcher recruitment; and, restructuring the organisation and management of university research. It should be added that the first call for CoEs did not only emphasise scientific excellence. There were also some applied objectives and it was announced that there should be at least one centre in each of Norway's four thematic priority areas.

In Finland, the objectives of the COE scheme include: fostering creative and efficient research environments, in order to reach top international level and scientific breakthroughs; the development of the research system, to enable research organisations to improve their profiles in terms of

international visibility and competitiveness; and moreover, the scheme was seen as having broader societal importance and supporting economic competitiveness. In recent years interdisciplinarity has been added to the list of objectives.

In Sweden the objectives of the CoE schemes are, as mentioned, somewhat mixed. Among the objectives aimed at the scientific community, we find attaining high international standard, enabling resource concentration by supporting research environments (rather than individuals), and reducing the burden of having to write many applications/administrate multiple funds for the same research, by enabling longer-time and larger grants.

Centre schemes funding and impact

The amount of money allocated is an important indication of the potential impact of research policy. As shown in Table 2.1, there is some variety in the size of the CoE schemes in the four countries. Looking at the general excellence schemes (those focusing at scientific objectives, see Chapter 3, Table 3.1), their total annual funding varies from €27 mill in the Swedish Linnaeus scheme to €43 million in the Danish CoE scheme. Average annual funding per centre varies between €0.5 million to the Finnish CoEs and €1.4 million to the Norwegian CoEs. Overall, the potential for impact can be expected to be somewhat higher in Denmark and Norway (larger scheme and/or larger average grants), than in Finland and Sweden (smaller grants). On the other hand, as far as the centres attract large amount of other external funding, as well as co-funding by the host institution and the partners, the national variations in the funding provided by the excellence scheme itself may be of limited importance.

Considering all the kinds of schemes in Table 2.1, the Finnish SHOK-scheme (Strategic Centres of Science, Technology and Innovation) is by far the largest. With annual total funding of €99 million, and an average centre size of €16.5 million per year, this scheme is much larger than any other scheme for which we have information. However, it is questionable whether the SHOKs should be classified as CoEs. The SHOK scheme may be more similar to schemes for Centres of Expertise[3] (not included in the table), than the schemes for research based innovation included in the other countries (e.g. the Norwegian SFI scheme and the Swedish VINN Excellence scheme). If we exclude the SHOKs from the calculations, the figure for total Finnish funding is drastically reduced, and the excellence schemes' share of total national government R&D expenditure varies a lot less between the four countries.

For Demark and Sweden, Table 2.1 also includes some more general excellence funds that are distributed to universities. These are of quite different size. In the Danish UNIK initiative, €13 million is shared by four initiatives, giving large amounts per initiative (average €3.2 million annually). In the Swedish Strategic Research Areas (SFO) on the other hand, more money (€46 million) is distributed to more initiatives (43), giving a much smaller average size per initiative (average €1 million annually). However, the budgets for the Swedish Strategic Research Areas are increasing. The 2012 budget is more than twice the 2010 amount (€114.6 million in 2012 compared to €45.8 million in 2010), giving an average of €2.7 million per initiative. The Norwegian SAK-funding (not included in the table[4]) has some similarities with these initiatives but is much smaller, with an annual total budget of €6.2 million (average funding per project €0.3 million in 2010).

In sum, Table 2.1 shows that there are notable differences in the size and terms of the excellence schemes, but these variations are smaller than might have been expected. Moreover, not all schemes are comparable and the totals for funding for each country will, of course, depend on which schemes are included and excluded from the calculations.

[3] For example the Norwegian Centres of Expertise funded by Innovation Norway.
[4] Much of the funding so far has been allocated to projects for collaboration within teaching (not research) between higher education institutions. Hence, the scheme does not belong in Table 2.1. The SAK scheme is described in Section 2.4.3.

Table 2.1 Excellence centre schemes included in the mapping, budgets and average size

Country and name of scheme	Total funding for the scheme 2010 (Euro)*	Scheme funding per centre 2010 Euro (average)	General terms for co-payments
Denmark			
Centres of Excellence (CoE)[1]	43 351 637	1 008 178	Co-payments are expected, as grants do not cover salaries for permanent staff. No fixed percentage.
SPIR – Strategic Platforms for Innovation and Research[2]	5 528 683	2 764 342	Co-payment is expected from participating public and private-sector actors. There is a cap of 10 per cent on the proportion of co-funding required from national research institutions in Denmark. The two platforms established in 2010 have 50% co-payment.
Strategic research centres[3]	15 560 938	648 372	Co-payment is expected from participating public and private-sector actors. As of 2009, a cap of 10 per cent has been put on the proportion of co-funding required from national research institutions in Denmark.
UNIK	12 892 800	3 223 200	(No demands)
Total for the schemes	**77 334 059**	**1 059 371**	
Per cent of total public R&D expenditure 2009	3.6 %	(of €2.1 bill gov R&D 2009[4])	
Finland			
Centres of Excellence in research (CoE)	30 000 000	520 000	Co-funding from the host institution is required but its share is not fixed. The funding for each centre is determined in negotiations between the Academy, the centre, host organisation and other possible funders. Usually the share of the host institution has been higher than in normal Academy project funding.
SHOKs – Strategic Centres of Science, Technology and Innovation	99 000 000	16 500 000	SHOKs are non-profit limited companies whose shareholders are firms, universities, research institutes. All shareholders have initially invested in the company. Tekes is the most important public funder of SHOK projects where its funding may be max. 70 %.
Total for the schemes	**129 000 000**	**2 015 625**	
Per cent of total public R&D expenditure 2010	6.1 %	(of €2.1 bill gov R&D 2010, 1.4 % without the SHOKs)	
Norway			
Centres of Excellence (CoE/SFF)	30 204 900	1 438 329	Host contribution required, no fixed percentage. Average contribution 24 per cent (2009)
Centres for Research-based Innovation (CRE/SFI)	19 142 200	911 533	Host and partners in total 50 per cent. Company partners at least 25 per cent.
Centres for Environment-friendly Energy Research scheme (CEER/FME)	21 628 200	1 966 200	RCN funds max 50 per cent of total centre budget. Company partners at least half the RCN contribution.
Total for the schemes	**70 975 300**	**1 339 157**	
Per cent of total public R&D expenditure 2010	2.5 %	(of € 2.8 bill gov R&D 2010)	
Sweden			
Linnaeus Environments	27 647 907	691 198	Host institution's co-funding is SEK 1 million (per centre).
FAS-Centres	7 085 600	708 560	Host institutions co-funding SEK 1 million annually (per centre).
VINN Excellence Centres	12 795 760	673 461	Co-funding per centre: SEK 14 million in co-funding from universities and companies, of which the university share is approximately SEK 3 million.
Strategic Research Centres	17 609 800	1 035 871	Host institution's co-funding varies.
Strategic Research Areas (SFO)	45 848 000	1 066 233	No requirements for co-funding.
Total for the schemes	**110 987 067**	**860 365**	
Per cent of total public R&D expenditure 2009	3.4 %	(of €3.3 bill gov R&D 2009)	

Sources: Finland: Tekes 2011c; Academy of Finland 2010; Statistics Finland (2011): Tutkimus- ja kehittämistoiminta 2010. www.stat.fi. Sweden: Annual reports available at the funding agencies' websites/Estimates based on data available on the funding agencies web pages. Government R&D expenditure 2009: www.scb.se Norway: http://statistikkbank.forskningsradet.no/ (Centre funding) and St.prop. 1 S (2009-2010) (Government R&D budget 2010).

*Exchange rates (1 July 2010): NOK 0.1243; SEK 0.1042; DKK 0.1343.

[1] Total payment from the foundation to CoEs concerning 2010 (Danmarks Grundforskningsfond (2011): Årsrapport 2010).

[2] The SPIR initiative was established in 2010, where also the first decision about allocation of grants was made. Grants allocated in 2010 will be used in the period 2011-2016. Figures are estimated as expected yearly resources.

[3] Figures are estimated departing from information on grant allocation decisions made in 2006, 2007, 2008 and 2009 about centres to be established in the following years. Figures are estimated on the preconditions that all grants concern a 6 year period and are equally divided across time.

[4] Gov R & D 2009 as stated in Forsknings- og Innovationsstyrelsen (2011): Tal om forskning. 2010, p. 8.

Overall, the excellence schemes account for a low percentage of the national public funding for R&D, but may still – due to co-funding and various cumulative effects – have substantial impacts in terms of redirecting research resources. Looking more closely at the information about co-payments in Table 2.1, we find that the innovation oriented centres demand more co-payments, especially from company partners, whereas the 'general' support schemes to universities (such as the Danish UNIK and the Swedish SFO) make no demands for co-payments. The CoE schemes with scientific objectives all require host contributions, although these may vary. In addition to co-payments, many centres attract considerable additional funding from various sources including both national and international funding schemes, as well as funding from multiple centre schemes. Taken together, co-payments, the ability to attract other funds and cumulative advantages, imply a high potential for these schemes to redirect research activity, even when centres are temporary and the funding from the centre scheme itself is limited. Apart from higher concentration of research sources in general, various impacts may be observed, including: reorienting research to new fields or to specific research areas, researchers following new lines of research and allowing more risk-taking. Moreover, a reorientation of resources within and between universities is apparent, and the national CoE schemes have also inspired institutional level CoE schemes, or host institution initiatives to award the 'silver medallists' of the national schemes.

When it comes to impacts on the organisation of research, changes observed include: an increased focus on academic leadership; increased facilitated recruitment of both junior and senior researchers, as well as researchers from abroad; and, increased research responsibilities for Postdocs. Moreover, the introduction of temporary centres imply challenges concerning the flexibly of research staff.

The above issues are elaborated in the country sections of this chapter. Observed impacts seem much the same in all four countries.

The future investment in the CoEs schemes is uncertain in some of the countries. Observing research policy trends, institutionally-directed support and individual grants have been gaining support in recent years, whereas the value of CoE schemes is disputed. On the other hand, the number of CoE schemes has increased. Such schemes seem to have become a permanent part of the policy portfolio in Norway and Finland at least. In Sweden, on the other hand, there seems to be a modest policy shift away from CoEs, while in Denmark future investments in the major CoE scheme is not settled. While the centres schemes have indeed become 'permanent' in Norway, at present their funding is not increasing and instead there is increased investment in the budget for individual grants/responsive mode funding.

2.2 Denmark

2.2.1 Introduction[5]

In recent years the overall concept of excellence, and related concepts such as world class research, have become widely used in Danish research policy and strategy documents at all levels, from governmental white papers, to research council strategies, university and university department strategies. The more specific idea of centres of excellence has also grown more important for several funding councils and foundations.

It is, however, not straight forward to determine when the CoE idea first emerged or the precise content of the concept. It is clear that the establishment of the Danish National Research Foundation (DNRF) in 1991 was a very important event for these development, but the idea of CoEs can be traced back to policy initiatives in the 1980s. In this national description, excellence policies and particularly

[5] Thanks to David Grønbæk, The Agency for Science Technology and Innovation, Finn Hansson, CBS, Nikolaj Helm-Petersen, The Agency for Science Technology and Innovation, and Kaare Aagard, CFA for input and comments.

CoE policies will be analysed as regards their historical development, the content of these concepts and the various schemes and instruments initiated. Two overall questions will be addressed:

1) What are the origins and objectives of the excellence centre schemes developed in Denmark since 1991?
2) How important are these schemes in the national policy context?

As a point of departure, one may reflect upon whether the aspiration for excellence is something new in research policy: this seems unlikely. The rationale for establishing traditional research councils and advancing responsive mode funding has always been to support the best scientific ideas, and the best researchers, in an attempt to secure high quality research. This said, CoEs and other excellence initiatives are often promoted as marking a departure from traditional research council practices that have come under criticism. Common criticisms include that while research councils are based on competition, they spread resources over too many small grants with durations that are too short; in this way they distribute resources in a more egalitarian way than is desirable. CoEs and other excellence initiatives try to cope with this criticism by offering larger grants with longer time horizons, and can therefore be seen as a more elitist way to distribute resources. Against this background, there are good reasons to explore excellence policies in terms of how they have developed, what they involve and what their impacts are.

This national description is structured in 5 sections. Section two contains the analysis of the history of the DNFR and the development and introduction of the CoE idea. Section three offers an analysis of the spread of the CoE idea, and section four presents the analysis of what CoE instruments have involved, besides the DNRF. Finally, section five looks at the importance of the CoE schemes in the wider research policy context, and reflects upon whether there are signs of policy shifts.

2.2.2 The history of the DNRF and the CoE idea

As mentioned above, the CoE idea in Denmark is primarily evident in the funding policy of the DNRF. This section will shed light on how the DNRF came about, where the CoE idea came from, how it was developed and how it has been put into practice in the DNRF.

The political process that established the DNRF

In 1990 the Danish research policy council's agenda included the topic of how to strengthen basic research. The chairman of the council, Jens Rostrup-Nielsen (vice president for research at the catalyst corporation Haldor Topsøe), was inspired by the German Max Planck Institutes. His idea was that, if it was possible to find 200 million DKK, five such institutes could be established in Denmark. He promoted the idea in meetings with politicians and high level governmental officials and they picked up the idea.

It turned out that the 200 million DKK needed matched the interest on the proceeds from the privatization of a former public life insurance company. The ministry of Finance approved the use of the funds and the Ministry of Education was asked to work out a budget for the establishment of a research foundation, the DNRF. The idea was met with scepticism by the research councils and universities and they tried to mobilize resistance. Political negotiations were drawn out, partly due to external factors such as a general election, resulting in a change of government. New negotiations started and in June 1991 the bill was passed by a nearly unanimous Parliament (for more detail see Rostrup-Nielsen 2001: 68-72).

During the negotiations there was some discussion about whether the foundation was to support research with relevance for industry or basic research in general, but the resolution by Parliament was in favour of basic research in general (Larsen 2003). The foundation was established as an autonomous organization, de-coupled from the research councils as well as the universities. The Ministry of Finance feared that if the money were given to the universities, it would be spread out in an

egalitarian fashion, and even if responsibility was given to the research councils there were concerns the implementation would be less elitist as wished (Larsen 2011).

The formative moment of the DNFR can be interpreted as a result of a policy entrepreneurial process, where a problem (the need to strengthen basic research) was coupled to a solution (proceeds from the privatization of a public company). The timing of the problem arising on the policy agenda can be characterized as a success, but the success may have been by chance. The decision not to place responsibility for distributing funds with any of the existing institutions was, however, deliberate and probably an important precondition for subsequent developments. This strategy of establishing new institutions for creating radical changes, rather than adding to and reforming existing institutions, is often used in Danish research policy. There are several other recent examples: the Strategic Research Council and the Danish National Advanced Technology Foundation were both established in 2004. Besides creating radical changes, this strategy increases the complexity of the research funding system, as existing institutions are rarely abandoned even though this is often suggested.

The DNRF and the development of the CoE idea

Later in 1991 the first chairman of the board and managing director of the DNRF was appointed. The choice fell on Peder Olesen Larsen, a professor in chemistry, who had been actively engaged in research policy and administration for several years. As head of the Agency for Research in the Ministry of Education he had been involved in the preparation of the bill concerning the DNRF. Even more importantly, he had been in charge of a large biotechnological research program (BIOTEK I) in later part of the 1980s. This programme had focused on encouraging research groups to collaborate in centres, the idea being to create collaboration between small research groups, to reach critical mass and thereby higher quality. The centres established were so-called centres without walls meaning that the research groups collaborating were still localized at different research institutions. The centres were seen as a partial success: some developed tight collaboration and reached critical mass, whereas others were organized in a more loosely-coupled way, and thus developed as kinds of mini research councils, distributing money between research groups (Agersnap & Hansen, 1990).

These experiences from BIOTEK I influenced how Peder Olesen Larsen developed the DNRF scheme. Under the auspices of DNRF the centre idea was further developed to avoid the problems experienced in some of the centres without walls. The DNRF centres were intended to be more coherent and organized with transparent management structures as well as follow-up and evaluation routines between the foundation and the centres. In this way the elitist principle and the centre idea was combined, and the Danish CoE concept coined.

The CoE idea as implemented by DNRF

In 1993/1994 the first 23 centres were established, with average grants awarded for each centre amounting to 8 million DKK annually. Although these grants were considerably larger than those normally given by the traditional research councils, critical voices argued that the consequences of following the CoE strategy would be that the money was distributed in a more egalitarian way than under the original Max Planck Institute idea. In 1994 the Ministry of Research even worked out a legal memorandum discussing whether the board of the foundation had violated the law by deciding to award so many grants; however, this violation could not be proven (Larsen 2003) and the CoE strategy was maintained.

Since its establishment the foundation has given grants to a total of 77 centres and a further 11 centres are planned to start by the beginning of 2012. All in all, the foundation has supported Danish research with more than 5 billion DKK (nearly €700 million). Centres started in recent years have been given grants amounting to 10 million DKK annually. All centres are supported for 6 years and evaluated after five years. If the evaluation is positive they may be supported for a further 4 years, and most of them are.

Today the foundation presents its mission like this:

'Our core mission is to fund innovative research by the best people in optimal surroundings. By recognizing and trusting their talent, we expect top researchers to deliver potentially ground-breaking results, thereby boosting the international competitiveness and impact of Danish research' (Danmarks Grundforskningsfond 2010).

The CoE program has been the corner stone in the activities of the DNRF (for key facts see box 1).

Box 1: Facts on the CoE scheme run by the DNRF

- Established in 1991 with capital of 2 billion DKK.
- An additional 3 billion DKK added in 2008.
- From 2010, it has distributed an average of 400 million DKK a year, corresponding to approximately 2 per cent of total public spending on research.
- Expected to continue up to 2026
- The last CoE will be established in 2017.

In recent years the CoE program has accounted for 80 per cent of the total expenditure of the foundation. The DNRF uses other instruments too; these are all excellence initiatives and some of them also support the CoEs. These other instruments are listed in box 2.

Box 2: DNRF schemes besides the CoE scheme

- The professorship programmes, including three elements: 1)The Niels Bohr Professorship programme, aiming at attracting strong, international senior-level researchers who are able to significantly advance Danish research, through the internationalization of a specific area of research in Denmark with lasting, long-term effects; 2) The Niels Bohr Visiting Professorship with the purpose of promoting the internationalization and the competitiveness of Danish research by attracting international top researchers to existing research environments. The programme ran 2006-2011; 3) The DNRF Professorships which is an extension of the Niels Bohr Visiting Professorships aiming at attracting elite international scientist to permanent employment. Positions for one or two younger scientist are attached to each professorship. Programme runs 2007-2012.
- Danish-Chinese Research Centres. A joint initiative with the National Natural Science Foundation of China aiming at strengthening collaboration between leading researchers from Denmark and China.
- International research centre in collaboration with the Max Planck Society.
- Nordic Research Opportunity, with the purpose of attracting American Ph.D. students to DNRF CoEs.
- The mobility program, in collaboration with the French Centre for Scientific Research (CNRS).
- Talent recruitment aiming at supporting international recruitment to DNRF CoEs.

In 2003, an international panel evaluated the DNRF (Evaluation 2003). The panel concluded that the CoE initiative has brought about genuine improvements in the Danish research system. Furthermore, the panel noted that about a quarter of CoEs had achieved distinction as world leaders in their respective fields, a conclusion that has been confirmed in several subsequent evaluations of individual centres.

The DNRF has also analysed the impact of its own activity: although the foundation only comprises 2 per cent of the total public expenditure on research, their analysis found that DNRF grants are involved in 20 per cent of all Danish publications in Science and Nature. In addition the analysis showed that key persons in DNRF centres are responsible for 9 of the total 12 advanced grants from the European Research Council received by Danish researchers (DNRF 2011).

The foundation therefore appears to have been a very important actor in developing new ideas on how to organize research in support of excellence, supported by its position as an autonomous actor, on the fringes of the research council system.

2.2.3 The diffusion of the CoE idea

As mentioned above, the DNRF initiative was at first seen as a sign of mistrust between on the one side the ministries and on the other the research councils and universities. Political support for the initiative has not turned out to be stable. In the mid-1990s the DNRF was in danger of being closed down, but a positive evaluation by the OECD saved it (OECD 1995, Larsen 2010).

Subsequently, the CoE idea and especially the broader excellence idea have gained a strong foothold in Danish policy. Many voices have contributed to this, but the recommendations from the Research Commission, published 2001, and from the Globalization Council, published 2006, have been particularly important. Each of these are briefly presented below.

The concept of excellence ideas in recommendations from the Research Commission

The Research Commission was asked to assess the coherence and need to renew the main acts constituting Danish research policy. It comprised high level civil servants, representatives from universities and governmental research institutes as well as industry representatives, and published its recommendations in 2001 (Forskningskommissionen 2001). The main research acts under scrutiny were the university act, the act on governmental research institutes, the act concerning the research councils and the act concerning the DNRF; in other words its scope involved a complete overhaul of research policy. The most important recommendations of the commission were to provide more resources for research, to introduce a management reform, to increase evaluation and quality assurance and to increase investments in the education of researchers. The issue of excellence was not directly addressed, but the instruments put forward were all presented as quality-promoting instruments. The commission recommended that the DNRF should carry on but be organized with a joint board for all research councils.

The concept of excellence in the Globalization Strategy

The Globalization Council, comprised ministers, university representatives, experts and industry and interest organization representatives. It published its recommendations in the Globalization Strategy, in 2006 (Regeringen 2006). The strategy concerned many topics, including research and innovation.

The strategy's aims related to the universities were especially ambitious. Universities were to conduct world class research as well as to be among the best in the world when it came to developing research results into new technologies, processes, products and services. Excellence thereby became defined as meaning world class. Besides these ambitious aims, the strategy introduced several instruments, some of these related directly to the university level, some related to public sector funding of research more overall.

The primary instruments that were recommended for the universities were: 1) Funding for research should be distributed according to quality, 2) governmental research institutes should be integrated into the universities, 3) competition should be increased, 4) the education of more highly qualified researchers should be intensified and 5) better possibilities to attract highly qualified researchers should be developed.

The primary instruments recommended for publically funded research were: 1) Increased competition should secure better quality, 2) larger grants should be given with longer time horizons, 3) investments in infrastructure should be increased, 4) higher priority should be given to strategic research, 5) systematic measurement and evaluation should be introduced and 6) better conditions for international collaboration should be developed.

The Globalization strategy became the stepping stone for several of the excellence initiatives elaborated in section 4, such as the further development of the strategic research council, the UNIK initiative and the bibliometric indicators.

2.2.4 The CoE idea as implemented by other funding actors

In recent years the CoE idea seems to have been more widely accepted by actors responsible for funding at different levels. In fact using excellence terminology seems to have developed as the norm: to be a legitimate funding actor one has to have CoE or CoE-like initiatives. The initiatives listed in boxes 3 and 4 are all CoE-like initiatives, as they combine ideas of excellence with large grants, though not necessarily targeting recipients defined as centres. Whereas box 3 lists publically funded initiatives, box 4 lists the initiatives used by private foundations.

Box 3: Publicly funded CoE-like initiatives		
Instrument	**Actor**	**Since**
UNIK (Investment capital for University Research): Funding allocated through competition between universities. Aims to develop elite research.	Danish Agency for Science, Technology and Innovation	Announced in 2007. Funding amounting to DKK 480 million, allocated to four projects at three universities, for 5 years from 2009.
Strategic research centres: Funding from DKK 30 million, for 5-7 years.	Danish Council for Strategic Research	First grants approved 2006.
SPIR (Strategic Platforms for Innovation and Research): Funding from DKK 60 million, for 5-7 years.	Joint initiative between the Danish Council for Strategic Research and the Danish Council for Technology and Innovation	First grants approved 2010.
Sapere Aude: Researcher career program for the elite. Three purposes: 1) strengthening young research talents, 2) more female researchers at the top, 3) launching point for research elite.	The Danish Council for Independent Research	Announced first time 2010.

The UNIK initiative grew out of the Globalization Strategy[6]. A call for proposals was initiated in 2007, proposals were assessed in 2008 and 5 year grants were allocated in 2009. The process was comprehensive: 28 proposals from eight universities each peer reviewed by four external reviewers, appointed from among 201 potential reviewers by an expert panel consisting of 11 international professors. On the basis of the reviews the expert panel classified the proposals in five categories, and the minister decided to give full funding to 4 proposals in the best category. The process also included three consultations with the applicants. A follow-up on experiences carried through in 2010 concluded that Denmark had built up valuable experiences (Danish Agency for Science and Technology 2010). The expert panel has been asked to follow-up the initiative. This is to be done by visiting the four research environments each year and writing a report to the minister in charge. The call for proposals has not been repeated.

Strategic research centres are one of three instruments used by the Strategic Research Council established in 2004. The others instruments are strategic research alliances and strategic research projects, both involving smaller grants. The general aim of the council is 'to contribute to secure the position of Denmark as regards welfare and economy as well as being a scientific frontrunner in global contexts in the short as well as long run' (web side). The overall criterion of assessment in the council is strategic quality, defined as relevance, potential impact and quality of research.

[6] In a recent OECD paper (Orr et. Al. 2011) providing an overview of research excellence initiatives in OECD countries the only Danish initiative mentioned is UNIK. As the SSF and SFI initiatives in Norway and the Linnéstöd, as well as strategiska satsningar in Sweden are mentioned, the DNRF CoEs and the strategic research centres also should have been mentioned.

The instrument of strategic research centres is a CoE initiative, as centres have to be linked to one or more well-established and strong research environments and have to be engaged in binding partnerships with strong international research environments. The profiles of the centres are problem oriented, not disciplinary. In recent years funding has concerned the fields of: energy, environment, food, transportation, education and health.

The centre scheme, along with other schemes, has given priority to public-private research collaborations evaluated in 2010 (Forsknings- og Innovationsstyrelsen 2010). Although the instruments used by the Strategic Research Council were criticized for not being clearly defined, the evaluation panel concluded that the centre grants had a budget size that made it possible to achieve synergy.

SPIRs, short for strategic platforms for innovation and research, are a recent joint initiative between the Strategic Research Council and the Danish Council for Technology and innovation. They aim at establishing tight public-private interactions, with a binding commitment to international collaboration.

For many years the classical research councils were not much influenced by the CoE idea. They continued supporting research based on a classical, disciplinary responsive mode. In 2003 it was decided that the former autonomous research councils should be reorganised into a structure with a common board of directors. In the short term the new superstructure turned out to be mostly symbolic, but after a critical evaluation in 2009 (Isaksen et. al. 2009), the new structure combined with persistent, considerable political pressure on the councils, led them to distribute grants in larger portions. Not only have the average sums of grants increased and the number of grants and success rates dropped (Aagaard and Ravn 2012), CoE inspired initiatives have also seen the light of the day. The Sapere Aude initiative is the most prominent of these. Sapere Aude is a researcher career program for elite candidates: excellent young researchers, who have just finished their post doc. period, are given grants making it possible to establish themselves as leaders of their own research group (Det Frie Forskningsråd, 2010).

Box 4: Private funded CoE-like initiatives

Instruments	Actor	Since
Centres of Excellence	The Lundbeck Foundation	15 grants decided 2005-2009 within medical and natural science. Grants are between 25 and 100 million. DKK for a five year period.
VKR Centres of Excellence	The Villum Foundation	11 grants since 2004 to natural and technical science. Grant sums between 25 and 33 millon DKK typical for a 5 year period.

As illustrated in box 4, private actors funding research have also adopted the CoE idea. This can be seen in both the Lundbeck Foundation and the Villum Foundation. Since the mid 2000 both foundations have supported several centres with considerable resources, though these initiatives are not nearly as large as those of the DNRF.

In recent years the CoE idea has even been adopted at the university level, as several universities have developed their own excellence programs. The University of Copenhagen launched an excellence programme in 2007, enabling researchers to apply for 5 million DKK a year, for a 5 year period. The application process resulted in 111 proposals. After two assessments rounds and a process of international peer review rather more than 350 million DKK were distributed in 20 grants. At the time of writing further excellence initiatives are discussed under the heading ‘lighthouses’.

Other examples of somewhat similar initiatives are the ‘Business in Society Platforms’ at CBS (Copenhagen Business School) which supports interdisciplinary problem oriented research within social science and interdisciplinary research centres at University of Aarhus.

2.2.5 The CoE idea in the wider research policy context

The history and spread of the CoE idea, and the content of current schemes have been described. Three important questions remain: How important are the schemes in the national context? Which interests do they serve? And are there any signs of policy shifts? These three questions will discussed below.

The importance of the CoE schemes can be discussed according to different dimensions and criteria. First of all, their importance can be measured by estimating the scale of the CoE schemes relative to total public R&D expenditure. In 2010 this share was 3.63 per cent (see table 2.1.), the share for Denmark being somewhat higher than the one for Norway, but considerably lower than Finland's. From an overall economic point of view the importance of the Danish CoE schemes thus seems limited.

Nevertheless, the importance of the scheme is higher than this figure indicates. Co-payments have reoriented other resources at the institutional level. Some CoEs have also been able to attract resources from other types of research council schemes, including the European Research Council. CoEs have become important actors in the education of young researchers at both the Ph.D. and post.doc. levels. Even more importantly, centres have become an increasingly popular organizational form within the university system, often creating tensions between centres and other types of organization. It is also noteworthy that the DNRF centres, which have prioritised visible leadership, seem to have influenced broader discussions on academic leadership. The DNRF leadership policy and experiences have been an important, if indirect lever for the leadership approach introduced in the 2003 university law.

Because CoEs are interdisciplinary to some extent, it is difficult to clearly determine the extent to which the CoE policies have contributed to changes in traditional balances in resource distribution between different research fields. There is however no doubt that the CoE schemes in general (and not only the strategic research centres) have been used strategically, in the sense that some research fields have experienced much larger increases in support than should be expected if we look at the overall distribution of public R&D expenditure. To illustrate this, 38 per cent of the DNRF centres are characterized as within the natural sciences (Danmarks Grundforskningsfond 2011), whereas natural science account for just 16 per cent in the overall national funding (Forsknings- og Innovationsstyrelsen 2011). There has been a discussion about the role of the social sciences and the humanities in the CoE policies; these fields still seem to be lagging behind the natural, medical and technical sciences, although this was even more marked in the past.

It is hard to conclude if there any clear signs of policy shifts relevant for the future of CoEs. Denmark has recently experienced a change in government: after 10 years of right-leaning governments a more left-leaning coalition, consisting of the Social Democrats, the Danish Social-Liberal Party and the Socialist People's Party, has formed a government. The former Ministry for Science, Technology and Innovation has been transformed into a Ministry for Science, Innovation and Higher Education, to be known simply as the Ministry of Education. This change in terminology may be primarily symbolic, but there does seem to be a shift towards giving educational policy a slighter higher priority than previously. In the government manifesto (Regeringen 2011), the government states that there will be investments in research and education, but the goals are much more concrete when it comes to education than in research policy. The government manifesto does reveal intentions to increase basic funding for the universities and concentrate strategic research funding in fewer areas. Budgets for strategic research have been slightly reduced in 2012 compared to last year, but whether this will continue is unclear.

Reflecting on signs of policy shifts, it has already been mentioned that according to the latest plans from DNRF CoEs will be established up until 2017, and the scheme will run out in 2026. On the other hand, there has been one injection of new capital into the DNRF in the past, and this could happen again. On the other hand, the government policy related to increasing basic funding at universities

could conflict with extra capital for the foundation. The conclusion at this stage must be that research policy, including CoE policy, is subject to uncertainty both due to the economic crisis and recent changes in politics.

2.3 Finland

2.3.1 Introduction

The current Finnish excellence policy in research largely revolves around the Academy of Finland Centre of Excellence Programme. The programme was launched in the mid-1990s, and started a new way of promoting excellence or scientific elites, based on research groups or centres instead of more traditional instruments focusing on individual researchers. It is currently the most important, and only national-level, instrument for promoting scientific excellence aimed at research groups or consortia. In the 2000s, new instruments related to excellence in research were added, in particular the Strategic Centres of Science, Technology and Innovation (SHOKs) and the Finland Distinguished Professor Programme (FiDiPro). The first of these focuses on promoting excellence with respect to the goals of the economy and international competitiveness. This chapter reviews the main policy aims and rationales related to excellence ideas, as well as key instruments for promoting excellence in Finnish research and innovation policy.

2.3.2 Promoting scientific excellence – the Academy of Finland's Centre of Excellence Programme

Background and policy origins

Discussions about promoting excellence in research have been on-going in Finland, with diverging emphases, since the 1960. In the 1960s and 1970s, the debate was dealt with mainly through individual researchers' comments but in the 1980s it became an increasingly prominent topic. At that time, a debate about the need to foster a "selective research funding policy" emerged. According to this view, the Finnish research system had been developed broadly as a whole during the 1970s and early 1980s, in order to do away with its backwardness, and, accordingly, this broad line of policy needed to be supplemented with a "selective policy aiming to generate top-level research" (STPC 1990, 46). In the early 1980s the so called basic research working group set up by the Ministry of Education argued that specific arrangements were needed in order to support very successful or scientifically promising projects. For this purpose, it proposed the establishment of specific units, for fixed terms, by the universities and the Academy of Finland (Ministry of Education 1980). Three such research units were indeed established in the 1980s (Pohls 2005, 461), and interestingly, and all three have been predecessors to subsequent CoEs in the same fields and universities:

- Collagen Research Unit, University of Oulu (Kari Kivirikko), established in 1982
- Department of Gene Technology, University of Helsinki (established in collaboration between the Academy of Finland, Sitra and foundations) (Leevi Kääriäinen), established in 1982
- Unit for Computer Linguistics, University of Helsinki (Fred Karlsson), established in 1985

Another working group established in the late 1980s emphasised the importance of grouping resources together into larger research entities, which it labelled "centres of excellence" (Ministry of Education 1989). The Science and Technology Policy Council also stressed the need to move towards "selective development" in research and the creation of "top-level units" soon after this (STPC 1990; 1993). Furthermore, in 1992 a working group that evaluated the activities of the Academy of Finland maintained that the Academy's funding should be channelled to fewer applicants and only to those of high quality (Heikkilä 2007, 308). In the late 1980s and early 1990s the Academy of Finland did start to focus on more selective research policies and in 1993 it underlined that it would channel increasing amounts of research funding to "top-level research" in different fields (Academy of Finland 1993).

The 1990s also saw a lot of debate about how to promote 'top-level research' and the ways that the 'centres of excellence' should be supported. An important part of this discussion took place in 1996, when the Ministry of Education asked academy professor Olli V. Lounasmaa to examine how research and education in the natural and engineering sciences should be organised. In his report, Lounasmaa (1996) strongly argued that 'centres of excellence' cannot be established via administrative decisions but rather "they create themselves". According to him, it is too often the case that 'an excellence unit' has been quickly established (in Finland and abroad) through administrative decisions, without properly setting goals and identifying competent leaders, which has led to very disappointing results after 5-10 years. He argued that, on the contrary, the correct model would be a slower way of establishing such centres, where promising researchers for future success are systematically sought after, and these identified researchers and his/her group should get substantial extra resources for 3 to 5 years. If, at that point, everything has gone as planned and results are good, then extra support should be continued.

The official centre of excellence policy started in Finland in 1994, when the Ministry Education nominated the first 12 centres. At first, the CoE nomination only gave the units the status of a centre of excellence: between 1995 and 96 there was no specific funding for the centres (Sihvonen 1998). This situation changed in 1997-99 as funding for the CoEs was channelled from the government's additional research funding programme, through the Academy of Finland. At that time, the CoE funding was directed to the host university which could use the funding as it liked. Normally the universities allocated around half of it to the CoE in question (Academy of Finland 1997, 14) while other parts of the funding were used for promoting new excellence units and researchers, for instance (Heikkilä 2007, 310). A national strategy for centres of excellence was prepared in 1997 and the first programme run by the Academy of Finland started in 2000. Originally it was estimated that there would be around 20 centres of excellence and that CoE-funding would form approximately 10-13 per cent of the Academy's overall research funding (Academy of Finland 1993).

The establishment of the CoE-programme was largely justified by the need to develop "creative research environments" as there were thought to be relatively few such environments in Finland in early 1990s (Academy of Finland 1997, 9; 2000, 3). This was related to the observation that across all scientific fields, in the social sciences and humanities to some extent and in technical fields in particular, the general trend was towards large and broader research units and research centres[7]. Although it was argued that the size of the research unit is not decisive in terms of quality, bigger units were seen as allowing larger groups of researchers to use common infrastructure and enjoy other benefits related to communication and interaction. It was therefore expected that these larger networks and centres might also be more prone to develop into creative environments. Furthermore, in terms of policy measures needed, it was thought that efforts to develop such environments in Finland would call for "open-minded measures and solutions in all parts of the research system". The broad geographical scope and diffuse nature of the university system were seen as particularly important challenges in this regard (also Lounasmaa 1996).

The CoE Programme in Finnish science, technology and innovation policy

Overall, the CoE programmes can be seen as a part of a continuum of the Academy of Finland's research funding instruments, where the key idea has been to move towards larger entities and a more systematic approach. The first attempts in this direction were the nomination of 'focus areas' for research (*tutkimuksen painoalat*) starting in the 1960s and 1970s. These were largely defined on the basis of societal and socio-political view points, and dealt with topics in the 1970s such as environmental research, national health, democracy and equality, working life and work conditions etc. The main aim of these was to move from funding based on individuals towards funding for larger research entities, bigger research projects and a greater concentration of resources (Pohls 2005, 578).

[7] This largely explains why there were so many large "umbrella organisations" among the first centres that were appointed in 1995 and 1997. These included the biocentres in Helsinki, Oulu and Turku and the Digital Media Institute of Tampere University of Technology.

In the 1970s the Academy's main aim was to increase project-based funding with focus areas, research contracts and collaboration groups as the main instruments. In the late 1980s, the Academy launched a new instrument, the research programmes. These are still run today, are thematically restricted and differ from the CoE programmes also in the sense that the projects do not necessarily need to be at the international top-level (Heikkilä 2007, 301). In the middle of 1990s the directed calls (*suunnattu haku*) which were 'mini research programmes' were introduced, and, as mentioned above, in 2000 the Academy's first CoE programme started (the 1995 programme was run by the Ministry of Education).

Interestingly, it has been argued that 'excellence', and other related criteria such as quality, creativity, internationalisation, opportunities for scientific breakthroughs, all emerged as a key criteria for research funding decisions in Finland in the 1980s (Pohls 2005, 581). Prior to that (in the 1970s) the content of research had been the most important criterion, as the focus was largely on research that was societally and socio-politically relevant. In the 1980s, priorities were thus increasingly set based on the international quality of research, not with respect to its relevance in terms of societal problems facing the Finnish society. The quality of research was thus emphasised and, as a result, the role and discussion about research evaluation became more concrete and increasingly important.

Taking a broader perspective on Finnish science, technology and innovation policy, the start of the CoE programmes fell in a period where technology policy had been strongly reinforced during the 1980s and 1990s (e.g. Pelkonen 2008). This included the establishment of Tekes - currently called the National Funding Agency for Technology and Innovation - in 1983, and which received growing funds from the state budged, rapidly exceeding those of the Academy of Finland. Overall, these changes implied an increasing importance and a stronger position for technology policy with respect to science policy throughout the 1980s and 1990s. This tendency was further strengthened with the adoption of the national innovation system approach as a key science and technology policy framework in 1990. In light of this increasing 'technologisation' of Finnish science policy in the 1990s, the CoE programmes – seem to represent a countervailing force to some extent, due to their emphasis on quality and basic research, and lesser focus on application and commercialisation (cf. Kolu 2003).

The start of the CoE programmes also coincided with a substantial increase of public R&D investments in Finland. Following the economic recession of early 1990s, the Finnish government made a decision in 1995 to provide an additional research funding programme which increased the public R&D funding by 500 million euros between 1996-1999. Over half of this additional funding was directed to Tekes, but around 20 per cent was channelled to the Academy of Finland and to strengthening the CoEs (Prihti et al. 2000). This followed the policy line where research funding was to become increasingly competitive, as increases in state appropriations for research were mainly directed to the funding agencies (Tekes and the Academy of Finland) (see e.g. Nieminen 2005).

Overall, the turn towards more competitive research funding has indeed been a major policy thread in Finnish research policy throughout the 1990s and 2000s. The officially stated aim has been to increase the quality of research, but it has also made the universities increasingly dependent on external funding, particularly that from the funding organisations. As a result of this funding system, universities' basic funding decreased during the 1990s compared to the number of students and completed degrees (Pelkonen 2008; also Hjelt et al. 2009, 56). In the 2000s, the universities' share of public research funding has been stable (around 27 per cent) and at the same level as Tekes' share (29 per cent) and considerably higher than the share of the Academy of Finland (16,9 per cent in 2011) (Statistics Finland 2011). The Academy's share has, however, been growing during the 2000s, which may also be reflected in the fact that the funding per CoE centre has been growing slightly in the same period (see table 1 below).

Another important contextual factor to consider was Finnish EU-membership in 1995, and the full participation of Finland in EU's research programmes. This has naturally tended to emphasize the importance of international competition and the related issue of high quality.

Early Criticism

The decision to implement CoE policies raised a lot of discussion and some fierce criticism. According to some sources, no science policy reform has generated as much discussion and resistance among researchers as the start of the CoE programme (Hjelt et al. 2007, 56). In addition to these academic circles, debate also took place at high political levels. Overall, the idea of selecting the 'best' research groups, and their prioritisation, received substantial critique in the 90s. It was feared that the funding channelled to the CoEs would be "taken away" from other research funding. Furthermore, critiques suggested the CoE policies would limit the scope of research conducted and that it would go against the principles of freedom of science (Ibid.). A discussion in Parliament in 1994 illustrates some of the arguments of the time: the opposition considered the decision of the University of Helsinki to channel additional funding to four research groups (named internal CoEs of the university) was against the principle of equality of opportunities (Varjo 2007, 245). It was also feared that the CoEs would be largely driven by market forces, and that the scientific quality would have a secondary role. Today, these kinds of criticisms have largely died down or disappeared.

Objectives

According to the original national strategy for centres of excellence in research, the aim of the centre of excellence policy is to "create preconditions for the development of high-level, creative and efficient research and education environments whose research can reach international top level and which also have societal importance" (Academy of Finland 1997, 22). In the strategy, the CoE policy was also linked to the broader goals of science policy such as enhancing the quality of Finnish research and promoting its international visibility, competitiveness and appreciation. It was also underlined that the CoE policy should enhance the training of professional researchers and high-level experts. Centres of excellence were seen as a mechanism to identify the best researchers in the country, as well as a tool for research organisations in their attempts to identify their strongholds and raise their own profiles. Overall, it was seen as way to foster the development of the whole national research system.

While being part of the national science policy, the CoE programme was also closely connected to the development of the national innovation system (NIS). As mentioned above, the NIS concept had been raised as the key concept for science and technology policy in 1990. In this framework, knowledge and knowhow were considered as the key components for fostering economic and international competitiveness in Finland. In this respect, the CoE policy needs to be seen as a part of this focus on economic objectives and international competitiveness (see e.g. STPC 1990; 1993). Thus, although the CoEs primarily focused on excellence in research, the objectives of economic and international competitiveness were present, underlying the scientific goals in the CoE programme.

It must be noted, however, that although the goals of the CoE policy have remained fairly similar, they seem to have shifted slightly over the years, or at least are expressed in different terms. Compared to earlier formulations, the current emphasis seems to be placed on promoting multidisciplinarity and collaboration. The stated goal of the CoE programmes today is to:

> "create favourable operating conditions for consortia of research groups and create potential for scientific breakthroughs. Aims also include promoting collaboration and the application of unconventional approaches at the interface of scientific disciplines and research fields. The CoE programmes further reinforce the use of research infrastructures, promote networking of the Centres of Excellence nationally and internationally, promote the societal impacts of research and raise the quality, international competitiveness, visibility and esteem of Finnish research." (Academy of Finland 2011a).

Originally, a centre of excellence was defined in following terms:

> "A centre of excellence is a high-level unit of research and research training with possibilities of reaching a leading position internationally. It consists of one or several research group(s) with high international level and clear common objectives. Individual top-level researchers may also be involved. Research units and researchers may focus on common research theme or problem or they may operate in neighbouring fields under an umbrella organisation. In the latter case, the unit is a centre-type excellence unit. In addition to the "excellence researchers", this type of centre may include also other internationally top-level units and researchers." (Academy of Finland 1997, 23).

Accordingly, it was originally anticipated that there would be two types of CoEs: smaller research groups focusing on a single research theme (units) and larger, more multidisciplinary entities (centres). The centre-type was seen to have several advantages. In particular, it was thought that such centres, consisting of broad and diverse groups of researchers, would provide methodological assets, facilitate the creation of larger research projects, make doctoral training more efficient, maintain competition and guarantee strict quality control (Ibid.).

It was also underlined that some of the centres may be more technologically oriented, and they should be evaluated not only in terms of scientific quality but also the utilisation of their research results in business and economic activities. This highlights the merging of the scientific and commercial objectives. Overall, however, the Finnish CoE programme seems to still be largely oriented towards science and basic research. For instance, compared to CoE programmes implemented in other countries, the peculiarity of the Finnish CoE programme seems to be that it is strongly focused on high-level basic research (including basic research in engineering sciences) (Kolu 2003, 163).

Implementation

Up to today, there have been six Academy of Finland's CoE programmes (including the first one in 1995 which was run by the Ministry of Education) (Table 1). A total of 115 centres have been involved in these six programmes. In practice, however, the number of different centres is clearly smaller, as same centres and groups have been involved in several programmes (see centre mapping). Currently, there is no limit for the number of terms one can apply to be a CoE, and there are three centres that have had the CoE status since the beginning up until today[8]:

- Metapopulation Research Group, University of Helsinki, led by prof. Ilkka Hanski
- Adaptive Informatics Research Centre / CoE in Computational Inference Research, Aalto University / Helsinki University of Technology led by Erkki Oja
- Low Temperature Laboratory, Aalto University / Helsinki University of Technology, led by professor Mikko Paalanen and professor Jukka Pekola.

It is currently stated, however, that if a CoE is applying for a continued term, and a new applicant is assessed as being scientifically equal to them, the new applicant will be given preference to become a CoE if it is not possible to appoint both. This is intended to support the dynamics of the programme. Table 1 shows that the number of new units (those that have not been involved in any of the previous programmes) has actually decreased over time.

The overall number of CoEs has also been dropping and the last programme, which started in January 2012, included only 15 centres (Table 1). This has raised substantial critiques from researchers. Several recognised Finnish professors, all currently working abroad, have argued that decreasing the number of CoEs cannot be explained by decreases in the quality of research; this implies that the CoE funding was taken from a number very high-level research groups, due to shortage of money rather than a shortage of suitable candidates (Kere et al. 2011). In light of this, they advised the Finnish science policy makers to look at, and imitate, the way top-level research is supported in other Nordic countries and in Sweden in particular.

[8] In 2006, a panel evaluating the impacts of Academy of Finland's research funding suggested that the number of terms as a CoE should be limited to two (Academy of Finland 2006, 33).

Table 2.2 Centre of Excellence programmes of the Academy of Finland

CoE programme	Applicants to the programme	Number of CoEs	Number of new CoEs[9]	Funding	Average funding / unit / year
2012 - 2017	135 (36 second round)	15	8*	For 2012-15: Academy: €45 million	€1 million*
2008-2013	113 (44 second round)	18	8*	Total: 56.3 million: of which KCL: €0.414 million Nokia: €0.15 million	€0.52 million* (variation between 0.27 and 0,66 / year)
2006-2011	143 (53 second round)	23	7*	Academy: €63 million Tekes: €4 million Nokia: €0.6 million	€0.49 million*
2002-2007	?	16	14*	Academy: €33.1 million Tekes: €5.3 million ** Other: €0.7 million	€0.36 million (variation between 0.18 and 0.55 / year)
2000-2005	166 (51 to the second round)	26	20*	Academy: €54.8 million Tekes: €10.8 million* Other: €0.7 million	€0.31 million (variation between 0.12 and 0.52 / year)
1995/97-99		17	17	1995-97 no funding	-

Source: Academy of Finland 2011a; Sihvonen 2008; Hjelt et al. 2009, 32; Academy of Finland 2010
*own calculation
* Tekes funding went to 11 CoEs.
** Tekes funding went to 6 CoEs.

The centres are elected for a term of six years and are nominated by the board of the Academy of Finland. The application process consists of two rounds and is based on an international peer-review process. CoE funding is normally granted for two three-year periods, so that the centre has to re-apply for funding for the second three-year period in the middle of the CoE period. The most important criterion in selection is the scientific quality of research. The main criteria used in selection are:

- scientific quality and innovativeness of the research plan
- feasibility of the research plan
- competence of the applicant/research group
- research collaboration and contacts
- the significance of the project in promoting professional research careers and researcher training

Other issues that are evaluated are: the applicant's position vis-a-vis international top level research in the field in question, the added value of the CoE activity and the significance and impact of the research for society and the economy.

The CoE funding is intended to provide favourable conditions and long-term funding for conducting top-level research for the selected research units. In the previous CoE programmes, the maximum Academy funding per CoE was €2 million for a three-year period. In the 2000-05 and 2002-07 programmes the average funding per unit per year was somewhat below €400,000 which is substantially less than in similar programmes in some other countries (e.g. the Netherlands and Switzerland) (Hjelt. et al. 2009, 58). On average, the Academy provided around 12 per cent of the total funding for each CoE in the second programme (2000-2005) and 16 per cent in the third programme (2002-2007) (Ibid. 33). However, there is great variation in this regard between the centres: at most, the CoE funding accounted for 51 per cent of a unit's total funding, while in some other units it

[9] This refers to CoEs that have not been involved in any of the previous programmes.

represented only 4 per cent of total funding (Ibid. 74). Overall, the CoE funding has had, in relative terms, a more important role in the smaller units' funding base than in those larger units with more staff.

Over the years, around 7 per cent of the Academy's yearly budget has been allocated to funding the CoEs (Sihvonen 2008) although in 2010 this share was somewhat higher (9 per cent) (Academy of Finland 2010, 16; Table 2). While the CoE programme is an important research policy instrument, its budget has been substantially smaller than other instruments such as the Academy's research project funding (Heikkilä 2007, 294). In 2010 for example, project funding accounted for 38 per cent of the Academy's research funding, and the funding for various researcher positions for 33 per cent (Table 2). Recently, the Academy has expressed a desire to increase the funding for CoEs (Academy of Finland 2011b). It is, however, unclear whether this will be possible in the current financial situation, where research and innovation funding has been cut under the Finnish Government budget, for the first time in decades.

Table 2.3 Funding decisions of the Academy of Finland in 2010.

Instrument	Million euro	Share
Research		
Academy projects	124	38 %
Research programmes	14	4 %
Centres of Excellence	30	9 %
International membership fees and collaboration agreements	21	6 %
Research environment		
Infrastructures	13	4 %
FiDiPro	11	3 %
Researchers		
Post-doc researchers	42	13 %
Academy researchers	23	7 %
Academy professors	6	2 %
Experienced researchers*	10	3 %
Research costs related to the researcher positions	27	8 %
Other		
Academy's administration and scientific associations	3	1 %
Total	**324**	**100 %**

Source: Academy of Finland 2010, 16.
*Varttuneet tutkijat in Finnish

It must also be noted that the units included in the CoE programmes are very diverse. For instance, in the 2000-2005 and 2002-2007 programmes the number of staff at the units varied between 20 and 140, while the units' yearly budgets varied between €0.7 and 8 million. Furthermore, the units' organisational structures are also very different: some are very compact units while others are network-based entities, which are shaped more like a research programme than a research unit (Hjelt et al. 2009, 40).

Some views on the impacts of CoE schemes on research activities

On the basis of the impact evaluation for the 2000-05 and 2002-07 programmes, the CoE programmes have had a wide range of positive impacts on the units' research (Hjelt et al. 2009, 29-42):

- *Size*. On average, the staff of units increased by 43 per cent during the CoE period. There is, however, great variation as in some units the CoE period has seen staff number rise to four times the previous amount, while in other units' staff numbers have decreased. The number of professors grew on average by 25 per cent in the 2000-05 programme and 18 per cent in the 2002-07 programme. The growth in numbers of post-doc researchers was still more significant: it rose by 80 per cent in the 2000-05 programme and by 130 per cent in the 2002-07 programme This implies a shift where post-doc researchers have growing responsibilities in research activities in many of these groups. The amount of foreign staff has also substantially increased.

- *Funding.* CoE status has brought other funding into units: the units have been successful in applying funding from Tekes and the Academy of Finland. Indeed, the largest share of funding that the CoE units have received from the Academy has come from other funding instruments and programmes than the CoE scheme (even though CoEs are not allowed to participate in some calls of the Academy). In general the CoE leaders felt that CoE status has had a direct and supportive impact on acquiring competitive funding, although, the scale of impact varies considerably between the units.[10]

- *Research content.* Long-term funding has enabled the development and establishment of new lines of research as well as the development and adoption of new methodologies. The possibilities for scientific risk-taking also increased. The opportunity to conduct "free research" is considered a significant asset of the CoE status and funding. Only very few units felt that the CoE status did not affect the content of their research. During the CoE period, the units also had scientific advisory boards which are thought to have been very useful and fruitful in terms of the unit's scientific development. Many groups have also become more multidisciplinary.

- *Research infrastructures.* In general, the CoE status has had positive impact on the premises and equipment provided by the host institution. In groups conducting experimental research, however, it was felt that more support would be needed.

- *Administration and organisation of research.* The CoE status has improved the management of research both at unit and group levels.

- *Recruitments and research work.* Recruiting has become easier after the CoE status. This hold both to undergraduate and graduate students as well as post-docs and experienced researchers, and in particular the latter.

- *Other impacts on research.*
    - International visibility among researchers has increased, to some extent.
    - The termination of the CoE period has been an important risk and turning point for research. At worst it may lead to the dissolution of the unit.

Overall, the centre of excellence programmes have been an important instrument aiming at concentrating resources in Finnish science policy and they have received broad support from different stakeholder groups. Their impacts appear to have been extensive, ranging across cultural and social, administrative and political, welfare, technological and economic impacts (Kolu 2003, 180). The evaluation of the 2000-05 and 2002-07 programmes was very positive, indicating that the major goals (creating preconditions for the development of creative, efficient and internationally top level research environments) have been "achieved excellently" (Hjelt et al. 2009, 9). According to the evaluation, the most important added value of the programmes has emerged through the improvement of the operational environment for top level research, as well as through researcher training (Ibid. 11). A panel investigating the impacts of the Academy's research funding also considered that the "cost effectiveness" of the programmes has been high (Academy of Finland 2006, 33).

There has, however, also been criticism towards the CoE programmes, with two major lines of critique. The first critique concerns size and resources of the programmes: the number of CoEs involved has been seen as too high and the amount of funding per each centre as too low. This argument has been raised both by evaluators (e.g. Hjelt et al. 2009, 58), an expert panel (Academy of Finland 2006, 33) and Finnish industry bodies (Confederation of Finnish Industries 2006). It has thus been suggested that the number of CoEs should be diminished and the funding for individual centres be increased. Change towards this direction has indeed taken place as in the latest programme, (starting in January 2012) there will be fewer CoEs and more funding per unit (Table 1 above). As mentioned above,

[10] The impacts in terms of EU and other international funding are not specifically discussed.

researchers have criticised the reductions in the number of CoEs, and argued that there are no scientific justifications for cutting the number of units (cf. Tirronen 2009).

The second line of critique concerns the selection process. Concern relate to the fact that differences between the groups ranked top in the evaluations are very small, and many groups get very high scores. According to some, the fact that only a small number of the good applicants then get CoE status stigmatises many more groups as "losers" (Nyman 2011). Furthermore, and perhaps more importantly, this has raised a lot of discussion about the criteria the Academy bases their final selection on. It has been asked, for instance, whether regional policy issues or personal contacts might have been involved in deciding between high ranked groups. For instance, in the evaluation for the 2008-2013 programme, 28 of the 44 applications in the final round were evaluated as belonging to the top 5 per cent in world research; as only 18 groups were selected, questions are raised about what grounds led the other 10 groups with high grades to be left out (Korhola 2006). It has been argued that the evaluation should have been made using expert panels, instead of individual expert evaluations. as the use of panels would have enabled a scientific prioritisation of applications (Thesleff et al. 2006; Thesleff et al. 2007).

Undoubtedly, the question of selection of CoEs is complex and difficult. On the one hand, the selection process should be relatively simple, easy and flexible. On the other hand, it should be transparent and sensitive to the specificities of different scientific fields, which inevitably leads to more complex processes (Hjelt et al. 2009). As CoE status has become very prestigious and desirable, it has been estimated that a majority of Finnish professors have now been involved in a CoE application processes: if the application process is time and resources demanding, the question of inefficient use of resources becomes very important.

2.3.3 Other instruments promoting excellence in research

Academy professor positions

Since its establishment, the Academy of Finland has had instruments to identify and support scientific excellence through individual researchers. The most important of these are the systems for academy professor positions and academicians of science. The latter of these is an honorary title that, according to current statutes, can only be held by maximum twelve Finnish scientists at any one time, and an unlimited number of foreign scientists. The academy professor positions are the most recognised and prestigious positions in the Finnish research system and these positions have been particularly important in promoting scientists that are in a productive phase of their careers (Alestalo 1996). In practice, many of the research groups that have been formed around academy professors have also been successful in competition for the CoE programmes (cf. Heikkilä 2007, 281).

The current system with the two positions dates from 1969 when the so-called new Academy of Finland was established. The "old" Academy had been only made up of the academicians of science. With the establishment of the new Academy, the position of academy professor was created and its goal was to provide good working conditions for talented researchers. As a consequence, a clear distinction was made between providing support for top-level researchers (academy professor positions) and rewarding distinguished scientists (academicians of science).

The position of an academy professor is intended for scientists whose research is at the international scientific forefront, the aim being to enable them to work full-time on scientific research. This acknowledges that most university professors' working time has to be divided between several tasks, in particular education, administration and research, instead of really being able to concentre on research. Academy professors are expected to contribute to the progress of science in their field and to the development of a creative research environment.

Originally, appointments of academy professors were made either for 5 years or permanently (Pohls 2005, 377). These appointments were made by the president of the republic. The long-running president Kekkonen, for instance, changed the proposed appointments a few times. Many professors

were appointed for several successive terms, and a share of the appointments were made permanent. During the 1970s, there was a debate about whether the positions should be fixed-term or permanent. In the 1980s and 1990s permanent appointments were rare. In the early 2000s the statutes were changed so that all appointments are for fixed terms of five years (Heikkilä 2007, 283-284). At present, only one term as an academy professor is usually possible, since appointments for a second term can only be made on the basis of exceptionally successful activities and a particularly competitive research plan.

The number of academy professors has grown steadily over the years: in the 1970s there were 15, in 1988 there were 21 and currently there are 42 academy professors (Pohls 2005, 361; Academy of Finland 2011a). Of the current 42 professors, 9 work in bio- and environmental sciences, 10 in social sciences and humanities, 13 in natural sciences and engineering and 10 in the area of health research. The funding for academy professor positions has been substantially increased throughout the 1990s and early 2000s (Heikkilä 2007, 279), but it still only accounts for 2 per cent of the Academy's research funding today (Table 2 above). During the 1970s and 1980s a majority of the academy professors were from the University of Helsinki and this university still dominates, with almost half of today's positions based there (Heikkilä 2007, 372; Academy of Finland 2011a).

Academy professors carry out their own research plan, supervise their own research team and provide guidance to junior researchers. Their duties also include supervision of thesis and dissertation preparation by students in their own field, and teaching related to their research. The position covers the salary of the academy professor and a research grant for their research costs, the salary costs of a research team, and costs related to national and international collaboration and mobility. Academy professors work at their host universities and, according to the new law of the Academy of Finland (20.11.2009), are also employed by the universities. Previously, the academy professors were employed by the Academy of Finland. This change has led to criticism from the scientists' side, as they see fear that their academic freedom may be in danger as the universities can set growing demands for academy professors as their employers (Suomen kuvalehti 2009).

The application process for Academy Professor posts has two stages. On the basis of letters of intent, the Academy's Research Councils decide whom they will ask to submit full applications. The full applications are reviewed using international peer review. Decisions are made by the Board of the Academy.

The positions are open to all disciplines with one exception: the Minna Canth Academy Professor position focuses on gender and equality studies (established in 1998). It will soon be accompanied by a new, similar professorship that the Academy has announced, a Martti Ahtisaari Academy Professorship in peace research and international conflict management (Academy of Finland 2011c).

Finland Distinguished Professors and Fellows (FiDiPro)

Finland's Distinguished Professors programme (FiDiPro) is intended to attract top-level researchers from abroad to come to Finland to conduct their research for a longer period than "normal" research visits allow. It is directed at both top-level Finnish researchers working outside Finland and foreign researchers. In practice, it is an instrument for Finnish universities and research institutes to hire top-level researcher from abroad for a fixed period of time. The FiDiPro professors are expected to be internationally highly merited researchers and have wide experience in researcher training (Academy of Finland & Tekes 2007).

The main goal of the programme is to strengthen the cutting edge of Finnish scientific research (STPC 2008, 23-24, 40). In addition to the promotion of scientific knowledge and knowhow, it also aims increase internationalisation of the Finnish research system, create novel international collaboration between research groups and companies' R&D activities, bring added value to the national innovation system, and support the research-driven profiles of universities and research institutes (STPC 2008; Academy of Finland 2011a). The programme is jointly funded by the Academy of Finland and Tekes.

The first FiDiPro call was opened in 2006 and first FiDiPro professors started working in January 2007. Overall, there have been 70 FiDiPro professors so far, of whom 35 have been funded by the Academy and 35 by Tekes. For the first 24 FiDiPro projects the budget was 17,5 million euros (Academy of Finland & Tekes 2007). The costs for one FiDiPro professor are estimated to be around 500,000 – 1,000,000 euros (Tekniikka & Talous 2007). FiDiPro professors work at universities and research institutes across Finland, in various disciplines from the humanities to medicine and engineering. The term of a FiDiPro professor is from 2 to 5 years.

In 2009, Tekes launched a new funding scheme, 'FiDiPro fellows', which focuses on attracting promising scientific talents in the early phases of their career, so they can establish themselves in Finnish research groups. Thus far there have been 11 FiDiPro fellows.

The application process for the FiDiPro programme is based on two rounds, and each application for a FiDiPro professor position must be made by a Finnish university or research institute. Applications can be made from all disciplines, but it is stressed that the proposed research projects need to be within the strategic key areas of the host university or research institute. The proposition has to include a project plan and an outline of the collaboration between the professor and the Finnish research teams and companies. It should also define how the cooperation will strengthen research excellence in the field. The competence of the proposed candidates and the excellence of the project proposals are evaluated by a panel of experts. The two funding agencies have slightly diverging emphases, as the Academy of Finland stresses researcher training in its evaluation, while Tekes requires active cooperation with companies.

The FiDiPro grant coves salary and travel expenses, research costs and related expenses for accompanying family members. FiDiPro professors may also bring along a key member or key members of their own research team, whose expenses may also be partially covered (Academy of Finland & Tekes 2007). The funding may also be used for setting up a research team.

While working in Finland, FiDiPro professors are expected to carry out, and actively advance, internationally competitive research and to strengthen Finnish research environments. The visiting FiDiPro researchers are always based at a Finnish university or research institute which also employs them. The FiDiPro professor is not allowed to work abroad for more than half of the FiDiPro period.

So far, the experiences of the FiDiPro programme have been positive (e.g. RIC 2011, 45-46). In many Finnish public research organisations, for instance in the Finnish Meteorological Institute, the programme is considered important. It is also argued that its indirect influence may be even bigger than its direct role in providing funding (Loikkanen et al. 2010, 72-73). In this sense, the programme plays an essential role in promoting the idea that foreign, top-level professors are needed and wanted in Finland, and thus can help change the whole working environment in Finnish research in this direction.

Support for participation in international schemes

The Academy of Finland has a support funding scheme for researchers who have been successful in the ERC Starting Grant and Advanced Grant calls, but have not eventually received the grant. The aim of this funding is to strengthen the competitiveness of the researcher and his/her project, and it is thus required that the researcher must go on to submit a proposal for the next available ERC call. This funding is for a maximum of one year and each person can only receive it once. In 2010, this support funding was granted for 3 researchers (2 advanced grant applicants and 1 starting grant applicant, with a total cost of 550, 000 euros) and in 2011, funding was granted for 9 starting grant applicants with a total cost of 1 million euros. The funding per researcher is normally 50 per cent of the average annual budget of the ERC application (around 90,000 – 120,000 euros) (Mattila 2011).

Universities' own excellence programmes and high-status research institutes

Some universities have their own centre of excellence programmes and other internal instruments for supporting top-level research. Currently, for instance, the Åbo Akademi University has internal Centres

of Excellence in research: in 2009, it elected four research groups that will obtain CoE funding from the Åbo Akademi Foundation for the period 2010-2014. The funding for these four research groups during the CoE period is 5 million euros (Turun Sanomat 2009).

The University of Helsinki also has had its own centres of excellence. These internal CoEs have been nominated twice, first between 1994-1999 and then between 1997-2001. In the University of Helsinki's strategy from 2000, however, it was decided that the internal CoEs are no longer to be nominated, but the university will instead focus on funding the CoEs that have been selected under the Academy of Finland's CoE programme.

In addition, some universities have established high-status research institutes to promote cutting-edge research. Examples of these include the Helsinki Collegium for Advanced Studies (University of Helsinki) and Turku Collegium for Science and Medicine and Turku Institute for Advanced Studies (University of Turku).

2.3.4 Promoting economic and international competitiveness through research - The Strategic Centres of Science, Technology and Innovation (SHOKs)

The idea of establishing 'internationally competitive centres in science and technology' was first put forward in 2005, in the Council of State decision-in-principle on the structural development of the public research system (Council of State 2005). The planning was then carried out by the Science and Technology Policy Council, which proposed the establishment of the Strategic Centres of Science, Technology and Innovation (SHOKs) as a new innovation policy instrument, in June 2006 (STPC 2006).

The establishment of the SHOKs has primarily been seen as a response to economic globalisation and increasing international competition. Furthermore, an important background factor has been the challenges arising from the transformation of economic and social structures, in particular those facing key Finnish economic sectors such as ICT, metal and forest industries. A third important dimension relates to the changes arising in the science and research world (STPC 2006, 2). The key idea behind the SHOKs is that, in order to be competitive in increasingly tight international competition, Finland has to make choices and concentrate its economic, human and other resources within entities that are scientifically and technologically high-level, large enough to attain critical mass and are internationally cutting edge (Ibid. 3).

Originally, the following goals were set for the SHOK activities (Tekes 2011a):

- Allocating limited national resources productively
- Developing closer cooperation between the business sector and scientists
- Creating world-class expertise and the critical mass required in strategically selected fields
- Generating knowledge that is new on the global level and making an efficient use of it
- Increasing the international pull of Finland to attract more international cooperation and funding

The objectives of the SHOKs were refined in June 2011 and at present the long-term goals of the SHOKs are defined as follows (Tekes 2011b):

- SHOK activities should create significant strategic knowhow that is important for Finnish companies internationally, in terms of future business.
- The activities should attract the best actors world-wide, and make Finnish actors desirable and central partners in this reference group.
- The activities should lead to results that can be commercially exploited to a significant degree although commercialisation as such is not part of the SHOK activities.
- SHOK activities and their results should have a visible impact for business, companies, the national economy and society.

- SHOKs should generate a comparative advantage for Finland in the international competition between innovation systems.

Currently there are 6 SHOKs in operation:

- Forestcluster Ltd. (first SHOK, established in spring 2007)
- CLEEN Ltd - Cluster for Energy and Environment
- FIMECC - Finnish Metals and Engineering Competence Cluster
- RYM Ltd - Built environment innovations
- TiVit - Information and communication industry and services
- SalWe Ltd - Health and well-being (thus far last SHOK , established in spring 2009)

Currently, the SHOKs are described as "cooperation platforms of a new type for innovative companies and spearheading research" and "networks of a new type that engage in intensive and long-term work to achieve shared goals" (Tekes 2011a). The SHOKs are organised as non-profit limited companies, whose shareholders consist of key companies, research institutes and universities in the area. Although the SHOKs have certain similarities with Tekes programmes, their organisational model means they represent a new kind of instrument. In particular, they have many features of governance networks, as they are characterised by strong interdependence between the actors, self-governance, relative independence from higher-level (state) authorities and an asymmetry of power (Lähteenmäki-Smith et al. 2011).

The activities of SHOKs are based on a strategic research plan compiled by the SHOK shareholders. The plan is implemented through research programmes and cluster projects. The research programme consists of work carried out jointly by research organisations and companies (Tekes 2011a). Research carried out by the SHOKs is intended to be strategic, pre-commercial and not associated with short-term market goals. The time span of SHOK research is usually is 5 - 10 years at least, and thus competitors may take part in the same programmes (Tekes 2011a). The actual research work is carried out in a virtual research organisation which can consist of units that are spread out around the country.

Tekes is the major financier of SHOKs' research programmes and projects initiated by companies. The Academy of Finland funds research carried out in the relevant areas for the SHOKs, which may then be connected to the SHOK programmes. Currently, around one fifth of all Tekes funding is allocated to SHOKs. In 2010, Tekes nearly doubled its funding for SHOKs, up to 99 million euros, accounting for 16 per cent of all Tekes funding (Table 3). Between 2008 and 2010 Tekes' funding for the SHOKs' research programmes was 175 million euros, while their total volume was 343 million euros. In terms of Tekes funding, the ICT-SHOK TIVIT and metal and engineering SHOK FIMECC receive the largest shares (with 36.5 per cent and 28.4 per centof total funding in 2010, respectively) (Tekes 2011c). It must be noted that Tekes funding for SHOKs is over three times the amount that the Academy of Finland invests in the CoE programme.

Table 2.4 Tekes' funding decisions in 2010.

Funding area	Million euro	Share
Grants to R&D and innovation activities in companies and public organisations	186	29 %
Loans to companies' development and innovation activities	155	24 %
Funding for SHOKs' research programmes	99	16 %
Research funding for universities and research institutes	193	30 %
Total	**633**	**100 %**

Source: Tekes 2011c

In 2011, the Federation of Finnish Technology Industries (2011) carried out an evaluation of four SHOKs (CLEEN, FIMECC, ForestCluster and TIVIT) from the companies' point of view. The evaluation was largely positive, finding that the SHOKs have been successful in being largely driven

by the companies' own agendas and aims. This implies that it is the SHOK firms who have been leading the definition of research activities. While similar views have recently been expressed by several observers there is variation in how this situation is interpreted and whether it is seen as positive or negative.

In the evaluation, the funding investments were considered to be "at least sufficient" in order to lead to world-class results but in order to be more efficient, the SHOK research programmes should have more focused objectives. In terms of top-level research, it was argued that the SHOKs do indeed generate world-class and 'better' research than has been done in Finland previously. Furthermore, SHOKs were considered to be a genuinely new way of operating, as the different actors and business ecosystems are really being brought together. The most important asset was seen to be the fact that things are done together in the SHOK consortia. It was also reported that the SHOKs have generated consortia across sectors that would not otherwise been created.

The most important concern raised about the SHOKs by many innovation policy actors and analysts is, however, the orientation of SHOKs. Many argue that the SHOKs have focused on more short-term research, while the original innovation policy goal was to focus on long-term strategic research. This issue was also referred to by the Federation of Finnish Technology Industries (2011, 6) who said that, from the companies' point of view, "the guidelines of Tekes have directed the SHOKs towards too large consortia and an *unrealistically long time span for capitalising the research results*". This extent of this tension varies between the SHOKs, as some of them are clearly carrying out more strategic and long-term research programmes. Another general critique has been - as referred to above - that the SHOKs have been mainly driven by the companies while universities and research institutes have had a smaller role and influence, leading to some critical views among universities.

Overall, the SHOKs have introduced a completely new element to the Finnish research and development scene, the impacts of which still remain to be seen. However, as a new instrument they do represent a new kind of thinking, geared towards larger entities and a longer-term, strategic orientation. As a growing amount of Tekes funding has been channelled through the SHOKs, they have changed and will continue to change the research funding landscape in Finland. The first official evaluation of SHOKs will take place in 2012.

2.4 Norway

2.4.1 Origin and precursors

The emergence of explicit policies for ‘excellence’ in research is of relatively recent origin in Norway. While policy to ensure and enhance quality may be seen to ubiquitous to research funding, in particular in schemes for competitive funding by research councils, distinctive policies for excellence, i.e., policies for generous, selective funding of the ‘very best’ researchers and research groups, may be seen to have developed during the last year of the 1980s and the first half of the 1990s, albeit with highly limited effect on overall research policy during this period. These developments took place as much in spite of, as in response to official research policy. The 1992-1993 White Paper on research (St.meld. nr 36 (1992-1993) *Forskning for fellesskapet*) did address the issue of balancing distribution and concentration of research resources (Ch. 6.2.3 Kvalitet eller bredde – eller begge deler?), and acknowledged the need for some areas where Norwegian research should take a leading, international role, while strongly emphasizing the distributive objectives. The main instrument for balancing the opposite concerns were then collaboration and division of work among research institutions, in particular in the HEI sector. This remains to this day a main approach to the balancing issue, as evidenced by the emphasis in present ‘SAK’-policies to enhance institutional collaboration, division of work and concentration within the HEI sector.

Centre for advanced studies

The first initiative that may be seen to have paved the way for the specific excellence policies that were put in place in Norway in the late 1990s and 2000s, was a proposal in 1987 to establish a Norwegian 'centre of advanced study', modelled on Princeton Centre for Advanced Studies, and argued in the terms of the superior quality of the best US universities, contrasting glaringly with the egalitarian Norwegian research policy, the average quality of Norwegian research in general, and the lack of opportunities in Norway for the very best to work under optimal conditions. It was established in 1992, its actual implementation being facilitated by the fact that the person who championed the idea, Gudmund Hernes, was appointed minister for research two years later. The centre remains in existence to this day, but as a quite small centre, and as an isolated case of its kind. It provides opportunity, in the form of seclusion from teaching and administrative task, for three high-level researchers and their foreign and national collaborators to work for one year on their research alone. It is administered by the Norwegian Academy of Science and Letters (DNVA), and is a rare example of a national research policy that is not managed by the Research Council of Norway (RCN).

Excellence in research: Top-level research programme, YFF, Centres of Excellence

A later initiative may, however, be seen to have pioneered more directly the track that led up to present excellence policy. This was an initiative by the sub-council for medicine and health within the Research Council of Norway for (more) long-term selective funding of the very best researchers. The idea of a programme for 'top-level research' was launched at a brainstorming seminar in 1993 and then developed further in several steps during 1994-1995 into a detailed proposal for a new research program. This led up to the decision by the medicine/health sub-council to establish the 'top research programme' in 1996, and to its effective implementation as a 5-year programme in 1998. Its ambitions were unrestrained, no less than achieving 'research of Nobel prize quality'. It is generally recognised that the main champion of this idea, professor Rolf Seljelid, effectively piggy-backed on the discourse of elite competition among sports performers at the time when that discourse was highly salient in Norway: in the period immediately preceding and during the 1994 Winter Olympics (Søgnen, 2003; Bladet Forskning, 2008). While it is generally acknowledged, the argument went, that competition at international top, Olympic level in sports is unquestionably elitist, it is not equally acknowledged that 'research as well is by nature elitist' (ibid. p. 12). While the top-level research programme remained during its six years' existence relatively small, it opened up a track that was succeeded by the centres of excellence scheme in 1999, and, even more directly, to the establishment in 2003 of a scheme for supporting 'Young excellent researchers' (YFF). The latter overlapped extensively both in their objectives and their structure with the top-level scheme, both targeting young researchers at a relatively early stage in their research careers. The YFF scheme eventually supplanted the top-level research programme, by which researchers in all academic fields became eligible for this type of support. While the YFF scheme is an integral part of the portfolio of key instruments to promote excellence in research, it was primarily through the CoE scheme that this track of elitist policy became a structurally important part of Norwegian research policy.

The idea of a centre scheme to promote excellence in research was launched in the 1999 White Paper on research (White Paper 1999/St.meld. nr 39). It was introduced as a 'follower' initiative, with the argument that similar schemes had already been in operation in a large number of countries, and experience indicated that 'these strategies have met with great success, often beyond expectations'. The scheme was implemented with the first call in 2001, and 13 centres were established in late 2002/early 2003. A second call in 2005 led to the establishment of another 7 centres in 2007. Also in 2005, the mid-evaluation of the extant 13 centres led to all getting their period as formal centres with RCN funding as such extended to the maximum ten years.

While the CoE scheme was launched in the 1999 White Paper on research, the CRI scheme – centres for research-driven innovation – was launched in the subsequent 2005 White paper. While the CoE scheme was based on models and experiences from several other countries (if Denmark's centre for excellence was often emphasized), the CRI scheme was explicitly based on the Swedish 'Competence Centres'.

Then, in a third step, the centre conception was applied within the context of the so-called 'climate agreement' between all political parties in 2008, when it was decided that R&D for clean energy and carbon capture and storage (CCS) would increase by NOK 600 million by 2010. As part of the implementation of the R&D strategy of the agreement, in all 11 Centres for environmentally-friendly energy research (CEER) have been established, 8 in 2009 and three in 2011, the latter for social science research related to energy. CEERs are, to all intents and purposes, CRIs within the specific thematic areas of R&D on clean energy and CCS.

Hence, the core of Norwegian policy to promote excellence in research by the establishment of centres encompasses three general schemes:

- Centres of excellence (CoE; Norwegian: Sentre for fremragende forskning, SFF)
- The Centres for research-driven innovation (CRI; Norwegian Sentre for forskningsdrevet innovasjon, SFI)
- The Centres for environmentally-friendly energy research (CEE; Norwegian: Forskningssentre for miljøvennlig energy, FME).

All schemes are developed and run by the Research Council of Norway.

2.4.2 Centres of excellence (CoE)

The idea of a centre of excellence scheme to promote excellence in research was launched in the 1999 White Paper (White paper, 1999) on research under the centre Bondevik II government. While a few single-standing schemes existed at that time to promote excellence in research by forming centres and/or long-term funding of the 'very best', the White Paper introduced what was to be called the CoE scheme, as the first systematic scheme for excellence in research in Norway. RCN was asked to design the scheme, drawing on international experiences. The report produced by the RCN indicated that while 'the scheme should apply to all research disciplines', it should 'to some extent' also be adapted to the official thematic priorities that were put forth in that White Paper (marine research, ICT, medicine and health, energy/environment), implying that at least one centre should be within each of the four priority areas.

The centres should, according to the RCN report, get an annual appropriation of NOK 10-20 million. Their maximum timespan should be ten years, on a five plus five model, according to which an extension beyond the first five-year period would be dependent on getting an appreciative evaluation after 3 ½ years. Host institutions in the HEI sector are expected to contribute to the centres' budgets, with extensive flexibility allowed concerning the sources, level or form (in kind, money…) of their support. The centres may mobilise additional resources from various sources, but – as the RCN report with the design of the scheme suggested – 'not regular project support from the Council'. However, 'activities funded by the Council can be included in the centre to strengthen its overall activity' (RCN, 2000: 9). In practice, these suggested limitations on RCN support to designated CoEs have not been implemented.

However, even before work on the RCN report on the scheme had started, the Government decided to establish one nominal 'centre of excellence'. This took place as the Government applied the new CoE concept that had been introduced in the 1999 White Paper a few months earlier to frame and justify its proposal put forward in the October 1999 budget proposal for the fiscal year 2000 to establish a centre for communication technology and software engineering the area of the closed-down Fornebu airport outside Oslo. This was part of a broader issue that had been the object of a highly resilient political conflict dating back as long as to 1996 about the use of the Fornebu area to establish a Silicon Valley type of ICT cluster. While the proposal was framed in the recently introduced 'centres of excellence' term the research institution that became in fact established differed in several respects from the 'proper' CoEs that would later be outlined in the RCN report on the scheme and subsequently established in line with its proposed guidelines. A main rationale of the new centre that was later to be called the Simula Research Laboratory, was economic/industrial, so it is in that respect closer to the

later CRI scheme than the CoE scheme. Its funding is much more generous than regular CoEs and CRIs: it received an initial core funding of as much as NOK 45 million in 2000, having since risen slightly to 49 million in 2011. It started, as the case would be for regular CoEs, on the basis of a ten-year contract with the RCN, extension beyond the first five years being contingent on a positive mid-term evaluation. But it has subsequently developed as a *de facto* permanent institution, as its initial ten-year contract has been extended when the first expired in 2010, and it has become host institution to one 'normal' CoE in 2006, one research school in 2007 and one CRI in 2010.

The CoE scheme as developed by the RCN was met with wide support within the research community, especially within universities, if some critical voices against the strong, inherent elitism of the scheme were also heard. The results of the first round of selections did, however, trigger much controversy, as it was claimed that 'political' criteria – in particular geographical and disciplinary distribution – had overridden purely scientific. This criticism had been taken into account in the second round of selecting CoEs, as these debates did not reappear at that time; in the meantime, however, the CRI scheme had been introduced, relieving the CoE scheme of the extra-scientific, applied objectives that had introduced complications in the first round.

21 CoEs have been selected,13 in 2002 and eight in 2006. The centres are awarded CoE status and funding for a maximum of ten years, the second five year period being contingent on a successful midterm evaluation after the first 3.5 years. So far all selected 21 centres have passed the mid-term evaluation and their period as CoE with centre funding from the RCN has been extended to the maximum 10 years. All centres are to some extent multidisciplinary. 6 are within life sciences, 4 within geosciences, 3 within humanities, 2 within social sciences, 4 engineering and technology, 1 mathematics (main field), and 1 has chemistry as main field.

There are no restrictions on the size of the centres or the additional funding the CoE may apply for/receive. The requirement and guidelines for the CoE scheme state that RCN and the host institution shall jointly contribute to the resources required. The size of the RCN funding, as well as the host's co-payments are based on the cost and funding plan of the CoE application. The annual CoE from RCN varies from NOK 5 to 20 million per year per centres. On average this account for 20 per cent of the centres income. Funding from the host institution accounts for 24 per cent on average. Many of the centres have large research funds apart from the CoE funding from RCN and the contribution from the host institution: The total RCN funding for the scheme in 2009 was NOK 239 million, whereas the total budget of the 21 centres was NOK 1176 million. The huge variation between CoEs in size and sources of additional income is shown in this table:

Table 2.5 CoE funding 2009, million NOK.

Centre	Total income 2009 (including transfers from 2008)	CoE funding 2009 (RCN)	Other funding from RCN 2009	Funding from host institution 2009
Center of Molecular Biology and Neuroscience, CMBN	156.2	20.8	40.5	35.1
Centre for Ecological and Evolutionary Synthesis, CEES	120.1	10.1	43.9	31.1
Centre for Cancer Biomedicine, CCB	102.4	11.1	12.5	6.7
Centre for Immune Regulation, CIR	94.9	11.0	9.5	26.5
Bjerknes Centre for Climate Research, BCCR	94.9	11.2	24.2	20.4
Centre for Integrated Petroleum Research, CIPR	74.8	14.0	13.3	12.5
Centre of Mathematics for Applications, CMA	67.6	12.0	4.8	20.2
Centre for the Biology of Memory, CBM	50.0	10.0	11.7	14.6
Cenre for Ships and Ocean Structures, CeSOS	47.6	10.0	1.9	10.3
Centre for Geobiology, CGB	43.2	15.3	8.4	15.2
Physics of Geological Processes, PGP	38.4	9.3	5.7	11.2
Center for Quantifiable Quality of Service in Communication Systems, Q2S	36.9	15.0	0.0	8.9
Center for Biomedical Computing, CBC	35.0	8.2	3.5	10.2
Aquaculture Protein Centre, APC	34.1	10.0	4.9	7.9
International Centre for Geohazards, ICG	31.7	14.0	0.0	6.0
Center for the Study of Civil War, CSCW	30.0	11.0	7.0	0.8
Centre for Medieval Studies, CMS	28.5	5.3	2.4	10.1
Centre for the Study of Equality, Social Organization, and Performance, ESOP	26.0	12.4	0.0	7.8
Centre for the Study of Mind in Nature, CSMN	23.9	8.6	1.5	12.5
Centre for Theoretical and Computational Chemistry, CTCC	22.3	11.1	3.3	7.9
Center for Advanced Study in Theoretical Linguistics, CASTL	17.2	8.6	0.0	8.7
Sum million NOK (21 centres)	1175.9	239.0	198.9	284.7
Per cent of total income	100.0 %	20.3 %	16.9 %	24.2 %

Source: RCN/Langfeldt et al. 2010.

In 2011 the total core funding of CoEs by the RCN is at NOK 248 million. The source of all core funding of CoEs is the RCN portion of revenues from the Research Fund, which amounts to about NOK 2 billion.

A key ingredient of CoE policy is the opportunity for and pressure on research groups to *reorganize and restructure*: 'The rational for [formålet med] establishing centres with long-term and generous funding is to provide research institutions with an opportunity to restructure their research groups [forskningsmiljøer] and develop new collaborative relationships, so that they may compete at the international level. Hence recruitment and international collaboration are key sub-objectives' (White Paper, 2009, p. 92). Thus, centres are larger and generally more interdisciplinary than 'spontaneously' organised research groups and projects, and graduate students and post.docs, often recruited from abroad constitute a main part of the researchers working in centres.

The evaluation of the CoE scheme in 2010 concluded that the scheme enables building strong research communities and that internationalization is strengthened through sponsoring international projects, senior researchers in part-time positions, guest researchers and generally increased funds for travelling. The excellence status is in itself important and helps securing additional funds and attracting highly qualified scholars and partners in a build-up phase. Moreover, the data indicated that the CoE scheme has led to increased academic competition and is likely to have lasting effects on work-sharing between the universities in Norway (Langfeldt et al, 2010).

There is no formal opening for any centre to have their centre period extended beyond the maximum ten years. This appears to be strictly upheld by the RCN. Hence, in 2012/13, the first 13 centres will be disbanded as formal centres with RCN funding as such. However, there is no formal limitation on centres continuing their activities more or less as established, albeit without the formal RCN core centre funding.

The 2009 White Paper established the CoE scheme as permanent, and a third call took place with deadline in June 2011. It is envisaged that new centres will be established by 2013 to replace the centres whose formal period as CoEs will expire at that time. As many as 139 pre-qualification

applications were submitted in that round, far more than in previous calls. The large number of applications has caused a delay in the procedure, as the selection of pre-qualified applicants has been postponed from Nov/Dec 2011 to February 2012. Between 15 and 30 pre-qualification applicants will then be selected and invited to submit full applications by April 2012, extended from the initially envisaged deadline in February.

2.4.3 Centres of research-driven innovation (CRI)

As with the CoE scheme, international models and experiences were instrumental in the process by which the CRI scheme, a scheme for supporting long-term innovation-oriented research, was established. The first ideas were discussed in 2002/2003, a report on international models was commissioned in 2004, written by Technopolis Ltd, the idea was discussed with stakeholders in research institutions, companies and ministries in late 2004, and the proposal to establish the CRI scheme was formally put forward by the RCN to the Ministry of Education and Research in early 2005 as part of its input to the next White paper on research. The proposal was supported by the Government and included in the 2005 White Paper published in March 2005. It was introduced as an instrument to stimulate innovative capacity in Norwegian companies through long-term, fundamental research performed in collaboration between research institutions and the companies. High standards of scientific quality as well as innovation relevance would be required to be eligible for support. Distinctive for the CRI scheme, the White Paper emphasized, is that it 'is targeted at the more research-intensive part of Norwegian companies'. Co-funding with companies would be required. The experiences from the development and implementation of the CoE loom in the background: 'The scheme will require extensive involvement from private companies, but is otherwise quite similar to the scheme for centres of excellence' (White Paper, 2005, p. 99). The explicit model for the CRI scheme is the 'Competence Centre' scheme, in particular the one in Sweden (VINN Excellence Centres).

CRIs have shorter time-spans than CoEs - five plus three years, where extension beyond the initial five years is contingent on favourable mid-term evaluation. There is no formal opening for extending the period of support beyond eight years. CRIs by requiring a formal connection to innovation and industrial users, one of the scheme's main objectives being to stimulate private long-term investment in R&D, and to make it more attractive for foreign companies to locate R&D activities in Norway. Research excellence remains, however, a main selection criterion. Host institutions of CRIs may be a research institution, i.e. either a university, a university college or an independent research institute, or a research-intensive company. The host institution is required to contribute to the funding of the centre, contributions from companies and host institutions need to add up to at least 50 per cent.

The CRI scheme is different from the CoE scheme in specifically targeting the knowledge needs of private companies, aiming to increase research collaboration between strong research groups and research-intensive companies. The CRI scheme also borders on, but is different from the Centre of Expertise scheme (run by Innovation Norway, not the RCN). The objective of the latter is to support industrial clusters with international ambitions, with research and research institutions in a less prominent role.

21 centres have been established after two calls, one in 2006 (14 centres, start-up in 2007) and in 2010 (7 centres, start-up in 2011). A highly positive mid-way evaluation of the first 14 centres was performed in late 2010 by a panel of international experts.

The total core funding of CRIs by the RCN is in 2011 at NOK 180 million, all from the revenues of the Research Fund.

2.4.4 Centres for environmentally-friendly energy research (CEER)

The CEER scheme is basically the 'application' of the CRI scheme applied and adapted to the field research for environmental-friendly energy. All political parties, except the Progressive Party, agreed in 2008, following the debate on a White paper on climate policy, that annual appropriations for research for renewable energy and carbon capture and storage should increase with NOK 300 million

in 2009 and NOK 600 million by 2010. A national research and innovation strategy, Energi21, had argued that Norwegian energy research should be strengthened and become more focused. Referring to the positive experiences with the CoE and the CRI schemes, the RCN proposed that a centre scheme should be a key part of policy to strengthen the research affected by this unusually strong political initiative. Such schemes were deemed appropriate to achieve the necessary critical mass and long-term scope of research to achieve 'the ambitious goals' of the initiative, and would create international visibility and attract researchers as well as research resources.

As CoEs and CRIs, CEERs will have a time-limited mandate – five plus three years, where extension beyond the initial five years is contingent on favourable mid-term evaluation. There is no formal opening for extending the period of support beyond eight years, and personnel connected to the centre are expected to return to their positions in the host institution on dissolution of the centre. CEERs are similar to CRIs by requiring a formal connection to innovation and industrial users, one of the scheme's main objectives being to stimulate private long-term investment in R&D, and to make it more attractive for foreign companies to locate R&D activities in Norway. Research excellence remains, however, a main selection criterion. Assessment of relevance to innovation is made on the basis of priorities designated by the Energy21 strategy: energy efficiency, climate friendly power (including bioenergy), carbon neutral heating, an energy system for the future, framework conditions and social analysis, CCS, environment friendly transport.

While the CEER is innovation-oriented, insofar as reaping societal and economic benefits from research and technology development is a fundamental rationale for the scheme, it is nevertheless a framework for supporting research: the host institution must be a research institution, i.e. either a university, a university college or an independent research institute. The centre should be an integral part of the overall research strategy of the host institution. Within the framework of the centre, the host institution will generally collaborate with several partners, research partners as well as 'user partners', which may include both companies and industrial partners (company partners) and public institutions. Each centre is expected to have more than one user partner, and including international companies in the consortium as user partner is an asset. It is stated that 'it is primarily the companies, other industrial enterprises and public institutions participating in the centre's activities that will reap the benefits of the centre's research activities'. To be in a position to do so, the user partners must take active part in the research of the centre, conduct extensive innovative activities and have the capacity to make use of advanced research. Innovative output of the centre's research may also be start-up research-based companies. Both centralised and decentralised, network-based organisational models are eligible.

CEERs are explicitly compared to other schemes, indicating that they are modelled on the CoE and CRI centres, but thematically restricted to the areas indicated above. It is also compared to another instrument for industry-relevant research support – large-scale Knowledge-building Projects with User Involvement, the main difference being that the latter are more limited in time and resources.

Following the first call and a comprehensive two-step selection procedure in 2008, eight centres were selected for funding in February 2009, one of which started up in 2010 first. NOK 66 million were committed for 2009, later expanded with another NOK 30 million for infrastructure for the centres. Two centres are within CCS and offshore wind each, one is in bioenergy, one in solar energy, one in energy systems development and in effective heating. The centres have from 5 to 19 user partners, and on average 5-6 research partners. The host institution are universities for two centres, while the remaining six have research institutes as host institutions, three of which are hosted by SINTEF Energy and two by Christian Michelsen Institute.

The aggregate budgets for support from RCN to the scheme were in 2009 NOK 95 million, rising to around NOK 150 million in 2010 (source: annual reports). In a second round of call in another three centres for social science were established in 2011, which will 'do studies on the interaction between technology and society' and fall under the framework conditions and social analysis priority in the Energy21 plan.

In late 2011 a new centre for research on 'climate dynamics' (SKD) was established, 'on the basis of' competence built up under one CoE for climate research, Bjerknessenteret in Bergen. Bjerknessenteret was one of the initial 13 CoEs that started in 2002/2003, and was now facing the prospects of imminent disbandment in 2012. The SKD is then a hybrid type of centre. While it belongs within the framework of the research strategy of the 2008 climate agreement, it is not a CEER – it will do R&D on climate, not on clean energy or CCS, as CEERs do. Nor is it simply an extended CoE. Its financial conditions differ from those of both CEERs and CoEs, being both more generously funded and more extended in time than either: it will have an annual appropriation of NOK 20 million for a period of 12 years. The establishment of SKD is 'a Kinderegg of research policy', stated the minister for research and higher education Tora Aasland at the formal opening of the centre in November 2011, combining 'research quality, global challenges and internationalisation'. The government has been criticised for not having increased appropriations for climate research, as proposed by the so-called Climate21 strategy. The minister sees the SKD centre as a partial response to this criticism (Forskningspolitikk, no 4, 2011).

The total core funding of CEERs by the RCN is in 2011 at NOK 140 million. While core funding of CoEs and CRIs are from the revenues of the Research Fund, core funding of CEERs is budgeted by the Ministry of Oil and Energy.

The total core funding of the three types of centres (excluding the Simula Centre) amounts, then, to NOK 580 million in 2011. All core funding of centres is by the RCN, amounting to about 8,5 per cent of the total RCN budget for 2011. Core funding of centres have become sizable parts of main budget items in the huge RCN budget, which is about 30 per cent of all public funding for R&D in Norway, and is sused to support a wide variety of R&D activities:

Table 2.6 CoE RCN budget 2011, million NOK

Instrument	Budget
Research programmes	**3 375**
User-oriented (industry)	1 000
Action (policy) oriented	895
Large programmes	1 300
Project support	**785**
Responsive mode support	520
Young researchers	30
Infrastructure and institutional support	**2 080**
Institute core funding	880
CoE/CRI/CEER	580
Equipment	335
Network support	**465**
Other	**285**
Total	**6 990**

Source: RCN 2011.

As the table above indicates CoEs received in 2009 almost as much other funding from RCN as core funding. We do not have the same information on additional funds of CRIs – from the RCN, host institutions and other sources. The formal rules require that host institutions and company partners contribute at least 50 per cent of the total budget of CRIs, and companies have to contribute with at least 25 per cent of the total. Hence, it is stipulated that each CRI will have a total budget of NOK 20-30 million. According to the financial rules of CEERs, the maximum RCN appropriation is 50 per cent of the total budget, and company partners should contribute with at least half as much as the RCN. As the annual core RCN funding of CEERs may vary between NOK 7 and 20 million, total budgets for individual CEERs may vary between NOK 14 and 40 million.

2.4.5 Other instruments to support research excellence

We have seen that the Norwegian centre model(s) have emerged within a context of related instruments. As a form of REI type of support which lies between or also amalgamates both project and institutional funding, centres borders on, on the project side, schemes for project support, in casu responsive mode support (FRIPRO) and support for Young, excellent researchers (YFF), and, on the institutional side, policies for enhancing institutional collaboration, division of work and concentration ('SAK policies') within the higher education sector.

Responsive mode support

The FRIPRO scheme under the RCN is an open, competitive arena for project support for basic research, based on scientific quality as primary or 'decisive' criteria (the FRIPRO web page). The scheme is based on strict bottom-up procedures, as FRIPRO support is not, in principle, contingent on any form of thematic nor organizational constraints, thus making this type of support different from programme and centre support respectively. However, some minimal organizational constraints have emerged within this traditional responsive mode research council support as the division of responsibilities between research institutions and research council have evolved over the years in a direction where the first are expected to assume responsibility for run-of-the-mill needs of day-to-day research by the institutions' own researchers and research groups, while national support from the research council is seen appropriately reserved for the support of ambitious, large and long-term projects. Nevertheless, no pre-set organisational or size criteria apply to projects eligible for responsive mode support, and the institutional dimension of these projects is – despite the fact that the institution of the applicant must approve submission – weak, making this type of support different in principle from what has been described as REI support (see chapter introduction).

While the low success rate of applications within this extremely competitive scheme have been an almost inherent concern connected to this scheme for several decades, these concerns have been increasing during the last years. The causes for this are not quite clear, relevant factors are less increase in resources for the scheme relative to other, related schemes and/or total competitive funds for research and to the increases in researchers, i.e. potential and actual applicants. The fact remains that success rates are presently extremely low. The last available numbers for FRIPRO support (2012) indicate a success rate for applications of 8.5 per cent and for resources applied for of 7 per cent (source: FRIPRO web page). These figures have remained more or less at this very low level over a number of years, and they have been the object of strong criticism from the basic research community, voiced in terms either of low overall growth in resources for research, of the diminishing proportion of responsive mode by the RCN relative to programme funding, or of redistribution of resources within basic/university research itself, partly due to the establishment of the CoEs, due to the core funding as well as their competitive advantage within FRIPRO and other RCN funding schemes. In response to this criticism, the Government increased its earmarked appropriation in 2011 for the FRIPRO scheme by NOK 60 million, raising the total FRIPRO budget in 2011 to NOK 520 million, and it increased this appropriation by another NOK 100 million in 2012. As the HE institutions have committed to setting aside in 2012 a matching budget of NOK 100 million in 2012 for the 'almost successful' within their institution in the FRIPRO competition, total available funds for FRIPRO competitors will in 2012 be NOK 720 million (the success rate numbers above for 2012 do not include institutional funding).

However, the increased FRIPRO budget in 2012 will also be used to fund 'almost successful' applicants for the Starting Grants scheme of the European Research Council. While five Norwegian applicants succeeded in getting a ERC Starting Grant in 2012, part of the FRIPRO budget will be set aside for funding up to 75 per cent of the sum applied for of 13 applicants to the ERC scheme that 'would have received ERC funding if the budgets had been large enough' (from the FRIPRO web page). Hence, 13 out of 83 new projects in 2012 under the FRIPRO scheme are 'number two' ERC applications.

A shift may be seen to have taken place during the last years in funding policies for basic research. One the one hand, the Coe funding that have grown during the first decade of the second millennium through two rounds of centre establishment is now under consolidation, as the third round of Coe establishment from 2013 will be funded by the formal disbandment under the RCN Coe scheme of the CoEs established in the first round in 2002-2003. On the other hand, the traditional responsive mode funding under the FRIPRO has become a high political priority, and will get an increase in funding even at a time when overall Government funding of research is stagnating or levelling out, as it does in 2012.

Support for excellent young researchers (Yngre Fremragende Forskere, YFF)

This scheme was introduced in 2003, its aim being to provide young, talented researchers with opportunities to develop 'research of world class quality'. The objective of the scheme is to provide 'young, talented researchers within all academic fields with an opportunity to work under particularly good conditions [ekstra gode rammevilkår], so that they may achieve international top class' (from the YFF web page). The YFF scheme was established as heir and follow-up to the top-level research programme that had operated under the medicine and health during the preceding years (see above). This scheme differs from both the centre model and the responsive support scheme by explicitly and exclusively targeting individual researchers, and focus on young and promising researchers as future leaders of research.

To be eligible, applicants should hold a PhD degree no older than eight years. Projects normally get an annual funding of NOK 2.5 million over a period of four years. The scheme is small in resource terms. There have been two calls only – one in 2003 and one in 2006, with a total annual budget of NOK 20 million and NOK 40 million respectively. The RCN suggested in its budget proposal for 2010 that a third call be announced that year, but the proposal was not supported by the Government.

SAK – Coordination, division of work and concentration

While the FRIPRO and YFF schemes address research groups or individual researchers and have a weak institutional dimension, a new scheme was introduced in 2009 to enhance quality, effectiveness and concentration at the specifically institutional level – the so-called SAK scheme to support initiatives to increase collaboration, national division of work and specialisation between HE institutions, and hence, to stimulate concentration of resources in institutions on research and teaching activities that are of sufficient critical size to gain viability, quality and attractiveness. It was introduced as a bottom-up 'voluntary' alternative to the immediately discarded proposal in a committee report from 2008 for an orchestrated, top-down, political reorganisation of the HE sector. The general issue takes its point of departure from the consensus that Norwegian higher education and academic research is highly fragmented, resources being too widely dispersed among too many too small institutions, departments and research environments.

The SAK scheme has been operative in the 2010-2012 period as a small annual budget of NOK 50 million distributed on the basis of project applications from individual or consortia of HE institutions to establish formal and informal collaboration, enhance leadership and develop strategies in both research and education. The SAK scheme is in itself an indication of the 'soft approach' in Norwegian higher education and academic research policy to achieve critical mass, concentration and 'excellence' at the institutional level. It remains to be seen whether and to what extent support under the scheme has amplified strategic initiatives by the institutions themselves.

2.4.6 Concluding remarks

Explicit policy for excellence in research emerged late and slowly in Norway. Initiatives in that direction were taken in the late 1980s and early 1990s. However, with the introduction of the Centre of Excellence scheme in 2001, and the establishment of 13 CoEs in 2003, this started a development by which excellence policies in general and centre policies in particular became an integral and structurally important part of Norwegian research policy. The introduction of the scheme was met with wide support, and less resistance than could have been expected, given the traditional notion of

Norwegian research policy as overly emphasizing equality and distributive objectives in research funding. While the CoE model emphasized excellence by purely research criteria alone, it was effectively implemented in Norway as a mixed or hybrid model, combining both research excellence criteria and alignment with thematic priorities and applied objectives. This hybridity became less salient in the second round. Important characteristics of the centre idea, distinguishing it from any other instrument in the extant policy portfolio, were the emphasis on highly generous, long-term funding as well as on size. Centres were expected to be something new, different and larger than average research group and normal research projects. Restructuration, up-scaling and international visibility (and attractiveness) were integral to the model, adding dimensions to the notion of research excellence as such (as already embodied in, for example and in particular, the responsive mode scheme).

The role and impact of the centre model in Norwegian research was considerable expanded with the introduction of CRI scheme in 2005. While the foreign models on which it was based, and justified, were other than those of the CoE scheme, and the overall objectives were different, as innovation and collaboration between public research and industry was a *conditio sine qua non* for eligibility, experiences with and the success of the CoE scheme shaped the design and implementation of the CRI scheme.

Both these schemes were made possible, or facilitated, by the Research Fund, which was established in 1996 and, due to several sizable capital instalments during the following years, made sizable funds available for new ideas and initiatives in Norwegian research policy, in particular during the first half of the 2000s. As the Climate Agreement in 2008 created new impetus for growth in governmental research, now independently of and in addition to the Research Fund, the centre model became even more strongly entrenched in the Norwegian research system as the CEER scheme was established by applying the CRI model within the areas of clean energy and CCS research. The long-term viability and strong structural embedding of the centre model in the Norwegian research system may be seen to be confirmed by recent developments: the 2009 White Paper made the CoE scheme a permanent part of the instrument portfolio; new CRIs will be established with earmarked Government funding in the 2012 budget; and a soon to be disbanded CoE within climate research was in November 2011 transformed into a new type of centre for 'climate dynamics', in the terms of addressing one 'global challenge', i.e., climate change.

Hence, the centre model has become an entrenched part of the Norwegian policy portfolio, with a relatively stable definition, if applied within different areas. The fact that all the varieties of the centre model has been designed and implemented by one single organisation, the Research Council of Norway, may be seen to have made it a coherent model and ensured that it has been uniformly put into action.

Research excellence is a necessary condition and strongly emphasized criterion for being accorded status as centre, but several additional aspects and objectives apply as well, not only for the CRIs and CEERs, where applied objectives are essential. Even for CoEs, additional objectives apply, such as restructuration and size, as well as international visibility and attractiveness. By being able to operate under extremely favourable conditions compared to other researchers and research groups, the centres are in a position to exploit the 'Matthew principle' dynamic inherent in research, and attract huge amounts of additional resources beyond their core centre funding. While the direct core funding of centres by the RCN was at nearly NOK 600 million in 2011, amounting to around 8.5 per cent of the overall budget of the RCN, and merely 2.5 per cent of all national public funds for R&D, the total public funds controlled by centres are far higher, often as much as by ten times (Langfeldt et al, 2010, p. 19). Funds from their host institution and other RCN funding were for a large number of COEs higher than their core centre funding (ibid). The funding structure of CRIs seem to be less skewed towards extra funds, but at least for the CoEs the conclusion seems warranted that they have a strong redistributive function in the Norwegian research system.

This may be a main reason why protests have emerged, and increasing concerns raised about the limited funds available for responsive mode funding by the RCN. Such concerns were raised in a 2007 report by the Norwegian Academy of Science and the Letters (DNVA, 2008) with the effects of the COE scheme on other research, in particular as a consequence of mandatory co-funding of centres by their host institutions. This effect may have been enhanced by the fact that 'silver medalists' are often offered funding from their host institution, despite being 'unsuccessful' in the national competition. The 2009 White Paper quoted from the Academy report, and acknowledged the validity of the concerns expressed, stating that 'centre formation is not appropriate for all research. Excellent research is in many disciplines produced by single researchers or small groups. To stimulate this type of high quality, responsive mode funding (fri prosjektstøtte) is the most appropriate form of support' (p. 104). While the same 2009 White Paper declared the CoE scheme to be a permanent part of the policy instrument portfolio, increased funding of the scheme is not envisaged within the policy announced by this White Paper. The last two years has instead seen a considerable increase in the funding of the responsive mode support scheme of the RCN: an increase of NOK 60 million in 2011, and of NOK 100 million in 2012, complemented by an additional increase of NOK 100 million from the university budgets. Hence, a rebalancing seems to be taking place between various RCN instruments for research excellence.

2.5 Sweden

2.5.1 Policy evolution 1980-2011

Policies for centres and large constellations of researchers were rare in Sweden until the early 1990s. A few initiatives were indeed taken, for instance the 'Interdisciplinary Materials Consortia' incepted in the 1980s jointly by the Natural Sciences Research Council and the Board for Technical Development. The sectoral research agencies (in areas like construction, housing, social affairs, work safety, environment, and so on) also supported large research constellations, however less with the intention to foster strong research environments and more with the intention to develop 'research stables' working on 'relevant knowledge' – i.e. a form of quasi-research institutes. Such initiatives notwithstanding, concentration of research resources was primarily achieved via professorial positions with additional support from the research councils.

A slow change towards a new mixture of research funding instruments began in the mid-1990s. While the mix of a small number of fully funded professorships with adjacent research council funding seemed sufficient to secure concentration and excellence in research, critical voices were raised that Swedish research had to be reinvigorated (see for instance research evaluations done in the 1990s by the Natural Sciences Research Council; NFR 1995). Research funding was seen as too incremental, with an overly strong focus on continuous support to relatively small groups working in traditional fields of investigation, whereas constellations with a more risk-taking approach were not adequately supported. The critique emanated from international reviews of Swedish research, but was well in line with a change in research policy discourse and practice. The economic crisis of the early 1990s fostered a reorientation of research funding towards larger constellations with a parallel orientation to research excellence and industrial innovation. One of the flagship initiatives of this new research policy regime was to channel large amounts of resources into research, but not via the faculties or the research councils but rather through research foundations. Their focus would not be on disciplinary research or on research in smaller constellations. Instead, large-scale programmes should be established, with an international orientation and with dense industrial contacts. Hence, centre programmes were part of a structural transformation of the economy where new academic-industrial constellations were identified as harbingers of a knowledge-based economy, and where such constellations would reinvigorate Swedish universities and Swedish research more generally.

An early formulation of policies for 'excellent' or 'strong' research environments in Sweden came with the inception of the family of Research Foundations in the early 1990s (founded on the basis of the

capital of the so-called wage earner funds that were dismantled in 1992). The Foundation for Strategic Research (SSF) – the largest of the foundations – set out, in its own formulation, to support 'research environments of the highest international standards' conducting research at the 'absolute cutting-edge' (Benner & Sörlin 2007). As indicated, one aim was to concentrate resources to a select number of 'research environments' rather than in the form of distributed research grants. Another was to create bridges between the environments and high technology-based industry. The implementation of these grand ambitions proved to be more difficult for SSF, and the foundation instead utilized a variety of support forms, primarily national networks for PhD training – hence, their impact on resource concentration was limited.

A more successful initiative to enhance resource concentration was incepted by NUTEK (The National Board for Technical and Industrial Development). NUTEK, inspired by the US National Science Foundation's programme for Engineering Research Centres, launched a ten-year centre scheme labeled 'Competence Centres' in 1995. These were to be co-funded by NUTEK and industry (50/50) with budgets over SEK 10 million (and more) per year. The centres – 28 altogether - were primarily virtual and spanned over disciplines and universities, however with a clear-cut management model with responsibilities for resource allocation, strategic issues and similar (for more information and a series of evaluations, see http://www.vinnova.se/en/Activities/The-Competence-Centres-Programme-1995-2007/). The competence centres call clearly addressed industrial issues and the centres were to be selected on the basis of their contributions to economic competitiveness of Swedish industry. However, judging from the aforementioned evaluations, the centres were relatively broad in their orientation: some primarily reflected industrial interests while others had a stronger orientation to basic research.

The research councils took no major initiatives to concentrate their funding in this period. Rather, they had to cope with major cut-backs in their budgets (see below). As a consequence, the research councils began spreading resources more thinly to compensate for their budget reductions and the continued demand for external funding – demand that continued to grow with the simultaneous cuts in floor funding to the universities. Several factors therefore contributed to the aborted first phase of centre policies in Sweden, despite the political ambition to establish centres.

The SSF takes the lead

The first phase of the centre orientation had thus limited impact. However, around the millennium shift things began to move, again with the research foundations at the core. In 2000, with the recruitment of a new SSF director (with a background as a medical professor in the US), the centre concept was retried and modified and the SSF established a large initiative for 'strategic centres in the life sciences'. This broke with the SSF's earlier orientation towards national networks and instead focused resources on coherent and integrated environments ('under one roof') with a clear-cut management structure (when the programme was announced, the headline was 'Directors wanted!').

The background of this was a shift in the funding of university research: the crisis of the Swedish economy in the early 1990s, and the ensuing debt crisis of the Swedish state, led to massive reductions in public expenditure, also on research. The main part of the savings was taken by the block grants and, in particular, the research councils. The latter saw their budget shrink by up to 15 per cent. The main issue at the time was to address the structural changes brought about by the weakened research councils (and faculties). To begin with, the foundations acted cautiously and indeed took over some of the obligations of the research councils. Gradually they began carving out a distinct niche for themselves as supporters of more concentrated and coordinated research efforts. While Sweden had (and still has) relatively many large research groups, almost all of them depended on a large number of relatively small grants for their continuation, often unsynchronized. Difficulties in achieving concentration and quality-focus ensued as the research groups were primarily focused on generating a sufficiently large number of grants for their survival. This became the starting point for the activities of SSF and its renewed interest in supporting research environments rather than individual scientists and projects.

The call for strategic research centres in the life sciences was well received – with over 90 applications and six centres funded – but the process came under much debate and the integrity of the SSF management was questioned, for instance in an evaluation of SSF done by the Royal Swedish Academy of Sciences and in several editorials in Swedish newspapers. The critique pointed to the importance of the evaluation, an issue that was taken up in later calls, where very stringent procedures were established to avoid discussions of conflicts of interests and transparency. A similar exercise was set up for microelectronics, and later (2004) for the entire spectrum of SSF activities.

Clearly, the research foundations – a much debated and controversial aspect of Swedish research policy, being private foundations operating on the basis of money formerly under control of the state – had taken the initiative. As time went by, the state intended to regain the initiative. Even though the centres proved to be a source of much friction and debate within and beyond the SSF, their policy impact was immense. One response was political – and paved the way for a major reform of public research funding. The foundations (private organizations, established in the midst of a heated political controversy on the 'privatization of research policy') could not in the long run be the sole providers of large scale focused support, while government bodies 'only' supported small-scale activities in project-based form.

The public funders responds

In 2001, a new system for research funding was established. The research councils for medicine, engineering, natural sciences and humanities-social sciences were merged. The explicit aim was to enable resource concentration ('kraftsamling') but to little initial avail due to organisational friction and constrained resources. The foundations remained the sole providers of large-scale research funding. However, a first attempt to formulate a response to the foundation's initiative came in 2004, when three research councils (VR, Formas and Vinnova), together with SSF, announced the support schemes for 'strong research environments'. The VR scheme was relatively small in scale, providing ten research constellations with a five-year grant of about 5 million Swedish kronor annually. This was far from the SSF had mustered but still represented a new direction of public funding.

There was still a great deal of hesitancy towards centre support as a funding mechanism: the Swedish Research Council, for instance in its research strategy for 2005-2008, instead favoured competitive hikes in floor funding rather than centre grants. The government on its side was strongly in favour of a resource increase channelled through direct support to research constellations, which would draw on research capacity of larger collectives but also on resource and organisational mobilization from the universities.

A government investigation, based on international policy surveys, was given the final responsibility of determining how the support of larger research constellations should be designed. It proposed a 10-10-10 template: SEK ten million were to be allocated over a period of ten years to groups comprising ten PIs (Ds 2004). Subsequently, the idea was taken up by the government in the 2005 research policy bill, where 'strong research environments' was a lead theme. More concretely, this took the shape of the Linnaeus environments and Berzelii centres, the latter in collaboration with VINNOVA.

After the establishment of the Linnaeus grants – which has gone through two rounds in 2006 and 2008 (Berzelii centres were however announced only in 2006) – the development of research support in collective form took another, and even more grandiose, jump with the introduction of 'strategic research areas' in the 2008 research policy bill. These areas were again – in similarity with the Linnaeus grants – devised by government rather than by the funding agencies: the ministry was instrumental in designing the scheme while the Swedish Research Council – after an initial discussion with the ministry – was involved only in the practicalities, devising the call, running the evaluation, etc (Benner 2008). Again, government and funding agencies seemed not to be synchronized in their activities, with the government pushing and the funding agencies being more hesitant.

The areas became the centrepiece of the 2008 research policy bill and covered – unlike the Linnaeus grants, which were open to all areas – pre-specified fields. These fields, altogether twenty in number,

were a mixture of primarily basic research fields (neuroscience, stem cell research, biomolecular sciences), socially relevant fields (caring research, psychiatry, climate, politically relevant regions) and fields of industrial interest (production technology, materials). The fields were specified by parliament, but the evaluations of applications were organized by the Swedish Research Council in collaboration with Vinnova (for applications in industrial research) and Formas (for applications in climate research). The evaluation criteria were geared toward scientific merit although relevance and industrial/societal partnerships were also included.

Such strategic research areas are grand in scale, and receive funding in the range of SEK 5-30 Million annually (for a five year period, and after an evaluation they may potentially receive the funding without a time limit). They are broader in their remit than the Linnaeus environments, and may also be organizationally distributed. They often span two or more universities, but their focus is similar to the Linnaeus environments: most of them are evaluated primarily on the basis of scientific track record and research plans. There is also an interesting pattern in the distribution of areas, as most of them are located in research environments that have been supported by either Linnaeus centres, VinnExc centres or SFC – or, in some cases, all three of these schemes. The Strategic Research Areas thereby represent the culmination of resource concentration in Swedish research funding.

The impact of centre support

Hence, the strategic research areas build upon earlier initiatives to bring about concentration and focus on fewer research environments. Together the schemes for centres (and areas) have led to a rather dramatic increase in the support of certain areas and environments – for instance in information technology (KTH), genomics/proteomics (Stockholm), materials research (Chalmers, Lund, Linköping), stem cell biology (Karolinska, Lund), neuroscience (Karolinska, Lund), climate research (Stockholm). Several of these areas and environments have received multiple support, from the SSF, from VINNOVA, from VR (or FORMAS) and later from the strategic research areas. Hence, centre schemes tend to accumulate in certain fields and environments (the Matthew effect). Materials science has been particularly well endowed and several of the environments in this field now receive – together with massive support from the EU framework programmes – funding in the range of 40-60 million kronor annually.

Other areas have been less fortunate. Among the area losers are clearly the humanities, receiving only two Linnaeus grants of a total of forty and virtually no representation in the strategic research areas. The social sciences have fared slightly better, but primarily in policy-oriented areas like social policy, public health, and climate policy. The natural sciences have also, perhaps somewhat surprisingly, been relatively weak, and central research areas in Sweden such as astronomy, ecology and chemistry have received only minute centre support. The distribution of support between universities has also been very uneven: Lund is the standout, as the largest recipient of SSF centre grants, 40 per cent of the Linnaeus grants and the largest share (715 million kronor) of the funding to the strategic research areas. Other large universities like Gothenburg, Uppsala and Stockholm have received far fewer centre grants which has caused agitated debates.

The centre drive has also been very clearly oriented to centres selected on the basis of their scientific merit primarily, even in the cases where other goals were stressed in the calls (in all calls except for the Linnaeus grants, which were solely dedicated to assessments of scientific quality). This may be one reason for the change of policy within VINNOVA, which has not launched any new centres in recent years and instead focused its resources on academic-industrial-societal ‘innovation pacts’ (see below).

Altogether, the centre programmes do not account for more than, roughly, 10 per cent of total research funding in Sweden, but their impact is more far reaching than that. The centre grants have trigged reorientations within universities, they have impacted upon the distribution of grants elsewhere in the funding system and they have generally caused a reorientation towards centres as an organizational form within the university system. Arguably, they have also elevated the status of centre leaders,

thereby contributing to a more pluralist system of research governance within the universities but also potentially a struggle between centres and other units within the universities.

A move away from centre support?

However, very recently we may be witnessing another policy u-turn and a return to individual support rather than support of 'strong research environments': the research foundations (together with the resourceful Wallenberg foundation) now increasingly support individual researchers and smaller research constellations, while the government has recently announced that the era of 'research environment support' may be over and that the government also will prioritize individual research support, in particular for junior researchers (Research Advisory Board 2010). This may again reflect a popular understanding – and critique – that the support schemes may be overly complex and 'negotiated' in their structure and that promising researchers (and women in particular) risk becoming marginalized and disempowered in such structures (Sandström et al. 2010). This may reflect a reorientation in Swedish research policy debates, which currently circles around the declining position of Sweden in international bibliometrical comparisons.

There is an ensuing shift from organizational issues to individual preconditions, and of research quality as more dependent on the preconditions for smaller research constellations than for 'grand coalitions'. The impact of the policies for 'strong research environments' may also impact: Stockholm, and Lund, represent two contrasts – the former a leading university in bibliometric rankings but with few CoEs and the latter a more median bibliometrical performer but with 14 out of 40 Linnaeus environments and the largest recipient of the strategic research area funding. This uneven pattern has triggered a discussion on the selection of CoEs and their impact on the national research performance and on incentives in the research system.

The background of the centres

The policies for CoE and concentration of resources to 'strong research environments' have primarily been shaped by political concerns, whereas the funding system (in particular the research councils) has been more cautious. Of course, one driving element – albeit silent and not very visible in the material – has been the interests of large-scale research constellations and their leaders. They have been successful in portraying a picture of resource concentration as a necessary measure to establish and reproduce scientific leadership (for an example of this argumentation with international support, see John Bell et al. Evaluation of the faculty of medicine at Lund University 2004).

The councils and their responses reflected their sociological environment – the large number of individual or small-group researchers who rely on faculty funding and project groups. The interests of larger research constellations were first taken up by the research foundations as part of their remit and mandate (around 1994-1995); after a hiatus in the late 1990s this has become their lead motive. Government and public funders reacted in the first half of the 2000s to this development and responded with the Linnaeus grants and similar schemes (organized by the Swedish Research Council's sister organizations FAS and Formas, for social and environmental research, respectively). This concentration of resources culminated with the large infusion of resources via the Strategic Research Areas, where very large amounts have been allocated to a select number of research constellations. Currently, this development is under debate and new measures contemplated, with a clear-cut focus on individual achievements and group-based research rather than the massive constellations that have emerged in response to – and to some extent of course also preceding them – the support to 'strong research environments'.

Research funding is therefore at a cross-roads in Sweden, where major investments have been made in large constellations, and also investment in large-scale research facilities (MAX IV and the European Spallation Source, estimated to cost about SEK 7 billion in construction for Sweden alone, and about SEK 200 million annually in running costs). Investment in centres of excellence and strategic research areas has also followed the logic of resource concentration and a structural

transformation of the Swedish research system to fewer areas and environments 8and eventually possibly also universities).

This development stands in sharp contrast to the renewed interest in small-scale ('personalized' as opposed to large scale and organized) research, and how these two interests will interact is a major future issue in research governance. Currently, it does seem clear at all that there will be any major calls for centres in the immediate future. Instead, after a decade of hectic activity to launch centre calls and to consolidate the research system around a select number of environments and areas, we may again see a policy shift. The long-term consequences of this movement back and forth, from individual grants to centre grants and again back to small and medium-sized grants, remain to be seen.

2.5.2 The schemes

We now turn to the schemes and their design and relative importance.

VINN Excellence Centres were established in 2005 (but dates back to the Competence Centre initiative taken by NUTEK in 1995, organized along similar lines) to provide a forum for collaboration between the private and public sectors, universities and colleges, research institutes and other organisations that conduct research. The Centres deal with both basic and applied research and they work to ensure that new knowledge and new technological developments lead to new products, processes and services. The centres are partly funded by VINNOVA, the Swedish Agency for Innovation Systems, with the ambition is to establish 25 different VINN Excellence Centres that will be funded for a period of 10 years (jointly between Vinnova, industry and the host universities). In April 2005, VINNOVA selected four VINN Excellence Centres in the field of transport and working life. In June 2006 VINNOVA selected another fifteen centres. However, after 2006, there have no further calls for centres. The most recent initiative from VINNOVA targeted 'challenge-driven innovation' (utmaningsdriven innovation). The programmes selected are almost all highly distributed (with 10-20 participants from industry, academia, public sector, etc.) and far more focused on industrial leadership than the Vinn Excellence Centres.

FAS (the Swedish Research Council for Working Life and Social Research) supports a number of research centres through centre grants, at present thirteen. They constitute a type of funding with a higher annual amount (up to SEK 10 million/year) and longer duration (5-10 years) and are restricted to the most prominent research environments within FAS's remit (also including medicine). FAS considers the establishment of strong research environments in all its key areas of responsibility highly essential. It is, according to FAS's strategy, important that research within FAS's sphere of responsibility be given the same opportunities as other research areas to develop leading edge competence, and it is also important that new emerging research groups within FAS's sphere of responsibility be given the opportunity to attain this higher form of basic funding. FAS has not launched any more calls for FAS centres.

The Berzelii Centres – run jointly by Vinnova and the Swedish Research Council – are an investment in strong research environments orientated towards excellent basic research and which have a clear ambition to develop active collaboration with trade and industry and the public weal so as to make research useful through commercial application. Funding will continue for up to ten years. The Swedish Research Council and VINNOVA will finance each centre with up to SEK 100 million during a ten-year period. Co-financing means that each centre will receive a total budget of around SEK 270 million.

The Linnaeus grants were established in the 2005 research policy bill. They are organized via SRC (the Swedish Research Council), partly in collaboration with Formas (the Swedish Research Council for Environment, Agriculture and Planning). The aim of the Linnaeus grants is to enhance support for research of the highest quality that can compete internationally. It also aims to encourage universities and colleges to prioritize research fields and to allocate funding for them. In order to accomplish this, the agreement stipulated that at least 50 per cent additional support of the granted amount should be

granted by the University in question. In 2006 and 2008 the Swedish Research Council and the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas) approved Linnaeus grants to 40 research environments. These represent different research domains – medicine, natural and engineering sciences, and humanities and social sciences. For each environment the amount of the Linnaeus grant is SEK 5–10 million annually for a maximum of ten years. The criteria for assessment of the applications were scientific quality and renewal, and in addition gender equality and organizational support.

A strategic research centre was the centre programme of the Swedish Foundation for Strategic Research. The programme was first launched in 2001 with a new round in 2005. The programme has since been discontinued. Altogether, such centres are characterised by the fact that several independent, preferably co-located research groups at a university or a research institute collaborate to solve an important research problem under the strong, uniting leadership of a centre director. The director is assisted by a steering committee and a scientific advisory committee. With its strategic research centres, the Swedish Foundation for Strategic Research intended to promote strong research environments with clear leadership structures. The goal has been geographically co-located centres where several research teams – preferably in multidisciplinary constellations – work together 'under one roof' (in one location, preferably in one organizational structure) to address particularly important or challenging questions. These centres have a unique opportunity to recruit new staff internationally to add expertise to the research setting. The Foundation expects the centres to tackle strategically important problems which, if they are solved, will not only lead to top high-class publications, but can also serve as an impetus for various kinds of innovations that can contribute towards Sweden's economic prosperity.

The Bank of Sweden Tercentenary Foundations runs programme grants (SEK 5-6 Million over six years) for the humanities and social sciences, altogether funding thirteen programmes in 2012. Programmes may be geographically dispersed and do not call for specific organizational arrangement though, and only few of them are represented with home pages and other manifestations. Even more significantly, the Bank of Sweden foundation does not require university support of the applications. Hence, any researcher may apply for a centre support without the blessing, support or commitment of their host university. Hence, they should be seen as extensions of research projects in time and size rather than centre programmes as such, and they have therefore not been included in the programme overview. However, they represent an interesting extension of funding for the social sciences and the humanities, which otherwise have received only limited support via the centre grants.

3 Mapping of excellence centres

This chapter reports the results from mapping existing centres under 11 excellence centre schemes in the four countries. All current public schemes which allocate substantial funds for establishing excellence centres[11] are included. As excellence schemes we include competitive and prestigious schemes aimed at frontier/cutting edge/top level research, and schemes aimed at improving the country's capacity for such top level research within specific/strategic research fields and for specific purposes (including economic growth/research based innovation). The mapping is restricted to schemes allocating public funds (private foundations are not included). See Appendix 1 for an overview of schemes which are *not* included.

The mapping was based on information about the centres available on the funding agencies' and the centres' web pages. We have included terminated centres (within existing schemes), and also newly established centres, to the extent that information is available.[12] In addition to the 11 national schemes, information about Nordic Centres of Excellence funded by NordForsk are included.

3.1 Types and scope of centre schemes

As part of mapping the centre schemes in the four countries, the schemes have been categorised according to the main objectives: (A) scientific excellences/scientific rationales; (B) economic rationales, including innovation, and (C) strategic rationales including solving societal challenges.

Table 3.1 gives an overview of the 11 centre schemes mapped. For Denmark and Norway one scheme in each category has been mapped. Centres of Excellence (CoE), Strategic Platforms for Innovation and Research (SPIR) and Strategic research centres in Demark, and Centres of Excellence (SFF), Centres for Research-based Innovation (CRE/SFI) and Centres for Environment-friendly Energy Research scheme (CEER/FME) in Norway. For Finland only one scheme – The CoE scheme of the Academy of Finland (category A) – is found, implying that there are no schemes that fund what we define as excellence centres within category B or C. For Sweden four schemes, of which two are of mixed categories, are mapped: Linnaeus Environments (category A), VINN Excellence Centres (category B), FAS-Centres (category A and C), Strategic Research Centres (category B and C).

[11] As used in this report 'centres' do not need to be co-located research units, but there should be an identifiable host institution/coordinator of the centre, and the scheme should provide a substantial amount of money for doing research, not just awarding prestige and money for coordination.
[12] This information may be used in future studies of possible patterns in which institutions/research fields that are awarded excellence status by different schemes or consecutively by the same scheme.

Table 3.1 Overview of excellence centre schemes included in the mapping

	A Scientific rational	B Innovation/economic rational		C Strategic/social challenges rational
Denmark				
Name of scheme:	*Centres of Excellence (CoE)*	*SPIR – Strategic Platforms for Innovation and Research*		*Strategic research centres*
Agency administrating the scheme:	Danish National Research Foundation	Danish Council for Strategic Research		Danish Council for Strategic Research
First centres in:	1993	2011		2007
Centre period:	10-year-scheme	5-7 year scheme		5-7 year scheme
Number of centres established/included in the mapping:	77/38	2/2		31/31
Finland				
Name of scheme:	*Centres of Excellence in research (CoE)*			
Agency administrating the scheme:	Academy of Finland	No scheme fulfilling excellence centre criteria.		
First centres in:	1995			
Centre period:	6-year-scheme			
Number of centres established/included in the mapping:	115/115**			
Norway				
Name of scheme:	*Centres of Excellence (CoE/SFF)*	*Centres for Research-based Innovation (CRE/SFI)*		*Centres for Environment-friendly Energy Research scheme (CEER/FME)*
Agency administrating the scheme:	Research council of Norway	Research council of Norway		Research council of Norway
First centres in:	2003	2007		2009
Centre period:	10-year-scheme	8-year-scheme		8-year-scheme
Number of centres established/included in the mapping:	21/21	21/21		11/11
Sweden	**Cat A**	**Cat A+C**	**Cat B**	**Cat B+C**
Name of scheme:	*Linnaeus Environments*	*FAS-Centres*	*VINN Excellence Centres*	*Strategic Research Centres**
Agency administrating the scheme:	Swedish Research Council (+Formas)	Swedish Research Council for Working Life and Social Research (FAS)	VINNOVA	Swedish Foundation for Strategic Research
First centres in:	2006	2007	2005	2001
Centre period:	10-year-scheme	5-10-year-scheme	10-year-scheme	5-6-year-schemes
Number of centres established/included in the mapping:	40/40	13/13	19/18	17+6+6/17

Source: The web sites of the funding agencies and the centres.
* Strategic Research Centres for Industry and Society/in the Life Sciences/in Microelectronics.
**The 115 centres appear as 75 centres in the mapping as this is the number of different units appointed CoE (several units have been appointed for multiple periods).

In total for the 11 schemes, 287 centres are identified. Some of these have just been awarded, and little information is available about the centres. Hence, some centres, are only partly mapped. Table 3.2 shows the number of centres by country and type. Of the 287 centres mapped, 226 were active in

2010, 25 had terminated before 2010[13] and 34 where scheduled to start up in 2011 or 2012 (for two of the centres we information about centre period).

Table 3.2 National centres schemes, number of centres by country and type, 2011.

Type of centre	DK	FI	NO	SE	Total
A – main rationales are scientific	38	75	21	40	174
B – main rationales are economic	2	0	21	18	41
C – main rationales are strategic/societal*	31	0	11	30	72
Total	**71**	**75**	**53**	**88**	**287**

Source: The web sites of the funding agencies and the centres.
*FAS-Centres (category A and C), Strategic Research Centres (category B and C) are included here.

In addition to the national centres schemes, the Nordic countries also have joint excellence initiatives. NordForsk has funded 22 Nordic Centres of Excellence (NCoE), based on open calls in the five Nordic countries (the four countries mapped in our study, plus Iceland). Of these, eleven centres are currently active (Table 3.3). The NCoEs are strategic initiatives within research areas of high priority in the Nordic countries. The aim is to promote Nordic cooperation between outstanding researchers and research institutions in the Nordic countries. Hence, the centres are category C – with strategic/societal rationales. Two of the calls have been within the Top-level Research-Initiative (TFI), which is a joint Nordic research and innovation initiative including NordForsk, Nordic Innovation Centre and Nordic Energy Research. So far, there have been seven calls covering various fields of research: Programme in Global Change (2003–2007); Programme in Molecular Medicine (2004–2009); Programme in Humanities and Social Sciences (2005–2010); Programme in Welfare research (2007–2012); Programme in Food, Nutrition and Health (2007–2012); Interaction between climate change and the cryosphere (TFI 2010–2015); Effect Studies and Adaptation to Climate Change (TFI 2011–2016). The NCoEs obtain funding for a five year period. Total funding is between 15 and 30 MNOK[14] per centre (in total for the five-year-period), implying that the NCoE-funding generally is lower than the funding provided by the national schemes, and the funding period is shorter.

Table 3.3 Overview of Nordic Centres of Excellence (NordForsk Thematic calls), number of centres by host country and period.

Centre period	DK	FI	NO	SE	Total
2003-2007	1	1	1	1	4
2004-2009	0	1	1	1	3
2005-2010	0	0	2	2	4
2007-2012	1	2	2	0	5
2010-2015 (TFI)	0	1	1	1	3
2011-2016 (TFI)	1	1	1	0	3
Total	**3**	**6**	**8**	**5**	**22**

Source: NordForsk.

Table 3.4 shows the distribution of NCoEs by host institution and research area. With one exception (NOVA – Norwegian Social Research), the institutions hosting NCoEs also host excellence centres funded by national schemes. In some cases the director/leader of the centre from the national scheme and the NCoE is also the same person – indicating that in some cases the Nordic and the national centre are closely related.

[13] These were all centres funded by the Academy of Finland's CoE-scheme. In the other countries we have not been able to map past centres.
[14] 15 to 17 MNOK for the sixteen first centres, about 30 MNOK each for the six TFI centres.

Table 3.4 Nordic Centres of Excellence (NordForsk Thematic calls), number of centres by host institution and research topic/area.

Host institution	Climate	Food, Nutrition and Health	Molecular Medicine	Humanities/ social sciences	Welfare research	Total
University of Helsinki	2	0	1	0	1	4
University of Oslo	3	0	1	0	0	4
Lund University	2	0	1	0	0	3
Aarhus University	2	0	0	0	0	2
University of Bergen	0	1	0	1	0	2
Danish Cancer Society, Institute of Cancer Epidemiology	0	1	0	0	0	1
NOVA – Norwegian Social Research	0	0	0	0	1	1
Umeå University	0	0	0	1	0	1
University of Kuopio / University of Eastern Finland	0	1	0	0	0	1
University of Tromsø	0	0	0	1	0	1
University of Turku	1	0	0	0	0	1
Uppsala University	0	0	0	1	0	1
Total	**10**	**3**	**3**	**4**	**2**	**22**

Source: NordForsk.

3.2 Host institutions and research areas

The majority of the host institutions are universities.[15] In total, 248 of the 287 centres are hosted by a university. In Sweden all host institutions are higher education institutions – full universities or other institutions accredited for research education. In Finland all but three centres are hosted by universities, the remaining four by research institutes – of which three are hosted by the same institute (VTT). In Denmark 6 out of 12 host institutions are outside the universities, but these institutions only host 8 of the 71 centres. Norway has the highest number of host institutions (20), and at the same time the lowest number of centres (53), and hence a more distributed centre profile than the other three countries (Table 3.5, last line). Still, a large part of the Norwegian centres are hosted by five universities, implying that the distributed profile foremost concern centres outside the universities. Fourteen of the 20 Norwegian host institutions, are outside the universities, and they host 24 of the 53 centres.

In all countries there are one or two universities that host a large number of centres (see Tables 4.14 to 4.17 in Chapter 4). The University of Helsinki (FI) hosts 33 centres, the University of Copenhagen (DK) hosts 25 centres, Lund University (SE) hosts 21 centres, the University of Oslo and NTNU (NO) hosts 9 each. In addition, Norway has a research institute which hosts a considerable number of centres (SINTEF with six centres, which is one more than the University of Bergen).

[15] This section only includes the national centres schemes. Also for the NCoEs the large majority of host institutions are universities, see Table 3.4.

Table 3.5 Overview of mapped centres, by country and type of host institution, 2011.

Sector	Denmark		Finland		Norway		Sweden		Total
	Centres	Hosts	Centres	Hosts	Centres	Hosts	Centres	Hosts	centres
University	63	6	71	9	28	5	86	12	248
Other higher education institution*					1	1	2	2	3
Institute sector incl. hospitals	7	5	4	2	23	13			34
Other**	1	1			1	1			2
Total	**71**	**12**	**75**	**11**	**53**	**20**	**88**	**14**	**287**
Average number of centres per host	5.9		6.8		2.7		6.3		5.0

Source: The web sites of the funding agencies and the centres. Includes the centres of the 11 national schemes (287 centres), not he centres funded by NordForsk.
*These are all institutions accredited for research education: Høgskolan i Gävle and Mälardalens Högskola (SE), and Norwegian School of Economics (NO).
**Includes an R&D facility for Microsoft (NO) and Danish Cancer Society (DK). Tables 4.14 to 4.17 in Chapter 4, shows all host institutions and the number of centres per host institution.

The host institution profile varies by type of centre. The universities host nearly all the centres funded by the 'scientific' schemes (95 per cent), while the institute sector's centres are mainly funded by the innovation/economic schemes, and also the strategic schemes (table below). Schemes with an innovation/economic objectives have the largest proportion of hosts outside the universities – with 29 per cent of centres hosted in the institute sector.

Table 3.6 Mapped centres, by centre type and type of host institution, 2011. Per cent.

Sector	A scientific	B economic	C strategic	Total
University	94.8	65.9	77.8	86.4
Other higher education institution	-	2.4	2.8	1.0
Institute sector incl. hospitals	4.6	29.3	19.4	11.8
Other	0.6	2.4	-	0.7
N	**174**	**41**	**72**	**287**

Source: The web sites of the funding agencies and the centres. Includes the centres of the 11 national schemes (287 centres), not he centres funded by NordForsk.

Splitting the centres on research areas we find some similarities, as well as some particular national profiles (Table 3.7). Biomedicine/Health Sciences and Engineering/ICT/ Materials Sciences are the two largest categories in all countries. Sweden has the highest proportion of centres within the Biomedicine/Health Sciences (38 per cent of the Swedish centres), whereas Norway has the highest proportion of centres within Engineering and Materials Sciences (43 per cent of the Norwegian centres). Norway also has a higher share of centres within Geosciences and Agriculture. Finland has a higher proportion of centres within the Humanities (12 per cent) than the other countries, and a substantially lower proportion within Engineering and Materials Sciences – which may be explained by the lack of Finnish centre schemes with innovation/economic or strategic rationales. Denmark does not have the highest share of centres within any of the fields, except for slightly higher shares within Physics/Mathematics and Chemistry.

Table 3.7 Overview of mapped centres 2011, by country and centres main research area. Per cent.

Centre's main research area	DK	FI	NO	SE	Total
Agriculture, Fisheries & Forestry	2.8	2.7	7.5	.0	2.8
Biology	11.3	13.3	3.8	5.7	8.7
Biomedicine & Health Sciences	28.2	30.7	15.1	37.5	29.3
Chemistry	4.2	4.0	1.9	2.3	3.1
Engineering, ICT & Materials Sciences	25.4	14.7	43.4	33.0	28.2
Geosciences	2.8	1.3	7.5	2.3	3.1
Humanities	2.8	12.0	5.7	2.3	5.6
Physics & Mathematics	12.7	12.0	3.8	6.8	9.1
Social sciences	7.0	8.0	11.3	10.2	9.1
Interdisciplinary	2.8	1.3	.0	.0	1.0
N (centres)	**71**	**75**	**53**	**88**	**287**

Source: The web sites of the funding agencies and the centres. Includes the centres of the 11 national schemes (287 centres), not he centres funded by NordForsk. Categorisation into research areas are done by NIFU (mainly using the same categories as for the bibliometric analysis as in Chapter 4) without any direct contact with the centres.

3.3 Centre leaders – Gender

In all the four countries, the large majority of the centres are led by men. Finland has the highest proportion of female leaders (19 per cent), Denmark the lowest with 7 per cent. In total for the four countries, 12 per cent of the centre leaders are female.

Table 3.8 Overview of mapped centres, by country and gender of centre leader, 2011. Per cent.

Gender (leader)	DK	FI	NO	SE	Total
Female leader	7.4	18.7	13.2	8.2	11.9
Male and female*				2.7	0.7
Male leader	92.6	81.3	86.6	89.0	87.4
N	**68**	**75**	**46**	**73**	**269**
Centres not included in the percentages**	3	0	0	15	18

Source: The web sites of the funding agencies and the centres.
*Shared leadership. There are also other cases of shared leadership – with same gender.
**Centres without an identifiable leader – these include centres not yet stated up or without a web page or where the webpage gives no information about the leader.

Splitting on research areas, the highest proportion of female leaders are found within agriculture, biology and humanities, with 21 to 38 per cent (Table 3.9), which indicate that to some extent there are higher proportions of female leaders in areas with more female researchers. We also find a lower proportion of female leaders at the centres under the schemes aimed at innovation and economic rationales (category B schemes, with only 7 per cent women). These are schemes dominated by engineering and technology and low percentages of female professors.

Table 3.9 Overview of mapped centres, by country and gender of centre leader, 2011. Per cent.

Gender (leader)	Agri	Biol	Biom and health	Chem	Engin	Geo	Hum	Phys	Soc	Interdisci-plinary	Total
Female leader	37.5	26.1	15.8		7.7		21.4		8.0		11.9
Male and female			1.3		1.3						0.7
Male leader	62.5	73.9	82.9	100.0	91.0	100.0	78.6	100.0	92.0	100.0	87.4
N	**8**	**23**	**76**	**8**	**78**	**9**	**14**	**25**	**25**	**3**	**269**

Source: The web sites of the funding agencies and the centres. See notes to Table 3.8 for the gender categorisation and Table 3.7 for the full names of the research areas.

Comparing the proportion of female leaders with the overall percentage of female professors in the four countries, we find that the shares of female centre leaders are far below what could be expected.

In Sweden, 20 per cent of the professors are female, but only 8 per cent of the centre leaders. In Denmark, 16 per cent professors are female, but only 7 of centre leaders. In Norway and especially in Finland the discrepancy is lower (Norway with 21 per cent female professors and 13 per cent female centre leaders; Finland with 25 per cent female professors and 19 per cent female centre leaders), but the shares of female centre leaders are still far below what could be expected.

Table 3.10 Percentage of female centre leaders compared to overall percentage of female professors, by country.

Country	Per cent female leaders in excellence centres*	Overall percentage of female professors 2010
Denmark	7.4	15.9
Finland	18.7	24.5
Norway	13.2	21.4
Sweden	8.2	20.0

Sources: Norway: http://www.foustatistikkbanken.no/nifu/; Denmark: The most recent official figure is 15.5 per cent in 2009 (Ståhle 2011). 15.9 is the provisional figure for 2010. Finland: Figures for 2009 from the Kota-database (https://kotaplus.csc.fi/); Sweden: Dryler et al. 2011.

*Includes all mapped centres for which we have information about centre leader. If we only include centres active in 2010 in the calculations, the figure is somewhat higher for Finland and Norway, and slightly lower for Denmark (for Sweden only centres active in 2010 are mapped, and hence the figures do not change). 20 per cent of Finnish centres active in 2010 had female leader (figure increase because past centres with lower proportion of female leaders are excluded). 16.3 per cent of Norwegian centres active in 2010 had female leader (figure increase due to exclusion of centres starting up in 2011 with lower proportion of female leaders). 6.8 per cent of Danish centres active in 2010 had female leader (figure decrease because exclusion of two centres with missing information about centre period).

Table 3.11 shows the gender distribution amount the leaders of the Nordic Centres of Excellence funded by NordForsk. For these centres the proposition of female leaders is below the overall figures for the national schemes in the four countries (9 versus 12 per cent). In conclusion, both for national and Nordic centre schemes there seems a general tendency that a disproportional high number of excellence centres are led by men.

Table 3.11 Overview of Nordic Centres of Excellence (NordForsk Thematic Centres 2003-2016), by research topic/area and gender of centre leader. Per cent.

Research topic/area	Female	Male	Shared leadership Male/Female	N
Climate		100.0		10
Food, Nutrition and Health	33.3	33.3	33.3	3
Humanities/social sciences		100.0		4
Molecular Medicine	33.3	66.7		3
Welfare research		100.0		2
Total numbers	2	19	1	100.0
Total percentages	**9.1**	**86.4**	**4.5**	**22**

Source: NordForsk.

Previous studies of Nordic centres schemes come to different conclusions regarding gender balance and impact. A broad study of many Swedish excellence instruments found negative effects on gender balance (Sandström et al. 2010). Male and female applicants to excellence schemes were compared and it was concluded that women benefit from the excellence schemes to a far lower degree than men. On the other hand, an evaluation of the Norwegian CoE scheme (SFF), found that the overall gender profile of the CoEs did not diverge much from the national structure. Splitting on research fields, the picture varied: In some fields the proportion of females at the CoEs was higher than the overall average for Norway; in some fields the female proportion at CoEs was about average and in other fields below the field average (senior and recruitment positions were measured separately). It was moreover concluded that measures taken to enhance gender equality had been effective (Langfeldt et at. 2010:55-57). This indicates that for individual schemes, a gender balance matching the national gender distribution in the relevant fields is feasible for 'scientific' excellence schemes, at

least when specific measures to obtain gender equality is implemented. On the other hand, gender balance for all types of excellence schemes, also including schemes aimed at innovation and economic rationales, may be more difficult.

Moreover, the centre schemes' impact on gender balance concerns more than the gender distribution among the centre leaders. Gender balance among the other participants – senior researchers as well as the recruitment positions – is also highly relevant. In sum, more detailed studies are needed to understand the effects of different kinds of excellence schemes and the effects on different research areas.

4 Host institutions' general competiveness

To what extent are the excellence centres hosted by institutions which are among the leading/strongest in the relevant fields? In this chapter we study the host institutions of the excellence centres and their general competitiveness in terms of attracting international research funds (Section 4.2) and measured by bibliometric indicators (Section 4.1). Note that analyses are at the institutional level and that results are preliminary – with approximate definitions of the relevant research areas (see Section 4.1.3). The analyses focus on the correlation between being a CoE host and score on the relevant indicators of competiveness. There is no attempt to study the time sequence. CoE host institutions are included in the analyses regardless of when they became hosts. Research institutions' scores on various competiveness criteria (hosting CoEs being one of them) are likely be part of interrelated processes of cumulative advantages, and are hard to study at the aggregate level.

4.1 Host institutions' bibliometric scores – preliminary results

4.1.1 Summary results

To assess the host institutions' strength in the relevant research fields we have applied a set of bibliometric indicators. See section 4.1.3 for explanation of these indicators. It is important to emphasise that the indicators presented do not relate to the centres, but to all research within the relevant area at the host institutions. Moreover, the analysis is limited to the host institutions/research areas of 204 centres – of a total of 287 mapped centres – in the four countries. These are the centres located at universities (for which we have relevant bibliometric data) that could be categorised within one of the predefined research areas (see Table 4.1).

Table 1 and 2 show the results per field and per country. These first results suggest that the centres mainly are selected in areas where the universities have specialization (see explanation of the specialisation indictor in the table notes). Moreover, the centres tend to be selected in fields where the impact of the university is good, i.e. the citation index is clearly above average (1.00 indicate world average, see explanation in the table notes). This holds for all fields with the exception of Biomedicine. Some overall results:

- 141 of 204 (69 per cent) of the centres included in the analysis are in fields where the host universities have a positive specialisation (i.e. an RSI above 1.0). On average the RSI is 1.14, that is, the host institution relative specialisation in the field is 14 per cent above the world average.
- 180 (89 per cent) of the centres included in the analysis are in fields where the host universities obtained a citation index above world average. The average relative citation impact is 17 per cent above the world average (1.17).

- Chemistry and Physics/mathematics are the fields where the host universities have the lowest relative specialisation (1.00-1.05). Less than half (33 and 44 per cent respectively) of the centres in these fields are located at universities with a relative specialisation above the world average. On the other hand, all centres within Geosciences, and close to all centres within Biology, are located at universities with above world average specialisation (Table 4.1).
- The relative citations impact is in some fields quite different from the relative specialisation. The host institutions for the centres within chemistry have the lowest relative specialisation (1.00) and the at the same time the highest citations impact (1.42), indicating that the hosts do not have higher than average activity in chemistry, but that their chemistry publications are far more than average cited. Biomedicine, on the other hand, is the field where the host institutions have the lowest relative citation impact, but most of them have a relative specialisation above world average; only 51 per cent of centres have a host with above world average citation impact, but 85 per cent of them have host with above world average specialisation (Table 4.1).
- When summarising results for all host universities, similar differences are seen between countries (Table 4.2). In Demark, as much as 94 per cent of the centres are located at universities with above world average citation impact in the relevant field, whereas the other countries score lower (Norway 86 per cent, Sweden 79 per cent and Finland 75 per cent). On the other hand, the Danish host universities have the lowest specialisation score. Only 56 per cent of the Danish centres are located at universities with a relative specialisation above world average, whereas the figures for the three other countries are higher (Sweden 78 per cent, Finland 72 per cent and Norway 65 per cent).

Table 4.1 Bibliometric indicators for the host universities by field, 2005-2008/9.

Main area	***Specialisation index Average	Specialisation index Proportion >1.0	**Citation index Average	Citation index Proportion > 1.0	N*
Agriculture, Fisheries & Forestry	1.29	83%	1.26	100%	6
Biology	1.34	96%	1.25	100%	23
Biomedicine	1.13	85%	1.01	51%	41
Chemistry	1.00	33%	1.42	89%	9
Engineering & Materials Sciences	1.12	66%	1.20	90%	64
Geosciences	1.31	100%	1.27	100%	7
Health Sciences	1.08	55%	1.13	76%	29
Physics & Mathematics	1.05	44%	1.23	100%	25

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.
*Number of centres.
**Citation index: Based on fractionalized citation indicators based on the publications from the period 2005-2008. The citation indicators are presented as field normalized citation indexes, where an index value of 1.00 is the 'world average' for the aggregated field. An index value of 1.10 represents citation rates ten per cent above the world average.
***Specialisation index: Relative Specialization Index (RSI) based on publication counts for the period 2005-2009. RSI will take its values in the range 0 to < 2. The value indicates whether a university has a higher-than-average activity in the world in a scientific field (RSI >1) or a lower-than-average activity (RSI <1).

Table 4.2 Bibliometric indicators for the host universities by country, 2005-2008/9.

Country	Specialisation index Average	Specialisation index Proportion > 1.0	Citation index Average	Citation index Proportion > 1.0	*N	Ref. citation index**
DK	1.04	56%	1.34	94%	55	1.27
FI	1.17	72%	1.08	75%	53	1.05
NO	1.14	65%	1.11	86%	23	1.08
SE	1.20	78%	1.14	79%	73	1.13

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.
*Number of centres.
**Overall citation index for the country. See notes to previous table and Section 4.1.3 for explanation of the indicators.

4.1.2 Detailed results by research area and host institution

We repeat that the indicators presented are not for the centres, but for the host-institutions in the relevant field.

Table 4.3 Bibliometric indicators for the host universities. Field: Agriculture, Fisheries & Forestry.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publications
DK	Technical University of Denmark	2	1.23	1.51	514.3
FI	University of Eastern Finland	1	1.37	1.06	316
	University of Helsinki	1	1.33	1.17	781.6
NO	Norwegian University of Life Sciences	1	1.76	1.20	450.9
	University of Bergen	1	0.84	1.11	144

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.4 Bibliometric indicators for the host universities. Field: Biology.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publications
DK	Aarhus University	1	1.41	1.50	429.1
	Technical University of Denmark	1	0.88	1.54	145.6
	University of Copenhagen	5	1.37	1.20	615.4
	University of Southern Denmark	1	1.13	1.14	90.1
FI	University of Helsinki	2	1.43	1.26	581.7
	University of Jyväskylä	2	1.43	1.12	139
	University of Oulu	1	1.27	1.17	142.6
	University of Turku	2	1.37	1.15	205.4
NO	University of Bergen	1	1.38	1.11	255.3
	University of Oslo	1	1.20	1.32	281.5
	University of Tromsø	1	1.53	1.28	159.3
SE	Lund University	2	1.29	1.33	480.7
	Swedish University of Agricultural Sciences	1	1.62	1.35	420.9
	University of Gothenburg	1	1.36	1.27	317.5
	Uppsala University	1	1.26	1.35	399.6

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.5 Bibliometric indicators for the host universities. Field: Biomedicine.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publica-tions
DK	Aarhus University	2	1.09	0.95	795.7
	University of Copenhagen	5	1.26	1.12	1791.6
	University of Southern Denmark	1	1.25	1.48	435.5
FI	Aalto University	1	0.45	0.84	115.1
	University of Helsinki	9	1.21	1.05	1306.2
	University of Oulu	2	0.96	0.85	280.3
	University of Turku	4	1.13	0.81	459.1
NO	Norwegian University of Science and Technology	1	0.74	1.13	293
	University of Oslo	3	1.08	1.00	806.2
SE	Karolinska Institutet	2	1.37	1.15	2029.4
	Linköping University	1	0.89	0.75	291.3
	Lund University	4	1.16	1.00	1364.4
	Royal Institute of Technology	1	0.58	0.88	244.9
	Stockholm University	1	1.10	1.15	571.2
	Umeå University	1	1.16	0.98	537.2
	University of Gothenburg	1	1.17	0.97	729.1
	Uppsala University	1	1.23	1.01	1396.1

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.6 Bibliometric indicators for the host universities. Field: Health Sciences.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publi-cations
DK	Aarhus University	2	0.86	1.22	953.3
	Technical University of Denmark	1	0.28	1.11	213.3
	University of Copenhagen	2	0.94	1.24	1749.4
FI	University of Eastern Finland	1	0.97	1.16	560.8
	University of Helsinki	1	0.90	1.18	1325.7
	University of Jyväskylä	1	0.84	0.95	284.8
	University of Tampere	1	1.37	1.11	541.3
	University of Turku	1	1.08	1.09	792.9
NO	Norwegian University of Science and Technology	1	0.80	1.03	634.7
SE	Karolinska Institutet	7	1.36	1.22	3813.8
	Linköping University	2	1.05	0.95	767.3
	Lund University	4	0.97	1.00	1770.4
	Umeå University	2	1.14	1.10	996.7
	University of Gothenburg	3	1.20	1.17	1609.1

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.7 Bibliometric indicators for the host universities. Field: Geosciences.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publications
DK	University of Copenhagen	2	1.23	1.33	326.3
FI	University of Helsinki	1	1.17	1.14	236.1
NO	University of Bergen	1	1.62	1.38	359.6
	University of Oslo	1	1.39	1.12	308.4
SE	Lund University	1	1.01	1.20	198.5
	Stockholm University	1	1.53	1.40	301.4

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.8 Bibliometric indicators for the host universities. Field: Chemistry.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publications
DK	Aarhus University	2	0.93	2.22	426
	Technical University of Denmark	1	1.06	1.44	574.2
FI	Aalto University	1	1.00	1.21	290.3
	Åbo Akademi University	1	1.40	0.90	232.9
	University of Helsinki	1	0.86	1.22	468.8
NO	University of Tromsø	1	0.74	1.16	78.6
SE	Chalmers University of Technology	1	1.16	1.11	400.7
	Lund University	1	0.95	1.31	659.6

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.9 Bibliometric indicators for the host universities. Field: Physics & Mathematics.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publications
DK	Aarhus University	1	1.00	1.48	667.1
	Roskilde University	1	1.08	-	46.3
	University of Copenhagen	6	0.82	1.33	719.4
	University of Southern Denmark	1	0.85	1.08	189.7
FI	Aalto University	4	1.34	1.11	800.6
	University of Helsinki	4	0.86	1.33	643.4
	University of Jyväskylä	1	1.31	1.43	394.1
NO	University of Oslo	1	0.99	1.20	673.9
SE	Chalmers University of Technology	2	1.33	1.03	790.9
	Lund University	1	0.94	1.39	868.3
	Royal Institute of Technology	2	1.37	1.06	1306
	Stockholm University	1	1.06	1.13	518

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

Table 4.10 Bibliometric indicators for the host universities. Engineering & Materials Sciences.

Country	University	Number of centres in the field	Specia-lisation-index	Citation index	Publi-cations
DK	Aalborg University	2	1.46	1.01	607.1
	Aarhus University	4	0.56	1.60	271.7
	Technical University of Denmark	8	1.33	1.42	1432.2
	University of Copenhagen	3	0.38	1.42	259.2
	University of Southern Denmark	1	0.59	0.77	113.9
FI	Aalto University	2	1.50	1.13	1223.9
	Åbo Akademi University	2	1.34	1.29	284.8
	Tampere University of Technology	3	1.55	0.80	494.3
	University of Helsinki	2	0.48	1.30	280.8
	University of Turku	1	0.75	0.76	219
NO	Norwegian University of Life Sciences	1	0.51	-	47.3
	Norwegian University of Science and Technology	6	1.35	1.02	1081.3
	University of Bergen	1	0.72	1.27	250.2
	University of Oslo	1	0.65	1.07	347.1
SE	Chalmers University of Technology	5	1.46	1.18	1110.4
	Linköping University	5	1.20	1.04	568
	Luleå University of Technology	1	1.53	0.91	355.2
	Lund University	5	0.85	1.40	756.9
	Royal Institute of Technology	8	1.39	1.12	1436.4
	Stockholm University	1	0.53	1.43	172.8
	Uppsala University	2	0.83	1.06	646.1

Source: Data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities'/Thomson Reuters.

4.1.3 Data sources and definitions of the bibliometric indicators

We have applied data developed for the NORIA-net project 'Bibliometric Indicators for the Nordic Universities' to assess the host institutions' strength in the relevant research fields. In this project the publications of each university have been classified in eight broad fields, based on the 248 journal subject classes used by Thomson Reuters: Agriculture, Fisheries & Forestry, Biology, Biomedicine, Chemistry, Engineering & Materials Sciences, Geosciences, Health Sciences, and Physics & Mathematics. Social Sciences and Humanities are not included in the project and have accordingly been excluded from the present analysis (but Psychology is included under Health Sciences).

Based on the scientific profile of the centres we have (tentatively) classified them under one of these broad fields. In order to do this classification, we have looked at the research profile of the centres and classified them within the field that appeared most appropriate. This was not always an easy task. For example, Center for Biomebrane Physics at the University of Southern Denmark is classified within Engineering & Materials Sciences, but could also be classified within Physics or Biomedicine. As the University of Southern Denmark has different specialisation and citation rates within different fields, the results of the analysis would have been different by choosing another category.

From the NORIA-net report the following indicators have been collected:

- Measures of research activity based on fractionalized publication counts for the period 2005-2009.
- Impact measures based on fractionalized citation indicators based on the publications from the period 2005-2008.
- Specialisation measures (Relative Specialization Index (RSI)) based on publication counts for the period 2005-2009.

The latter indicator gives an overview of a university's research profile or specialization by comparing the shares of fields of science among the university's total publications to the overall shares of each field among the world's total publications. RSI is a relative indicator which is based upon the Activity Index (AI). The Activity Index is defined as:

$$AI = \frac{\text{the share of the given field in the publications of the given university}}{\text{the share of the given field in the world total of publications}}$$

The RSI is then defined as:

$$RSI = 1 + \frac{AI - 1}{AI + 1}$$

RSI will take its values in the range 0 to < 2. The value indicates whether a university has a higher-than-average activity in the world in a scientific field (RSI >1) or a lower-than-average activity (RSI <1).

The citation indicators are presented as field normalized citation indexes, where an index value of 1.00 is the 'world average' for the aggregated field. An index value of 1.10 represents citation rates ten per cent above the world average.

Based on the field classification of the centres, we have retrieved the relevant indicators for the universities. For example, the Bjerknes Centre for Climate Research (BCCR) at the University of Bergen is classified with Geosciences. The citation index for the University of Bergen is 1.38 in this field, and the university has a specialisation index of 1.62.

4.2 Host institutions' success in EU applications (FP7)

4.2.1 Summary results

To what extent are the excellence centres allocated to host institutions which are successful in terms of attracting international research funds? Based on data from a major source for international research funding, the EU Framework programme (FP7), this section analyses of the institutions' success rates for 7th FP applications, and ERC grants in particular.

The table below shows overall FP7 participation figures for the four countries. There is no significant difference between the countries' overall success rates, but the contribution per capita is significantly lower for Norway than for the other countries. The number of ERC grants is also much lower in Norway, both in numbers and in relation to the population.

Table 4.11 FP7 success: overall figures by country, November 2011.

Country	Success rate FP7 proposals	Number of approved proposals	EU contribution (k€) to approved proposals	EU contribution (k€) per participation	EU contribution € per capita (pop. levels from OECD)	Number of ERC grants	% of EU contribution to ERC grants
Danmark	24,5%	1599	558 721	349	102	40	10 %
Finland	23,0%	1674	548 731	328	104	42	12 %
Norge	24,3%	1342	423 770	316	90	21	9 %
Sverige	24,2%	2730	950 979	348	104	86	15 %

Source: FP7 data has been made available through the Research Council of Norway. Extraction of the data is from the CORDA database for project proposals per November 2011.

Table 4.12 shows aggregated FP7 participation figures for those research institutions that host excellence centres (hereafter named 'host institutions') in each country. The host institutions altogether account for 49 per cent the four countries' participations in FP7, and 59 per cent of the contribution from EU/FP7 to the four countries. The host institutions dominate the ERC grants and also have a higher average contribution per participation (over average is k€ 407 per host institution participation[16] compared to 316 to 349 for all participations in the four countries, see table above). Only 6 out of 189 ERC grants cannot be traced to an institution with an excellence centre (identified institutions with an ERC grant but no excellence centres are listed in the notes to Table 4.12).

Table 4.12 Excellence centres' host institutions: FP7 success by country.

Country	Number of host institutions	Number of centres	Number of ERC grants	Number of FP7 participations	Host institutions' share of country's participations	EU contribution (k€) in approved proposals	Host institutions' share of EU contribution*
Danmark	12	71	37	856	54 %	317 506	57 %
Finland	11	75	40	862	51 %	339 465	62 %
Norge	20	53	20	533	40 %	234 347	55 %
Sverige	14	88	86	1362	50 %	579 080	61 %
Total 4 countries	57	**287	183	3613	49 %	1 470 398	59 %

Source: FP7 data has been made available through the Research Council of Norway. Extraction of the data is from the CORDA database for project proposals per November 2011.

*All rows show national figures for the institutions which host excellence centres, e.g. this column shows the host institutions' share of EU contribution (FP7) to the country.

**Compared to a total of 189 ERC grants in the four countries (cf. previous table). Institutions that have obtained ERC grants but do not host an excellence centre include Copenhagen Business School (DK); NIVA (NO); Research Institute of the Finish Economy; Finish Meteorological Institute (FI).

[16] Denmark 371, Finland 394, Norway 440 and Sweden 425.

There is a rather high correlation between number of approved ERC grants and the number of centres at the host institutions (Table 4.13). For most universities with ERC grants, the ERC grants are a significant part of the EU contribution, close to 50 per cent for both Stockholm University and University of Helsinki (Tables 4.14 to 4.17).

Table 4.13 Excellence centres' host institutions: ERC grants by number of excellence centres.

Rank	Host institution	Country	Number of centres	Number of ERC grants
1	University of Helsinki	FI	33	22
2	University of Copenhagen	DK	25	14
3	Lund University	SE	21	13
4	Aarhus University	DK	16	15
5	Technical University of Denmark	DK	13	5
6	KTH - Royal Institute of Technology	SE	11	12
7	University of Turku	FI	10	3
8	Karolinska Institutet	SE	9	18
8	Linköping University	SE	9	6
8	NTNU	NO	9	4
8	Stockholm University	SE	9	11
8	University of Oslo	NO	9	10
13	Aalto University	FI	8	8
13	Chalmers University of Technology	SE	8	5
15	Uppsala University	SE	7	10
16	SINTEF	NO	6	
16	University of Gothenburg	SE	6	8
16	University of Jyväskylä	FI	6	1
16	University of Southern Denmark	DK	6	2
20	University of Bergen	NO	5	4
21	Tampere University of Technology	FI	4	
22	Christian Michelsen Research	NO	3	
22	Statens Serum Institut	DK	3	1
22	Umeå University	SE	3	2
22	University of Oulu	FI	3	
22	University of Tromsø	NO	3	2
22	VTT	FI	3	1
22	Åbo Akademi University	FI	3	

Source: FP7 data has been made available through the Research Council of Norway. Extraction of the data is from the CORDA database for project proposals per November 2011.
The table below shows the number of centres and the number of ERC grants sorted by numbers of excellence centres at the host institution. All host institutions with at least three excellences centres are included.

Whereas there is no categorisation of the FP7-applications into research fields, the *Cooperation* part of the FP7 is divided into thematic subprogrammes. The table below shows the EU-contribution to the CoE host institutions, split on the ten relevant *Cooperation* subprogrammes. The figures indicate different relative strengths in the different countries. Swedish host institutions get the highest share of their FP7 funding from the *Health* subprogramme (35 per cent of the contribution to the Swedish host institutions), whereas Norway here has the lowest share (13 per cent). Norway on the other hand has the highest share of funding from *Energy* (16 per cent) and *Environment* (13 per cent, slightly higher than Denmark), while Finland the highest share from *ICT* (32 per cent). The Danish CoE hosts have the highest share from the food subprogramme (*BIO*). In the other subprogrammes there are no significant differences apart from *Security* where the Danish CoE hosts have a small activity (1 per cent compared with the others 5-6 per cent. Compare also Table 3.7 showing the distribution of CoEs by research areas in the four countries.

Table 4.14 Excellence centres' host institutions: EU contribution from the Cooperation programme within FP7, by subprogramme and country. Per cent.

Subprogramme	Denmark	Finland	Norway	Sweden
HEALTH	23 %	20 %	13 %	35 %
BIO	16 %	10 %	7 %	8 %
ICT	16 %	32 %	25 %	24 %
NMP	13 %	14 %	13 %	12 %
ENERGY	10 %	5 %	16 %	2 %
ENVIRONMENT	12 %	3 %	13 %	5 %
TRANSPORT	3 %	4 %	3 %	5 %
SSH	3 %	3 %	3 %	2 %
SPACE	2 %	2 %	2 %	0 %
SECURITY	1 %	5 %	6 %	5 %
Total funding *Cooperation* (k€)	203 799	241 556	168 042	364 635
Total funding FP7(k€)	317 506	339 465	234 347	579 080
Cooperation as share of FP7*	64 %	71 %	72 %	63 %

Source: FP7 data has been made available through the Research Council of Norway. Extraction of the data is from the CORDA database for project proposals per November 2011. Only FP7 contribution to institutions hosting centres funded by national CoE schemes are included in the analyses.

* Note that *Cooperation* accounts for a larger part of the EU-contribution to Finland and Norway, than to Denmark and Sweden. The main reason for this difference is that research institutes have few ERC-grants and their majority of EU-contribution is from Cooperation.

4.2.2 Detailed results by country and host institution

Table 4.15 Denmark: Excellence centres' host institutions success in FP7.

Host institution	Number of centres	Success rate FP7 proposals	Number of approved proposals	EU contribution (k€) in approved proposals	Number of ERC grants	% of EU contribution from ERC grants	Number as large beneficiary in FP7*
University of Copenhagen	25	26 %	244	92 783	14	21 %	25
Aarhus University	16	25 %	170	63 956	15	34 %	54
Technical University of Denmark	13	26 %	247	93 473	5	6 %	26
University of Southern Denmark	6	18 %	46	19 534	2	21 %	200
Statens Serum Institut	3	33 %	17	6 017	1	28 %	
Aalborg University	2	19 %	81	26 581			159
Danish Cancer Society	1	50 %	13	5 475			
Danish Meteorological Institute	1	36 %	18	5 148			
Institute of Preventive Medicin	1						
Odense University Hospital	1	27 %	4	444			
Rigshospitalet	1	10 %	4	1 611			
Roskilde University	1	13 %	12	2 483			

*The 'ranking' of beneficiaries is from the contract database, where the latest contract was signed 18 October 2011. The remaining columns present figures per November 2011 from the CORDA database.

Table 4.16 Finland: Excellence centres' host institutions success in FP7.

Host institution	Number of centres	Success rate FP7 proposals	Number of approved proposals	EU contribution (k€) in approved proposals	Number of ERC grants	% of EU contribution from ERC grants	Number as large beneficiary in FP7*
University of Helsinki	33	20 %	160	79 864	22	49 %	32
University of Turku	10	19 %	59	18 599	3	9 %	
Aalto University	8	23 %	121	41 457	8	29 %	115
University of Jyväskylä	6	16 %	36	8 718	1	9 %	
Tampere University of Technology	4	7 %	13	2 957			
University of Oulu	3	18 %	51	16 647			
VTT	3	24 %	287	127 231	1	1 %	17
Åbo Akademi University	3	20 %	22	5 519			115
University of Eastern Finland	2	21 %	48	15 309	2	23 %	
University of Tampere	2	14 %	26	10 094	3	39 %	
National Public Health Institute	1	45 %	39	13 069			

*The 'ranking' of beneficiaries is from the contract database, where the latest contract was signed 18 October 2011. The remaining columns present figures per November 2011 from the CORDA database.

Table 4.17 Norway: Excellence centres' host institutions success in FP7.

Host institution	Number of centres	Success rate FP7 proposals	Number of approved proposals	EU contribution (k€) in approved proposals	Number of ERC grants	% of EU contribution from ERC grants	Number as large beneficiary in FP7
NTNU	9	17 %	72	34 452	4	26 %	121
University of Oslo	9	19 %	94	40 166	10	42 %	89
SINTEF	6	25 %	150	86 109			28
University of Bergen	5	21 %	67	28 807	4	29 %	134
Christian Michelsen Research	3	33 %	1	217			
University of Tromsø	3	27 %	28	10 266	2	37 %	
Institute for Energy Technology	2	19 %	6	1 623			
Norwegian University of Life Sciences	2	17 %	19	3 162			
Oslo University Hospital	2	20 %	22	6 450			
Simula Research Laboratory	2	9 %	3	1 511			
CICERO	1	22 %	4	978			
Institute of Marine Research	1	58 %	32	9 676			
International Research Institute of Stavanger	1	11 %	1	200			
Microsoft Development Center Norway	1						
Norwegian Computing Center (NR)	1	18 %	6	2 604			
Norwegian Geotechnical Institute	1	28 %	8	3 257			
Norwegian School of Economics	1	25 %	2	419			
Peace Research Institute Oslo	1	39 %	16	4 077			
Ragnar Frisch Centre for Economic Research	1	100 %	1	169			
University Hospital of North Norway	1	5 %	1	203			

*The 'ranking' of beneficiaries is from the contract database, where the latest contract was signed 18 October 2011. The remaining columns present figures per November 2011 from the CORDA database.

Table 4.18 Sweden: Excellence centres' host institutions success in FP7.

Host institution	Number of centres	Success rate FP7 proposals	Number of approved proposals	EU contribution (k€) in approved proposals	Number of ERC grants	% of EU contribution from ERC grants	Number as large beneficiary in FP7
Lund University	21	23 %	214	88 702	13	26 %	29
KTH - Royal Institute of Technolgy	11	22 %	188	80 212	12	24 %	24
Karolinska Institutet	9	25 %	219	120 248	18	26 %	18
Linköping University	9	19 %	65	27 418	6	32 %	145
Stockholm University	9	21 %	90	34 001	11	50 %	109
Chalmers University of Technology	8	27 %	156	59 876	5	18 %	53
Uppsala University	7	24 %	145	61 028	10	26 %	61
University of Gothenburg(SE)	6	25 %	113	50 879	8	29 %	76
Umeå University	3	19 %	49	19 868	2	12 %	208
Karlstad University	1	13 %	9	1 745			
Luleå University og Technology	1	26 %	38	16 585			
Mälardalen University	1	20 %	13	2 194			
Swedish University of Agricult. Sciences	1	23 %	62	16 231	1	9 %	
University of Gävle	1	7 %	1	94			

*The 'ranking' of beneficiaries is from the contract database, where the latest contract was signed 18 October 2011. The remaining columns present figures per November 2011 from the CORDA database.

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Appendix 1 Overview of other excellence schemes

As evident from the account of the policies for research excellence in the four countries (Chapter 2), there are diverse portfolios of excellence schemes – comprising much more than centres of excellence. Below is a tentative overview of the schemes that are *not* included in the mapping of CoEs in Chapter 3. The table gives a brief overview of other kinds of schemes than the centres schemes, split on schemes funding individual researchers and organisational level schemes. The lists below the table give key information on all kinds of excellence schemes – including centre schemes funded by private foundations and terminated centre schemes.

Table A 1 Overview of excellence policies and instruments in Denmark, Finland, Norway and Sweden (excl. centre schemes)

Type	Individual schemes	Organisational level instruments (for task division, specialisation, etc)
Denmark	• *Professorships programmes:* The Niels Bohr Professorship Program; The Niels Bohr Visiting Professorships; The DNRF Professorships • *Sapere Aude* researcher career programme • *Responsive mode funding*	• *UNIK:* globalisation funds distributed to the universities based on proposals. • *Strategic research alliances:* One of three instruments in the thematic calls of Danish Council for Strategic Research. • *Universities' own excellence programmes*
Finland	• *Professorships programmes* • *Responsive mode funding* • Academy of Finland funds to 'almost' ERC successful applicants	• *Universities' own excellence programmes*
Norway	• *YFF* (Young excellent researchers) RCN scheme / RCN funds to 'almost' ERC successful applicants • *FRIPRO* (general responsive mode funding, RCN)	• *SAK* - initiatives to increase division of work, collaboration and concentration
Sweden	• *Responsive mode funding (various schemes)*	• *Strategic research areas* (SFO) in the 2008 research policy bill. Twenty pre-specified fields.

Source: Web pages of the funding agencies and various policy documents. See sections 2.2-2.5 above for more information.

Denmark

UNIK

- Objective: Meet challenges related to the globalisation of research
- Funds distributed to the universities based on proposals. Four proposals funded starting in 2009 (five-year-grants). About €13 million annually (see Table 2.1). No new call for proposals so far.

Technology platforms

- Objective: Collaboration between companies and research institutions to develop path breaking technology.
- Funded by The Danish National Advanced Technology Foundation. First platforms 2005 (3-5 year scheme). 25 platforms established.

VKR Centres of Excellence

- Objective: Strengthen selected research environments with a potential for scientific advancement and researcher recruitment.
- Funded by the Villum Foundation from 2004. 11 centres established within technology and natural sciences.

The Lundbeck Foundation CoEs

- Objective: To establish Centres of Excellence within medical and natural sciences.
- Thematic calls for proposals. 15 centres established. Last centres established 2009 (5-year scheme).

Finland

Strategic Centres for Science, Technology and Innovation (SHOKs)

- Administrated by TEKES, first centres 2007, 6 centres established, all active in 2011.
- Objectives, terms and budget: see section 2.3.4 and Table 2.1.
- Available studies/evaluations: Study of network governance 2011.

Academy professor positions

- Objectives: To support internationally top-level scientists and allow them to work full-time on research.
- Terms of funding: Funding covers salary for the academy professor and a research grant covering research costs, salary costs of a research team, as well as costs related to national and international collaboration and mobility.
- Total budget: €6 million in 2010.

FiDiPro

- Objectives: The FiDiPro instrument aims to attract top-level researchers from abroad to come to Finland to carry out research and to develop the Finnish research environment. This is expected to strengthen Finnish science, increase the internationalisation of the Finnish research system, create new collaboration between research and companies R&D activities and support the research-driven profiling of universities and research institutes.
- Terms of funding: Funding coves salary and travel expenses, research costs and related expenses of accompanying family members. Funding may also be used for setting up a research team.
- Total budget: In 2010, Academy of Finland €11 million euros. Tekes also provides funds. Cost for one FiDiPro professor is around €500 000 - 1 000 000.

Academy of Finland Grants to ERC applicants

- Objectives: To support applicants who have been close to obtaining ERC funding in the previous call.
- Terms of funding: Maximum one year funding and it can be obtained only once.
- Total budget: €1 million in 2011.

Norway

YFF (Young excellent researchers)

- Objective: Provide talented young researchers with particularly good research conditions to achieve international top class research.
- Funding scheme organised by the Research Council of Norway. Last call in 2006. Now ‘replaced’ by RCN funds to ERC almost successful applicants.
- Terms: Funding for each awardee is about NOK 2.5 million annually for 5 years. Eligibility: Hold a PhD no older than 8 years.

SAK - Initiatives to increase division of work, collaboration and concentration

- Objective: Introduced in 2009 to enhance quality, effectiveness, concentration and specialisation between higher education institutions.
- Funding: Annual budget about NOK 50 million (2010-2012), distributed on the basis of project applications from higher education institutions (single institutions or consortia). Much of the

funding so far has been to project aimed at education, not research. Average project size for the 21 projects funded in 2010 was €0.3 million.

Responsive mode support (FRIPRO)

- Objectives: Promote research of outstanding scientific quality, scientific renewal and development of basic theory and methods.
- General funding scheme organised by the Research Council of Norway. Open national competitive scheme for research project funding, low success rates.
- Budget: NOK 720 million in 2012 (including 100 million from the higher education institution to fund almost successful applications within their institution).

Sweden

Strategic Research Areas (SFO)

- Initiated in the 2008 research policy bill to promote concentration, specialisation and international competiveness. Twenty pre-specified fields, defined by parliament.
- The review of applications is organised by the Swedish Research Council, FORMAS and VINNOVA. 42 research environments (often spanning to or more universities) receive from SEK 5 to 30 million per year (for a five year period, and may after an evaluation be extended without a time limit).

Berzelii Centres

- Objectives: Both scientific and innovation/economic rationales.
- Collaboration between the Swedish Research Council and VINNOVA, from 2005 (10-year-scheme).
- 4 centres established, listed on vr.se. Funding 2010: SEK 40 million from VINNOVA and SEK 20 million from Swedish Research Council.

Strong Research Environments

- Administrated by the Swedish Research Council. First centres 2006, 5-year-scheme, 10 centres established, ended 2010.

Riksbankens Jubileumsfond – Programme grants

- Average size of programmes is SEK 35 million (total for 6 to 8 years) for the humanities and social sciences. Max three new programmes funded each year.
- Rationale: Responsive mode funding, scientific quality is the decisive criterion for funding.

Appendix 2 Field classification of centres

Table A 2 Overview of field classifications of centres included bibliometric mapping

Country	Host university	Name of centre	Classified within
DK	Aalborg University	Center Of Reliable Power Electronics (CORPE)	Engineering & Materials Sciences
DK	Aalborg University	Strategic Research Centre on Zero Emmission Buildings	Engineering & Materials Sciences
DK	Aarhus University	Center for Functionally Integrated Neuroscience (CFIN)	Biomedicine
DK	Aarhus University	Center for Insoluble Protein Structures (INSPIN)	Biomedicine
DK	Aarhus University	Center for Massive Data Algorithmics (MADALGO)	Engineering & Materials Sciences
DK	Aarhus University	Center for Materials Chrystallography (CBC)	Engineering & Materials Sciences
DK	Aarhus University	Center for Oxygen Microscopy and Imaging (COMI)	Chemistry
DK	Aarhus University	Center on Autobiographical Memory Research (CON AMORE)	Health Sciences
DK	Aarhus University	Centre for Carbohydrate Recognition and Signaling (CARB)	Chemistry
DK	Aarhus University	Centre for DNA Nanotechnology (CDNA)	Engineering & Materials Sciences
DK	Aarhus University	Centre for Energy Materials (CEM)	Engineering & Materials Sciences
DK	Aarhus University	Centre for Membrane Pumps in Cells and Disease (PUMPKIN)	Health Sciences
DK	Aarhus University	Centre for mRNP Biogenesis and Metabolism (mRNP)	Biology
DK	Aarhus University	Centre for Quantum Geometry of Moduli Spaces (QGM)	Physics & Mathematics
DK	Roskilde University	Centre for Viscous Liquid Dynamics (Glass and Time)	Physics & Mathematics
DK	Technical University of Denmark	Biological Production of Dietary Fibres and Prebiotics	Agriculture, Fisheries & Forestry
DK	Technical University of Denmark	Center for Computational Wind turbine Aerodynamics and Atmospheric Turbulence (COMWIND)	Engineering & Materials Sciences
DK	Technical University of Denmark	Center for Individual Nanoparticle Functionality (CINF)	Chemistry
DK	Technical University of Denmark	Center for molecular epidemiology/Center for genomic epidemiology	Health Sciences
DK	Technical University of Denmark	Center for Power Generation from Renewable Energy (GREEN)	Engineering & Materials Sciences
DK	Technical University of Denmark	Centre for Metal Structures in Four Dimensions (M4D)	Engineering & Materials Sciences
DK	Technical University of Denmark	Danish Centre for Composite Structures and Materials for Wind Turbines (DCCSM)	Engineering & Materials Sciences
DK	Technical University of Denmark	Design of microbial communities in membrane bioreactors: the next generation of environmental biotechnologies	Biology
DK	Technical University of enmark	InSPIRe - Danish Industry-Science Partnership for Innovation and Research in Food Science	Agriculture, Fisheries & Forestry
DK	Technical University of Denmark	iPower - Strategic Platform for Innovation and Research in Intelligent Power	Engineering & Materials Sciences
DK	Technical University of Denmark	Knowledge Based Engineering for Improves Reliability of Critical Wind Turbine Components (REWIND)	Engineering & Materials Sciences
DK	Technical University of Denmark	Strategic Electrochemistry Research Center (SERC)	Engineering & Materials Sciences
DK	Technical University of Denmark	Strategic Research Center in Precision and Nano-scale Polymer Mass Fabrication (POLYNANO)	Engineering & Materials Sciences
DK	University of Copenhagen	A strategic centre for the development and implementation of biotechnology for bioenergy (Bio4Bio)	Biology
DK	University of Copenhagen	Center for Antimicrobial Research (CAR)	Health Sciences
DK	University of Copenhagen	Center for Computational and Applied Transriptomics (COAT)	Physics & Mathematics
DK	University of Copenhagen	Center for GeoGenetics	Biology
DK	University of Copenhagen	Center for Macroecology, Evolution and Climate (CMEC)	Biology
DK	University of Copenhagen	Center for Models of Life (CMOL)	Biology
DK	University of Copenhagen	Center for non-coding RNA in Technology and Health (RTH)	Biomedicine
DK	University of Copenhagen	Center for Particle Physics – DISCOVERY	Physics & Mathematics
DK	University of Copenhagen	Center for Quantum Optics (Quantop)	Physics & Mathematics
DK	University of Copenhagen	Center fpr Social Evolution (CSE)	Biology
DK	University of Copenhagen	Centre for Epigenetics	Biomedicine

DK	University of Copenhagen	Centre for Ice and Climate	Geosciences
DK	University of Copenhagen	Centre for Molecular Movies	Physics & Mathematics
DK	University of Copenhagen	Centre for Pharmaceutical Nanotechnology Nanotoxicology (CPNN)	Biomedicine
DK	University of Copenhagen	Centre for Star and Planet Formation (StarPlan)	Geosciences
DK	University of Copenhagen	Centre for Symmetry and Deformation (SYM)	Physics & Mathematics
DK	University of Copenhagen	Centre for Textile Research (CTR)	Engineering & Materials Sciences
DK	University of Copenhagen	Centre of Energy, Environment and Health (CEEH)	Engineering & Materials Sciences
DK	University of Copenhagen	Danish Arrhytmia Research Center (DARC)	Health Sciences
DK	University of Copenhagen	Danish Stem Cell Center (DanStem)	Biomedicine
DK	University of Copenhagen	Dark Cosmology Centre (DARK)	Physics & Mathematics
DK	University of Copenhagen	Functional High Performance Computing for Financial Information Technology (HIPERFIT)	Engineering & Materials Sciences
DK	University of Copenhagen	Wilhelm Johannsen Centre for Functional Genome Research (WJC)	Biomedicine
DK	University of Southern Denmark	Center for Biomembrane Physics (MEMPHYS)	Engineering & Materials Sciences
DK	University of Southern Denmark	Centre for Particle Physics & Origin Mass (CP3 – Origins)	Physics & Mathematics
DK	University of Southern Denmark	Nordic Center for Earth Evolution (NORDSEE)	Biology
DK	University of Southern Denmark	Nucleic Acid Center (NAC)	Biomedicine
FI	Aalto University	Bio- and Nanopolymers Research Group	Chemistry
FI	Aalto University	CoE in Computational Nanoscience	Physics & Mathematics
FI	Aalto University	CoE in Generic Intelligent Machines Research	Engineering & Materials Sciences
FI	Aalto University	CoE in Low Temperature Quantum Phenomena and Devices - Low Temperature Laboratory	Physics & Mathematics
FI	Aalto University	CoE in Systems Neuroscience and Neuroimaging Research	Biomedicine
FI	Aalto University	Computational Nanoscience (COMP) -	Physics & Mathematics
FI	Aalto University	COSY - CoE in Computational Complex Systems Research	Physics & Mathematics
FI	Aalto University	Finnish CoE in Computational Inference Research / Adaptive Informatics Research Centre	Physics & Mathematics
FI	Aalto University	SMARAD - CoE in Smart Radios and Wireless Research	Engineering & Materials Sciences
FI	Tampere University of Technology	Institute of Hydraulics and Automation (IHA)	Engineering & Materials Sciences
FI	Tampere University of Technology	Laboratories of Compound Semiconductor Technology and Surface Science	Engineering & Materials Sciences
FI	Tampere University of Technology	The Signal Processing Algorithm Group (SPAG) - CoE in Signal Processing	Engineering & Materials Sciences
FI	University of Eastern Finland	CoE in Cardiovascular Diseases and Type 2 Diabetes Research	Health Sciences
FI	University of Eastern Finland	Research Unit for Forest Ecology and Management	Agriculture, Fisheries & Forestry
FI	University of Helsinki	Algodan - CoE in Algorithmic Data Analysis Research / From data to knowledge (02-07)	Engineering & Materials Sciences
FI	University of Helsinki	Applied Microbiology Research Unit	Agriculture, Fisheries & Forestry
FI	University of Helsinki	Biocentrum Helsinki	Biomedicine
FI	University of Helsinki	CoE in Analysis and Dynamics Research / Research Unit of Geometric Analysis and Mathematical Physics	Physics & Mathematics
FI	University of Helsinki	CoE in Cancer Biology	Biomedicine
FI	University of Helsinki	CoE in Cancer Genetics Research	Biomedicine
FI	University of Helsinki	CoE in Complex Disease Genetics CoECDG	Biomedicine
FI	University of Helsinki	CoE in Computational Molecular Science	Chemistry
FI	University of Helsinki	CoE in Molecular and Integrative Neuroscience Research	Biomedicine
FI	University of Helsinki	CoE in Physics, Chemistry, Biology and Meteorology of Atmospheric Composition and Climate Change	Geosciences
FI	University of Helsinki	CoE in Plant Signal Research	Biology
FI	University of Helsinki	Developmental Biology Research Programme	Biology
FI	University of Helsinki	Finnish Centre of Excellence in Atomic Layer Deposition	Engineering & Materials Sciences
FI	University of Helsinki	Finnish Centre of Excellence in Inverse Problems Research / CoE in Inverse Problems	Physics & Mathematics
FI	University of Helsinki	Finnish CoE in Virus Research	Biomedicine
FI	University of Helsinki	Helsinki Bioenergetics Group	Physics & Mathematics

FI	University of Helsinki	Helsinki Brain Research Centre (HBRC)	Biomedicine
FI	University of Helsinki	Hereditary Disorders Research Unit	Health Sciences
FI	University of Helsinki	Metapopulation Research Group (MRG) - CoE in Metapopulation Research	Physics & Mathematics
FI	University of Helsinki	MiFoSa - Finnish Centre of Excellence in Microbial Food Safety Research	Biomedicine
FI	University of Helsinki	Tissue Engineering and Medical, Dental and Veterinary Biomaterial Research Group	Biomedicine
FI	University of Jyväskylä	CoE in Evolutionary Research	Biology
FI	University of Jyväskylä	CoE in Learning and Motivation Research	Health Sciences
FI	University of Jyväskylä	CoE in Nuclear and Accelerator Based Physics	Physics & Mathematics
FI	University of Jyväskylä	Finnish Centre of Excellence in Biological Interactions Research	Biology
FI	University of Oulu	Biocenter Oulu	Biology
FI	University of Oulu	Centre of Population Genetic Analyses	Biomedicine
FI	University of Oulu	Finnish Centre of Excellence in Cell-Extracellular Matrix Research	Biomedicine
FI	University of Tampere	FinMIT - CoE in Research on Mitochondrial Disease and Ageing	Health Sciences
FI	University of Turku	BioCity-Turku	Biomedicine
FI	University of Turku	Cell Surface Receptors in Inflammation and Malignancies	Biomedicine
FI	University of Turku	CoE in Host Defence Research	Biomedicine
FI	University of Turku	CoE in Integrative Photosynthesis and Bioactive Compound Research at Systems Biology Level	Biology
FI	University of Turku	CoE in Molecular Imaging in Cardiovascular and Metabolic Research	Biomedicine
FI	University of Turku	Research Programme on Male Reproductive Health	Health Sciences
FI	University of Turku	Research Team for Ecology and Animal Systematics	Biology
FI	University of Turku	Turku Centre for Computer Science (TUCS)	Engineering & Materials Sciences
FI	Åbo Akademi University	CoE in Formal Methods in Programming	Engineering & Materials Sciences
FI	Åbo Akademi University	CoE in Functional Materials - Center for Functional Materials (FUNMAT)	Engineering & Materials Sciences
FI	Åbo Akademi University	Åbo Akademi Process Chemistry Centre (ÅAPCC) - CoE in Process Chemistry	Chemistry
NO	Norwegian University of Life Sciences	Aquaculture Protein Centre (APC)	Agriculture, Fisheries & Forestry
NO	Norwegian University of Life Sciences	Bioenergy Innovation Centre (CenBio)	Engineering & Materials Sciences
NO	Norwegian University of Science and Technology	Centre for Quantifiable Quality of Service in Communication Systems (Q2S)	Engineering & Materials Sciences
NO	Norwegian University of Science and Technology	Centre for Ships and Ocean Structures (CeSOS)	Engineering & Materials Sciences
NO	Norwegian University of Science and Technology	Centre for the Biology of Memory (CBM)	Biomedicine
NO	Norwegian University of Science and Technology	IO-CENTER - Center for Integrated Operations in the Petroleum Industry	Engineering & Materials Sciences
NO	Norwegian University of Science and Technology	MI Lab - Medical Imaging Laboratory	Health Sciences
NO	Norwegian University of Science and Technology	SIMLab - Structural IMpact Laboratory	Engineering & Materials Sciences
NO	Norwegian University of Science and Technology	Sustainable Arctic Coastal and Marine Technology,	Engineering & Materials Sciences
NO	Norwegian University of Science and Technology	The Research Centre on Zero Emission Buildings (ZEB)	Engineering & Materials Sciences
NO	University of Bergen	Bjerknes Centre for Climate Research (BCCR)	Geosciences
NO	University of Bergen	Centre for Geobiology (CGB)	Biology
NO	University of Bergen	Centre for Integrated Petroleum Research (CIPR)	Engineering & Materials Sciences
NO	University of Bergen	Salmon Louse Research Centre	Agriculture, Fisheries & Forestry
NO	University of Oslo	Centre for Cancer Biomedicine (CCB)	Biomedicine
NO	University of Oslo	Centre for Ecological and Evolutionary Synthesis (CEES)	Biology
NO	University of Oslo	Centre for Immune Regulation (CIR)	Biomedicine
NO	University of Oslo	Centre for Molecular Biology and Neuroscience (CMBN)	Biomedicine
NO	University of Oslo	Centre of Mathematics for Applications (CMA)	Physics & Mathematics
NO	University of Oslo	INGAP - Innovative Natural Gas Processes and Products	Engineering & Materials Sciences
NO	University of Oslo	Physics of Geological Processes (PGP)	Geosciences

NO	University of Tromsø	Centre of Theoretical and Computational Chemistry (CTCC)	Chemistry
NO	University of Tromsø	MABCENT - Marine bioactives & drug discovery	Biology
SE	Chalmers University of Technology	Chase - Chalmers Antenna Systems Excellence center	Engineering & Materials Sciences
SE	Chalmers University of Technology	Engineered quantum systems (Linneqs)	Physics & Mathematics
SE	Chalmers University of Technology	GigaHertz Centrum	Engineering & Materials Sciences
SE	Chalmers University of Technology	Strategiskt forskningscentrum för matematisk modellering	Physics & Mathematics
SE	Chalmers University of Technology	Strategiskt forskningscentrum för mikrovågs- och antennsystem	Engineering & Materials Sciences
SE	Chalmers University of Technology	SuMo Biomaterials	Engineering & Materials Sciences
SE	Chalmers University of Technology	SUPRA – A Linnaeus Centre for Bioinspired Supramolecular Function and Design at Chalmers	Chemistry
SE	Chalmers University of Technology	Wingquist Laboratory Excellence Centre for Efficient Product Realization	Engineering & Materials Sciences
SE	Karolinska Institutet	A Strategic Research Center in Developmental Biology for Regenerative Medicine	Biomedicine
SE	Karolinska Institutet	Ageing Research Centre	Health Sciences
SE	Karolinska Institutet	Centre for Hearing and Communication Research	Health Sciences
SE	Karolinska Institutet	CERIC - a Linné Center for Research on Inflammation and Cardiovascular Disease	Health Sciences
SE	Karolinska Institutet	Linné Centre for Prevention of Breast and Prostate cancer: CrisP	Health Sciences
SE	Karolinska Institutet	STARGET – a cancer research network for studies of the diagnostic, prognostic and therapeutic potential of mesenchymal cells of the tumor stroma	Health Sciences
SE	Karolinska Institutet	Strategiskt forskningscentrum för kognitiv neurovetenskap och matematisk modellering	Biomedicine
SE	Karolinska Institutet	The Human Regenerative Map	Health Sciences
SE	Karolinska Institutet	Working life: Interdisciplinary research on job-related stress and health	Health Sciences
SE	Linköping University	FunMat - Functional Nanoscale Materials	Engineering & Materials Sciences
SE	Linköping University	HELIX - Managing Mobility for Learning, Health and Innovation	Health Sciences
SE	Linköping University	Linköping Linnaeus Initiative for Novel Functional Materials (LiLi-NFM)	Engineering & Materials Sciences
SE	Linköping University	Linnaeus Centre for Research on Hearing and Deafness, HEAD: Excellence in the field of Cognitive Hearing Science	Health Sciences
SE	Linköping University	Strategiskt forskningcentrum för modellbygge, visualisering och informationsintegration	Engineering & Materials Sciences
SE	Linköping University	Strategiskt forskningscentrum för organisk bioelektronik	Biomedicine
SE	Linköping University	Strategiskt forskningscentrum inom material- och nanovetenskap för avancerad ytteknologi	Engineering & Materials Sciences
SE	Linköping University	The Linnaeus Center for Control, Autonomy, and Decision-making in Complex Systems, CADICS	Engineering & Materials Sciences
SE	Luleå University of Technology	Faste Laboratory - Centre for Functional Product Innovation	Engineering & Materials Sciences
SE	Lund University	a cross-disciplinary research and technological platform combining neuroscience, nano- and microtechnology and biotechnology	Biomedicine
SE	Lund University	Antidiabetic FoodCentre	Biomedicine
SE	Lund University	Bagadilico - nya terapier för sjukdomar i basala ganglierna	Biomedicine
SE	Lund University	Centre for Ageing and Supportive Environments	Health Sciences
SE	Lund University	Centre for Animal Movement Research	Biology
SE	Lund University	Dissection of the genetic and metabolic complexity of diabetes and its complications	Health Sciences
SE	Lund University	Exploring and Controlling the States of Matter with Light – Multidisciplinary Laser Spectroscopy within the Lund Laser Centre	Physics & Mathematics
SE	Lund University	Hemato-Linné	Biomedicine
SE	Lund University	LUCID — Lund University Centre of Excellence for integration of social and natural dimensions of sustainability	Biology
SE	Lund University	Lund Center for Control of Complex Engineering Systems, LCCC	Engineering & Materials Sciences
SE	Lund University	Lund Centre for studies of Carbon Cycle and Climate Interaction, LUCC	Geosciences
SE	Lund University	METALUND – Centre for medicine and technology for working life and society	Health Sciences
SE	Lund University	Nanoscience and Quantum Engineering	Engineering & Materials Sciences
SE	Lund University	Organizing Molecular Matter	Chemistry

SE	Lund University	Strategiskt forskningscentrum för studier av förbränningsprocesser	Engineering & Materials Sciences
SE	Lund University	Strategiskt forskningscentrum för tillämpningar av nanotrådar	Engineering & Materials Sciences
SE	Lund University	Strategiskt forskningscentrum för translationell cancerforskning	Health Sciences
SE	Lund University	Strategiskt forskningscentrum för trådlös höghastighetskommunikation	Engineering & Materials Sciences
SE	Lund University	The Neuronano Research Center –	Biomedicine
SE	Royal Institute of Technology	A blueprint for future flow research	Engineering & Materials Sciences
SE	Royal Institute of Technology	ACCESS - Autonomic Complex Communication nEtworks, Signals and Systems	Engineering & Materials Sciences
SE	Royal Institute of Technology	BiMAC	Engineering & Materials Sciences
SE	Royal Institute of Technology	Centre for ECO2 Vehicle Design	Engineering & Materials Sciences
SE	Royal Institute of Technology	Centre for Sustainable Communications	Engineering & Materials Sciences
SE	Royal Institute of Technology	HERO-M - Hierarchic Engineering of Industrial Materials	Engineering & Materials Sciences
SE	Royal Institute of Technology	iPack Center - Ubiquitous Intelligence in Paper and Packaging	Engineering & Materials Sciences
SE	Royal Institute of Technology	ProNova VINN Excellence Centre for Protein Technology	Biomedicine
SE	Royal Institute of Technology	Strategiskt forskningscentrum för biomimetisk fiberteknologi	Engineering & Materials Sciences
SE	Royal Institute of Technology	Strategiskt forskningscentrum för industriell och tillämpad matematik	Physics & Mathematics
SE	Royal Institute of Technology	the Linneaus center for Advanced Optics and Photonics	Physics & Mathematics
SE	Stockholm University	Climate evolution, variability and sensitivity	Geosciences
SE	Stockholm University	Mobile Life Centre	Engineering & Materials Sciences
SE	Stockholm University	Strategiskt centrum för biomembranforskning	Biomedicine
SE	Stockholm University	The Oskar Klein Centre for Cosmo Particle Physics at Stockholm University, OKC	Physics & Mathematics
SE	Swedish University of Agricultural Sciences	Insect Chemical Ecology, Ethology and Evolution, ICE3	Biology
SE	Umeå University	Ageing and Living Conditions	Health Sciences
SE	Umeå University	FAS Centre for Global Health Research	Health Sciences
SE	Umeå University	Umeå Centre for Microbial Research, UCMR	Biomedicine
SE	University of Gothenburg	BIOMATCELL	Biomedicine
SE	University of Gothenburg	EpiLife	Health Sciences
SE	University of Gothenburg	Linnaeus Centre for Marine Evolutionary Biology (CeMEB)	Biology
SE	University of Gothenburg	Strategiskt forskningscentrum för kardiovaskulär och metabol forskning	Health Sciences
SE	University of Gothenburg	Strategiskt forskningscentrum för slemhinnebiologi och vacciner	Health Sciences
SE	Uppsala University	Strategic funding of Uppsala RNA Research Center (URRC)	Biomedicine
SE	Uppsala University	Strategiskt forskningscentrum för funktionell genetik - metabolism och sjukdomar	Biomedicine
SE	Uppsala University	The Genomics of Phenotypic Diversity in Natural Populations	Biology
SE	Uppsala University	Uppsala Programming for Multicore Architectures Research Center, UPMARC	Engineering & Materials Sciences
SE	Uppsala University	Uppsala VINN Excellence Center for Wireless Sensor Network (WISENET)	Engineering & Materials Sciences

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