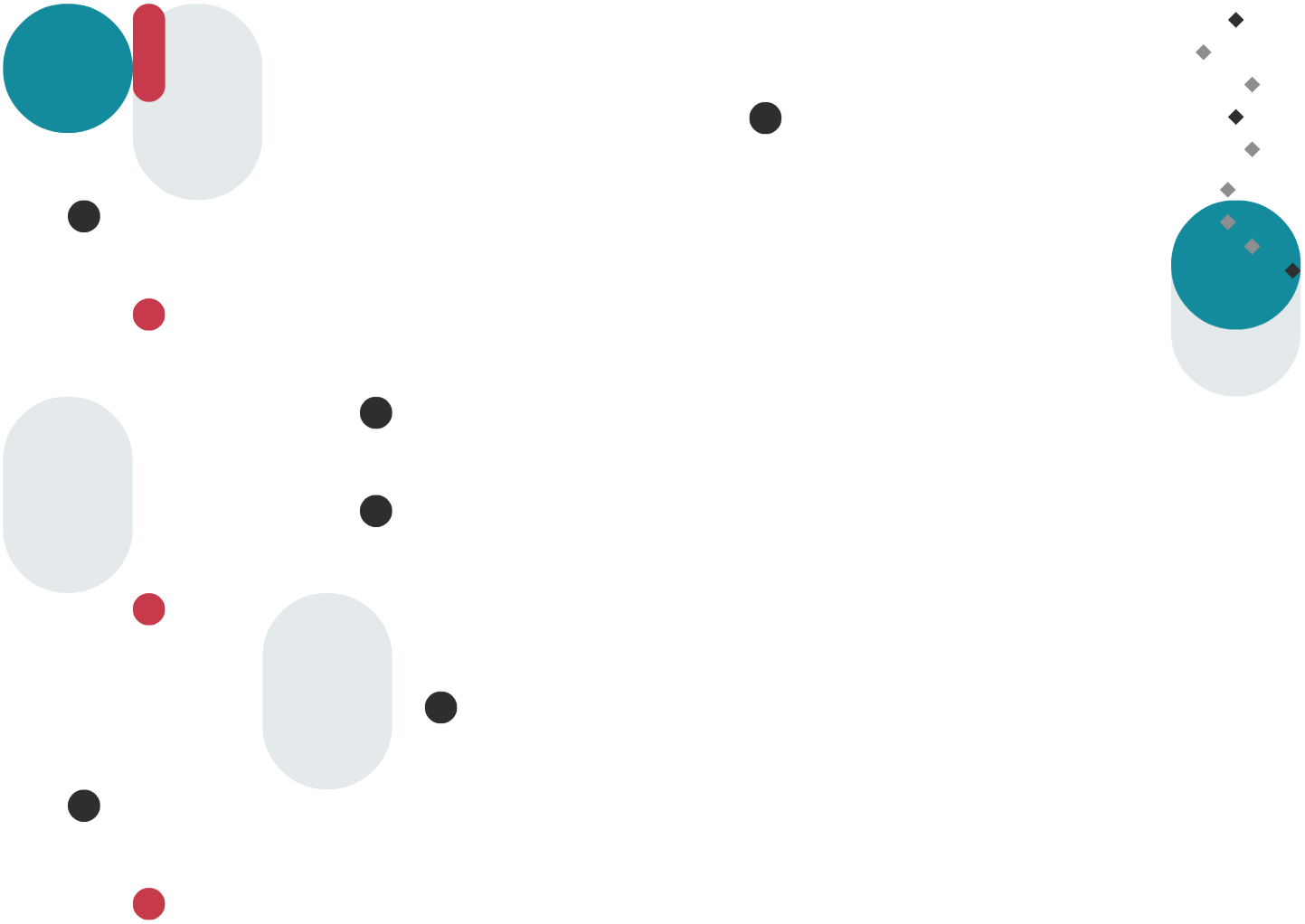

Excellence initiatives in Nordic research policies

Policy issues – tensions and options

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Working Paper 10/2013

NIFU

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Preface

This report presents results from a research project (PEAC)[1] studying the impact of funding schemes for Centres of Excellence (CoE) in the Nordic countries. The project is sponsored by the Research Council of Norway (the FORFI programme) and aimed at improving the knowledge base for research and innovation policy. The target groups of this report are the CoEs' host institutions, the funding agencies and the policy makers at the governmental level. Further results from the project will be published in scientific journals.

A preliminary version of the report was presented as a point of departure for discussions at the PEAC conference 7th May 2013 (Appendix 4), from which the present report includes input.

The report presents summary results of comparative case studies of the impact of excellence centre schemes in four countries and indicates policy challenges. It 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), Gunnar Sivertsen (NIFU).

Oslo, June 2013

Sveinung Skule
Director

[1] Full title «coping with globalisation: how do Policies to promote Excellence Affect the research Community?"

Contents

Main issues

The introduction of schemes for Centres of Excellence (CoE) has contributed to raising standards in the Nordic research system, fostering entrepreneurial activity among Nordic scholars, and forcing universities to concentrate activities around environments and topics in which they can excel.

At the same time, the impact of CoE schemes may be disputed: they skew the distribution of resources, primarily rewarding already existing strongholds rather than fostering new ones; they may not fit all research areas equally well; their focus on large constellations may impede bottom-up renewal and hamper the establishment of younger scholars; they risk driving a wedge between research and education; and their gender profile is debatable.

The preliminary findings of the PEAC project indicate that:

- The impact of CoE schemes varies: long-term flexible funding from the CoE schemes provides more leeway for different kinds of collaboration, new alliances and interdisciplinarity, and risk-taking more generally. In some cases the schemes support the building of new research units with a separate identity across departmental, faculty and institutional borders. In other cases the schemes strengthen and rejuvenate already strong and well established research environments and involve few organisational changes.
- In the majority of the cases, the centres have attracted much funding in addition to the centre grant. Some have obtained ERC grants and other prestigious long-term funding. The additional funding enables extensive research activities and boosts the research fields; in many cases the centres have the size of regular departments with 50 to 150 researchers, including large numbers of PhDs and in many centres also postdocs. Still, in some cases the project portfolio is somewhat fragmented and extra effort/coordination is needed to facilitate synergies.
- The role of the centre leader seems particularly important in terms of entrepreneurial capacities and laying the ground for the cumulative advantages of the excellence status and long-term funding.
- Measured bibliometrically, most of the studied centres are high performing groups. Their citation rates were well above the world average in their field of research before they obtained their CoE status. In most cases the publication and citation rates of the principal investigators increased during the CoE period. It is difficult, however, to see any general impact on international collaboration. The proportion of internationally co-authored publications has increased in only a minority of cases.
- We found a broad set of local impacts upon the host institutions: on the positive side, impacts include added value for host institutions in terms of recruiting highly competent and international researchers, rejuvenation, more students, increased ambitions in the local research environment, and contribution to local research infrastructures. On the negative side, we found increased local

competition for resources, space, personnel, and frictions generated by new organisational structures and scarce resources. New units with separate identities, and units crossing organisational boundaries, more easily provoke local friction than centres with little local visibility already integrated with existing structures.

Policy issues needing further elaboration

Chapter 3 of this report identifies different perspectives and challenges pertaining to CoE policy, as well as a request for more direct dialogue between the funding agencies and the CoEs and their host institutions. Below is a list of identified key issues needing further elaboration and where more direct dialogue may help improve national excellence initiatives.

How to formulate aims and terms of CoE schemes and provide for divergent needs across different fields and kinds of research:

- The importance of centre identity, organisation and institutionalisation varies between the studied centres as does the degree of renewal. This discussion includes for example how to combine expectations for renewal and high-risk, high-gain research, with demands for an impressive scientific track-record when selecting CoEs, and whether CoE schemes should target only research efforts needing 'centre structures', or be open for all kinds of research in need of long-term flexible funding in order to succeed.

How to combine concentration of resources (elitism) and good general conditions for research:

- Added value for the selected groups/CoEs is important for their success, but may have negative consequences for neighbouring research fields and groups. This discussion includes how the terms of the CoE schemes – e.g. demands for local co-funding, the size, duration and academic scope of the CoEs – should be adjusted in order to promote positive and avoid negative local impact.

How to ensure balanced recruitment at the centres, avoiding unintended effects:

- Recruitment to the CoEs is often faster and less bureaucratic than within ordinary university structures, presenting a golden opportunity for recruiting young researchers, female leaders and important foreign expertise, and whatever is missed in fixed/rigid academic structures. The studied centres have, to varying degrees, seized this opportunity in terms of recruiting younger and female group leaders. Moreover, there is substantial international recruitment, which accentuates the dilemmas concerning temporary centres, and maintaining competencies and activity after the centre period.

How to maintain CoE competencies and activity after the CoE period and at the same time ensure host institutions' autonomy and room for strategic thinking:

- One of the ambitions behind the CoE schemes has been to foster strategic thinking among universities. The data indicate that the host institutions mostly respond to the demands of the CoE schemes without much prior strategy, and support 'all groups' which succeed in major external competitions. Lasting impacts of the CoEs depend on the institutions' ability and willingness to provide for the centres after the CoE-period, underlining the importance of the universities' priorities both prior to the application process and at the termination of a CoE-period.

How to design appropriate and effective CoE policies, taking into account their systemic effects and their role and weight within the broader portfolio of policy instruments:

- The PEAC project has observed that centre policies in the Nordic countries diverge in several respects, not only in their internal design, but also in terms of function in, and impact on, the overall research system. There are indications that the stability and longevity of Danish DNRF-scheme, as the dominant centre scheme in Denmark, has contributed to the improved performance of Danish science over a sustained period of time. Since its inception in the early 1990s the scheme has pursued a long-term policy that has remained stable during this period. By

focusing on research excellence objectives alone and using a relatively stable set of instruments, it seems to have succeeded in improving conditions for a sufficiently large number of research groups and environments to have achieved system-wide impacts. In comparative terms, the relative role and impact of CoE-policy seems to be less salient in Finland where the CoE scheme of the Academy of Finland has been relatively minor, and appropriations to each centre relatively small. Its impacts may also have been less salient, as this policy for research excellence has been developed and implemented in the shadow of dominant technology policy and its powerful instruments. In Norway, centre policies seem to have gained increasing importance and impact during the decade they have existed, partly due to relatively large centre appropriations and the concomitant growth dynamics sustained by, inter alia, high institutional co-funding and enhanced competitiveness. Stable centre policies seem gradually to have triggered developments towards stronger strategic orientation at host institutions, but they still hesitate to set priorities before the CoE-status is awarded. While Swedish centre schemes have been models for similar schemes in other countries, they have been more fragmented, short-lived and/or unstable; their system-wide impacts appear to be less certain within a system where the dependence of HEI research on external funding from a large number of various support schemes is particularly high. Hence, the development and implementation of CoE policies need to take into account interactions and balance between instruments and the institutional and funding structures which they are, or may be, intended to supplement or modify.

1 Introduction

During the last two decades a number of research policy instruments have been developed to enhance the conditions for selected research groups and to enable them to establish themselves as powerful players within an increasingly open, global and competitive research system. Through more extensive coordination of activities and concentration of resources on the best and strongest performers, efforts are made to create conditions of critical mass, international visibility and enhanced scientific and economic competitiveness. Centres of Excellence are expected to become highly visible poles of attraction, both to the best talents among increasingly mobile researchers looking for outstanding work conditions and creative work environments, and to volatile investment capital searching for high-tech and R&D-intensive investment opportunities.

In many countries these polices seem to imply that a sizeable proportion of resources available to research is being redistributed, and may have strong restructuring effects on research institutions. These processes may be amplified as the research groups awarded excellence status gain advantages in building reputation and in competition for additional research funding (Langfeldt et al. 2010; Hjelt et al. 2009; Godø et al 2009: 93). In other words, research excellence initiatives seem to generate cumulative advantages for the beneficiaries and may have profound structural effects on the general conditions for performing research, for the allocation of resources and for the role of national funding schemes in defining and creating excellence.

The PEAC research questions

The main objective of the PEAC project is a better knowledge base for research and innovation policy for the formation of centres of excellence. This report presents the results from a comparative case study of excellence schemes in Denmark, Finland, Norway and Sweden (Chapter 2), and points out some challenges for policy-makers (Chapter 3). Key questions include:

- **Does organisation matter?** To what extent and in what ways do excellence schemes promote new kinds of research units and activities? To what extent are organisational changes/centre organisation needed to achieve the research aims of the centres?
- **Added value:** How and to what extent do centres benefit from and exploit cumulative advantages that their status and conditions provide? What affects how well the centres are able to play their cards and profit from the excellence status and long-term funding?
- **How do the centres impact upon their research environments?** To what extent has the establishment of centres affected internal distribution of resources at their host institutions? Do the centres promote competition or cooperation? How do they affect international recruitment and the opportunities for young scholars and for female leaders?

In the first report from the PEAC project, the excellence policies and centres profiles in Denmark, Finland, Norway and Sweden were mapped and compared (Aksnes et al. 2012). Key findings included:

- CoE schemes are introduced based on different opportunities and arguments. The various schemes have scientific and economic aims as well as broader social objectives. The scientific objectives include international visibility and competitiveness, resource concentration, researcher recruitment and restructuring of the research system.
- The CoE funding accounts for 2.5 to 6.1 per cent of national governments' R&D expenditures in the four countries studied (figures for 2010). The number of centres and annual funding provided by the centre schemes, as well as the terms for host institutions co-funding, vary between the countries.
- A lack of gender balance: comparing the proportion of female centre leaders with the overall percentage of female professors in each of the four countries, the share of female centre leaders is below what could be expected (in total 12 per cent female centre leaders).
- Concentration of resources: in all countries a few universities host a large number of the centres. A large part of the centres are within biomedicine/health sciences (29 per cent) and engineering sciences (28 per cent). Studying the general competitiveness of the host institutions we find that they have high citation rates in the relevant fields of research. Moreover, there is a correlation between the number of approved ERC grants and CoEs.

Data: Four countries, eight funding schemes and twelve cases

At this second stage of the PEAC-project we have studied 12 centres funded by eight different funding schemes for temporary research centres in Denmark, Finland, Norway and Sweden. Table 1.1 gives an overview of the eight schemes studied. The schemes have different scopes and aims, and centre duration and size (in terms of funding), and the terms for host institution's co-funding vary.

Two schemes in each country are studied, one ordinary CoE scheme with mainly scientific objectives, and one other scheme with either economic/innovation or broader social objectives.

- In Denmark, the Centres of Excellence (CoE) scheme funded by the Danish National Research Foundation, and the Strategic research centres funded by the Danish Council for Strategic Research are included.
- In Finland, the for Centres of Excellence (CoE) scheme funded by the Academy of Finland, and the Strategic Centres of Science, Technology and Innovation (SHOKs) scheme funded by Tekes and the Academy of Finland are included.
- In Norway, the schemes for Centres of Excellence (SFF) and Centres for Research-based Innovation (SFI) funded by the Research Council of Norway are included.
- In Sweden, the Linnaeus Environments funded by the Swedish Research Council and the VINN Excellence Centres funded by VINNOVA are included.

Comparing the four schemes with mainly scientific objectives (the upper one under each country in Table 1.1), the average annual funding per centre varies between €0.5 mill. to the Finnish CoEs and €1.4 mill. to the Norwegian CoEs. Comparing all eight, the Finnish SHOKs are by far the largest, with an average funding of €16.5 mill. per year. The SHOKs are also dissimilar in other respects: they are not hosted by research organisations, but are separate non-profit limited companies, and may have more in common with 'Centres of Expertise' than Centres of Excellence (Lähteenmäki-Smith et al. 2013).

In addition to the funding from the centre scheme, centres' budgets may include both extensive co-funding from host institutions and partners, as well as other grants and funding. The last column in Table 1.1 lists the terms for co-funding. In most cases there are no fixed terms for co-funding for the ordinary CoE schemes (schemes with mainly scientific objectives) – co-funding from host institutions is required but may vary. The Swedish Linnaeus Environments are the exception with a fixed 'in cash' co-funding of SEK 1 mill. per centre per year, and a requirement for 50 per cent co-funding in total (including funding 'in kind'). The schemes with economic/innovation objectives have more fixed

requirements for co-funding from hosts and partners. The SHOK-scheme requires at least 30 per cent co-funding, the SFI-scheme requires 50 per cent and the VINN Excellence-scheme requires a total of SEK 14 mill. per centre (from host and partners in total).

Table 1.1 Excellence centre schemes studied, terms and average size

Scheme, funding agency and start year	Centre period	Number of active centres	Scheme funding per centre 2010 mill. Euro* (annual average)	Co-funding (per centre)
Denmark				
Centres of Excellence (CoE) The Danish National Research Foundation, 1993, (scientific rational)	10-year-scheme	48	1.01	Co-funding expected, no fixed percentage.
Strategic research centres, Danish Council for Strategic Research, 2007 (strategic/social challenges rational)	5-7-year-scheme	31	0.65	Co-funding expected from participating public and private-sector actors.
Finland				
Centres of Excellence in research (CoE) Academy of Finland, 1995 (scientific rational)	6-year-scheme	33	0.52	Co-funding required, no fixed percentage.
SHOKs – Strategic Centres of Science, Technology and Innovation, Tekes and the Academy of Finland, 2007, (innovation/economic rational)	No set period/may vary	6	16.50	SHOKs shareholders contribute to the research they take part in. Tekes funding is max. 70 %.
Norway				
Centres of Excellence (CoE/SFF), Research Council of Norway, 2003, (scientific rational)	10-year-scheme	21	1.44	Co-funding required, no fixed percentage. Average contribution 24 % (2009)
Centres for Research-based Innovation (CRE/SFI), Research Council of Norway, 2007, (innovation/economic rational)	8-year-scheme	21	0.91	Host and partners in total 50 %. Company partners at least 25 %.
Sweden				
Linnaeus Environments, Swedish Research Council and Formas, 2006, (scientific rational)	10-year-scheme	40	0.69	Host: 50% (including infrastructure/in kind) of which 1 million SEK per centre per year in cash.
VINN Excellence Centres, VINNOVA, 2005, (innovation/economic rational)	10-year-scheme	18	0.67	14 million SEK from universities and companies (of which university appr. 3 million SEK)

Sources: The web sites of the funding agencies and the centres. Aksnes et al. 2012, which provide a comprehensive overview.
*Exchange rates (1 July 2010): NOK 0.1243; SEK 0.1042; DKK 0.1343.

The twelve cases studied are presented in Appendix 1. Three centres in each country were studied, two from 'ordinary' CoE schemes (mainly scientific objectives) and one from a scheme with economic/innovation or broader social/strategic objectives. The overall concern in the case selection was to allow a comparative design describing and explaining common characteristics and mechanisms, as well as some tentative conclusions about differences between countries and research areas. Similar research areas are studied in all four countries to facilitate comparison: the fields dominating the CoE schemes – biomedicine and engineering/ICT/material sciences – are covered in all countries. In addition, fields with a particular national emphasis were selected (e.g. geosciences in Norway, ICT in Finland and Sweden). Within the scope of the study, it has not been possible to include humanities and social sciences in the comparative design. Groups sponsored by multiple sources were included to enable the study of cumulative advantages. Centre period of operation was a key selection criterion in order to study impacts and also ensure easy access to informants: all studied centres had been active (i.e. funded by the centre scheme) for at least 5 years and were still active in 2012.

Data sources include in-depth interviews with centre staff, partners and host institution representatives, as well as available documentation on the centre activities/research portfolio, their annual reports, the publication and citation profiles of key personnel (Appendix 2), and funding data before and during the centre period (Appendix 3).

2 Role and impact of centre-schemes

Based on the case studies in the four countries this chapter presents some preliminary findings regarding the role of centre-schemes and their positive and negative effects.

2.1 Centre organisation

To what extent are 'centres' funded by centre schemes new organisational units, and to what extent do the centre schemes alter research activities, practices and collaboration?

The Centres of Excellence schemes
The extent to which the CoE schemes are designed to have an impact on the organisation of research varies between the four countries:

- Denmark: The CoE scheme entails no requests for specific organisational structures as there is no fixed formula for creating a centre.
- Finland: The CoE scheme has no specific organisational requests except that the centres should have a scientific advisory board.
- Norway: The CoE scheme requires that the centres have a governing board and a scientific advisory board. It also encourages physical co-location of research groups.
- Sweden: The CoE scheme requires a governing board and a scientific advisory board.

All schemes request a well-defined framework for collaboration and emphasise the importance of research leadership.

The organisational terms of the schemes affect the research activities of the centres in different ways. The governing boards appear to have only an approving and more symbolic role with no direct influence on the organisation of research in the centres[2]; they signal however that the centre is a separate organisational unit. The scientific advisory boards are, on the other hand, reported to influence the priorities and direction of research in the centres.

In general, it seems that the organisation of research activities in centres which involve research groups located in the same department or on the same floor prior to the CoE-grant, is affected to a lesser extent than in centres where the centre grant enables an integration of research groups across departmental, faculty and university boundaries. In these centres we see that the grant enables the

[2] This applies to cases where the governing board is composed of members external to the CoE, not for boards composed of the centre partners and taking a role in strategy formulation and allocations of funds.

development of new and joint research projects. The diversity is illustrated by the centres within biomedicine: here we find cases where the CoE scheme supports already strong collaboration between different research environments, involving few organisational changes, and cases where the grant has enabled new collaboration and increased multidisciplinarity.

The impact of the grant on the organisation of research also varies in terms of the size of the funding and the length of the centre period. Data from the cases indicate that the largest regular CoE scheme in this respect, the Norwegian CoE scheme, also has the greatest impact on the organisation of research activities. This is the only scheme that encourages physical co-location of the researchers, and many informants pinpointed the importance of this for the increased collaboration between diverse research groups. In comparison the main organisational rule in the other countries seems to be that researchers remain physically located in their 'home' department (also viable for some Norwegian centres) and that the researchers meet in workshops and seminars with varying frequency; some organise meetings each month, others twice a year. This implies that the centre identity appears to be stronger in Norway compared to the other countries. Notably, the studied Swedish centres seem to be more loosely organised than the centres in the other countries, even though the Swedish scheme requests specific organisational measures.

Overall, it seems that the degree to which the CoE schemes encourage the organisation of new research groups or support the continuation of already strong research groups and collaborations, varies between the countries; changes seems more frequent in the Norwegian cases, and partly in the Swedish, and less frequent in the Danish and Finnish cases.

However, another question is: to what extent was/is organisational change needed to achieve the aim of the centre? This pertains to the degree of complexity in the centre; whether the research questions demand the involvement and integration of new research groups and disciplines, or may be solved based on already developed and strong collaboration ties. We will return to this in Section 3.1.

The strategic/innovation schemes
Compared to the CoE schemes the innovation/strategic schemes involve a third partner – industry and/or public agencies. This raises other challenges concerning the organisation of the activities in the centre. As with the CoE scheme, the Finnish, Norwegian and Swedish schemes require a governing board and they also encourage a scientific advisory board. The governing board seems to function as an arena where the main partners can meet, and in the Finnish SHOK centres the board is the most important decision-making body.

A general trait of many of these centres (the SHOKs not included) seems to be that the education of PhDs is the main activity of the centres, and that collaboration between the partners is organised through joint supervision and mobility of the PhDs between the partners.

2.2 Added value for the centres

High and increasing performance
Measured bibliometrically, most of the studied centres, and 'ordinary' CoEs more so than those of strategic/innovation schemes, are high performing groups. They were well above the world average in their field of research before they obtained their CoE status. Studying the publication and citation rates of the principal investigators/group leaders, we find that in most cases their scores on such quantitative measures increase or are stable in the CoE-period (table below/elaborated in Appendix 2). Hence, there is evidence that in most cases, high performing groups are selected for the CoE schemes.

Table 2.1 Impact on research activity: Key researchers' publication and citation scores before and during centre period

Case*	Data	Res	Prod	Impact	Jnls	Int %	Collaboration abroad
D1	2002-2011	7	HH ↗	HHH →	HH	H →	Italy: European Inst Oncol, FIRC Inst Mol Oncol, Univ Turin.
D2	2001-2011	5	H ↗	HH ↗	HH	HH ↗	Harvard Univ, Max Planck Inst Quantum Opt, Harvard Smithsonian Ctr Astrophys
D3	2002-2011	2	H ↗	H →	H	A →	Lund University, Columbia University
F1	1995-2011	7	H →	HHH ↗	HH	A ↘	Karolinska Inst, Univ Tartu, Estonian Acad Sci, Univ Uppsala
F2	1997-2011	5	HH ↗	HH ↗	A	A ↗	St Petersburg State Polytech Univ, Russian Acad Sci
N1	2002-2011	6	H ↗	HHH ↗	HH	A ↘	Natl Inst Hlth (USA), Univ Copenhagen, Portuguese Oncol Inst
N2	1998-2011	7	L ↗	HHH ↗	HH	H →	Max Planck Inst Meteorol, Woods Hole Oceanog Inst, Aarhus Univ
N3	2002-2011	9	(L) ↗	H ↗	H	H →	Tech Univ Denmark Denmark, Aalborg Portland AS
S1	2001-2011	7	H →	A ↗	H	H ↗	Univ of Coimbra and Univ of Porto (Portugal), Haverford College (USA)
S2	2001-2011	5	(L) ↘	H ↗	L	H ↗	JSC Radiophyzika (Russia) , University Carlos III Madrid (Spain)
S3	2001-2011	8	L ↘	A ↗	A	L →	University of Copenhagen, Technical University of Denmark

*Cases are presented in Appendix 1. F3 is excluded from the analysis, as this case does not include PIs or group leaders.
Data sources: see Appendix 2. **Res=**number of key researchers included in the analysis; **Prod**=Productivity – publications per year, compared to size of group and characteristics of the field; **Impact**=Citation impact – relative to the field, the selected journals and the country of the CoE; **Jnls**=Journal profile – citation impact and characteristics of the journals in which the CoE publishes; **Int%**=percentage of publications with co-authors abroad.
HHH=Extremely High; **HH**=Very High; **H**=High; **A**=Average; **L**=Low.
Arrows indicate change – increase, decrease, stable – after the start-up of the centre period.

Table 2.1 indicates that the Swedish centre schemes have awarded centre grants to groups with somewhat lower publication and citation scores than the schemes in the three other countries; that is, that the Swedish schemes follow a more high-risk strategy in the selection of centres. Based on the limited number of cases, however, no conclusion can be drawn. We do not expect the studied centres to reflect general country differences.

Additional funding

In the majority of the cases, the centres have attracted much additional funding. As a proportion of the total budget of the centres, the centre grant accounts for between 10 and 50 per cent. All have additional funding from host or partners, and most have much additional funding from external sources. Some have obtained ERC-grants and other prestigious long-term funding.

In the innovation/strategic centres, we find no added value in terms of increased funding from the EU Framework programme. In comparison, several of the 'ordinary' CoEs have obtained increased funding from the EU Framework programme after the start-up of the centre period (Appendix 3).

In sum, the additional funding enables extensive research activities and boosts the research fields; in many cases the centres have the size of regular departments with 50 to 150 researchers, including large numbers of PhDs, and in many centres also postdocs.

Large amounts of additional funding from a variety of funding sources for separately defined projects may also imply an increase in the administrative obligations of the centres. While some report that writing applications and reporting to funding agencies is time-consuming, the combination and integration of the objectives and research tasks of the various projects into the centres, are described as straightforward and uncomplicated. In fact, due to the long-term and flexibility of funding, potential tensions in adjusting to objectives of several funding sources may be minor/less evident. In some

cases the project portfolio is somewhat fragmented and extra efforts/coordination are needed to facilitate synergies.

Little measurable impact on international collaboration
The proportion of internationally co-authored publications has increased only in a minority of cases (Table 2.1). In some cases the number of partners in their EU FP projects has increased, but in other cases decreased (Appendix 3). Hence, it is difficult to see any general impact on international collaboration. However, several informants emphasise recruitment of researchers from internationally renowned institutions and internationalisation of the research environment as an important result of the CoE. This recruitment is important for the centres' international networks as well as for their international branding.

Cumulative advantages?
The centres are complex structures of researchers, projects and funding. Informants emphasise that the impact of the various funding sources is difficult to measure, and that it is difficult to single out direct advantages resulting from the centre grant alone.

There seem to be some general experiences concerning the advantages generated by the schemes. Centre status is often highly attractive and may in some cases imply enhanced ability to recruit internationally and attract both eminent team members and new academic and industrial partners. Apart from this, the status itself is found to have little importance. It is foremost the centre funding which facilitates new research, recruitment and collaboration, and lays the ground for high performance and increased success in attracting additional funding and projects. Informants emphasise that it is the track record and achievements that are basis for their success in competition for new grants, and that national CoE schemes, as a brand, only have a limited impact in international competitions. Those who have obtained for instance ERC grants, emphasise that the achievements facilitated by the CoE grant, rather than the CoE status itself, were important for obtaining the additional grant. Some have increased success in national competitions for grants, but cannot say whether the CoE status had any influence on the results.[3] On the other hand, some add that for attracting PhD students and for impressing non-academic partners, the CoE status may be important.

Studying academic added value, the 'ordinary' CoEs seem to have more advantages than centres funded by strategic/innovation schemes. The added value of strategic/innovation centres seems to a limited extent to be measurable in terms of scientific publications and citations, or success in competitions for research grants. Conversely, these centres report added value in terms of new partners, funding from industry and more risk-taking (following new lines of research that could not otherwise be funded). Moreover, the schemes have in some cases contributed to raising the attractiveness of the field, evident inter alia in the number and the quality of the applicants for the PhD positions.

In some of the centres the role of the centre leader and other key personnel seems particularly important. Initiating and establishing research centres demands entrepreneurial capacities and leadership. Such abilities seem important in attracting additional funding, interacting with the local environment/host institutions and laying the ground for cumulative advantages. In other words, characteristics of centre leadership may affect how well the centre is able to play its cards and profit from the excellence status and long-term funding provided by the centre scheme.

2.3 Dependency on the funding from the centre-scheme

Whereas informants have problems identifying and attributing the particular impact of the CoE scheme, they have concurring and clear accounts of the importance of the centre schemes, and how

[3] There are also cases where some national competitions are closed to the CoEs (Denmark and Finland).

they differ from other schemes. The funding from the centre scheme gives long-desired flexibility; the funding is described as a 'strategic buffer' which allows pursuing long-term research interests, enables interdisciplinary collaboration and gives a leeway for pursuing new interesting findings as well as risk-taking.

The degree to which the studied centres depend on the centre grant differs. Some have a small proportion of their income from the centre grant and some have multiple major long-term funding sources which enable them to continue the core activities without the centre grant. For others the dependency of the centre grant is high – they have no other sources for funding crucial positions or projects, or they have generally few other funding sources.

The studied Norwegian centres seem somewhat more dependent upon the centre grant than the other cases. This might be attributed to the fact that the Norwegian CoE scheme allocates larger grants than the other CoE schemes. Similarly, the Finnish centres seem, from the interviews, to be less dependent on the CoE grant, and this may be attributed to the scheme offering only six years and less funding compared with the other CoE schemes. However, in the Finnish system there are no other instruments offering the opportunity for long-term research with no strings attached, and therefore the CoE scheme is emphasised as very important.

The way the centre grant is important is still quite similar in all cases: long-term flexible funding provides more leeway for different kinds of collaboration, new alliances and interdisciplinarity, and risk taking more generally. In some cases this contributes to strengthen and rejuvenate already strong and well established research environments, in other cases to establish new and strong groups.

On average the centre grant makes up about a quarter of the total budget of the centres. The remaining funding stems from the host institution and other external sources, FP7 amongst others. However, in many cases it is difficult to delimit the centres and estimate their total budget. While it is rather straightforward to estimate the budget of the Norwegian cases from their annual reports, such figures are not available for the Swedish cases.

The data indicate that the Swedish researchers have more difficulties in delimiting their centres and there is a weaker 'centre identity'. As in most other cases the centres have additional funding, but in the Swedish centres additional funding sources are not so different from the CoE funding. This contributes to the difficulties of drawing the boundaries of the centre. Another issue is that the researchers' affiliation with the centres varies and in some cases the Swedish centres are more similar to a mini-research council – researchers apply for funding from the centre grant – than a research centre. This makes it more difficult to estimate the centres' dependency on the grant, that is, to what extent the research would have been done without the CoE grant.

Regarding the centres with strategic and innovation rationales, we observe a varying degree of dependency. In fields which are generously funded the dependency is low, i.e. they are not dependent upon the grant for pursuing their research activities. However, the grant facilitates collaboration with industry and for some of the cases the scheme has been an important means to generate close relations with industry. The scheme has further contributed to a boost in the PhD education in the field, and this is emphasised as the main important output by all cases in this project.

2.4 Local impact

The centres' impact on the local host institution

The extent to which the centre schemes are designed to impact upon the local host varies between the countries. In Sweden one explicit goal of the CoE scheme is to influence the local host's strategic priorities; there is more explicit emphasis on the host institutions' role and engagement in the CoEs than is found in the other countries. Nevertheless, the Swedish host institutions seem more indifferent

towards the centres when it comes to prioritising strong research environments and providing extra support for the CoE. This may relate both to the lower level of institutional core funding and the allocation of centres between the Swedish universities. Lund University hosts a large part of the CoEs (14 Linnaeus Environments), which generates local impact in terms of branding Lund as an excellent university, but the university has not been able or willing to provide much additional support to the CoEs. In Norway on the other hand, we see that the CoE scheme has entailed increased local emphasis on strategic prioritising and on facilitating strong research environments. We further see that hosts award centres with additional funding and positions. The latter is also observed in Finland. In Denmark, the host institutions appreciate the centres, but, compared with other schemes, have no particular engagement or strategy for helping or promoting the centres.

However, the CoE brand is important in all countries, and perhaps more for the host institutions than the individual centres. Hosting several CoEs and centres with innovation/strategic objectives signals research environments of high scientific quality and innovativeness.

Local frictions?
As demonstrated above, the studied centres differ in terms of organisational structures, additional funding and added values. These differences provide for varying local impacts. On the positive side, the kind of impacts found include added value for host institutions in terms of recruiting highly competent and international researchers, more (international and domestic) students, rejuvenation, increased ambition in the local research environment, and contribution to local research infrastructures. On the negative side, we find increased local competition for resources, space, personnel, and frictions generated by new organisational structures and scarce resources.

The extent of positive and negative impacts on the host varies between the countries. In Denmark the scheme has been operative since 1993 and in Finland since 1995. Almost 20 years later there are few frictions to detect in the local environments of the case centres in this project. We further observe few frictions in Sweden. This might refer to the plurality of funding options in the Swedish research system and that Swedish researchers are accommodated by similar policy instruments. As noted above, among the countries studied in this project, the Swedish funding system is perhaps the most competitive. In the Norwegian cases we observe in general more perceived tensions, especially around large centres. There is a tendency that the larger the centres and the more impact they generate in terms of organisational structures, additional funding and added values, the more local impact – both positive and negative. Moreover, in Norway the centres seems to have a stronger centre identity compared to the centres in the other countries, which may contribute to frictions in the local environment; the distinctions between insiders and outsider are more visible.

The degrees of friction depend upon whether the centres are integrated in existing structures and have little local visibility, or whether they are new units crossing organisational boundaries. In the latter case, centres more easily provoke friction and strained relations between the centre, the host institution and the local research environment.

Note that we have studied centres hosted by large universities, and impacts might be different in smaller and regional universities, especially those which host few or only one CoE. Hence, the above is most likely not typical across all different national host institutions, and local friction might occur in all countries depending on local context.

Concerning the centres aimed at innovation and strategic rationales we see few tensions in the local environment.

Training new leaders and gender balance
Table 2.2 illustrates variation in local impact in terms of rejuvenation and gender balance in research leadership. In four of eleven centres for which we have information, all key researchers/group leaders are men. In total, 12 of 66 key researchers/group leaders are women (18 per cent). There are however, large variations between the cases, and the sample should not be taken as representative

for CoEs in the four countries or for Nordic CoEs. In particular, the Finnish cases are unlikely to be representative; of the four countries Finland has the highest total proportion of female centre leaders (21 per cent, Table 2.3). In the studied Finnish cases on the other hand, there is not a single key female researcher/group leader.

Table 2.2 also illustrates large variation in the age profile of the principal investigators. In three of the cases, all principal investigators are above 45 years[4], in three cases there is a 50-50 balance or the younger principal investigators are in majority, whereas in the remaining five cases the majority of the PIs are above 45 years (but at least one principal investigator at 45 or younger). In total, 77 per cent of the PIs are over 45.

The large variations indicate that the CoEs may provide an opportunity for rejuvenation and gender balance in research leadership, but that this opportunity is used differently by the CoEs. It should be added that the centres' role in training new research leaders cannot be reduced to statistics according to set age categories. In a large part of the cases, the centres include new research groups and new leadership tasks which may represent a new career stage for the involved researchers regardless of age. Moreover, rejuvenation and training new researchers are key tasks for all the centres. All studied centres have large numbers of junior personnel PhDs/postdocs and/or spend a significant part of the centre grant on PhDs and postdocs.

Table 2.2 Composition of the centres: gender and age of group leaders

Case	Total number group leaders	Male	Female	≤ age45	≥ age46
D1 (CoE)	7	5	2	1	6
D2 (CoE)	5	5	0	3	2
D3 (DSF centres)	2	1	1	1	1
F1 (CoE)	7	7	0	0	7
F2 (CoE)	5	5	0	0	5
N1 (CoE)	6	4	2	0	6
N2 (CoE)	8	6	2	4	4
N3 (SFI)	8	6	2	2	6
S1 (CoE)	8	6	2	2	6
S2 (VinnEx)	5	5	0	1	4
S3 (CoE)	5	4	1	1	4

Data source: PEAC case studies 2012-2013.

* F3 is excluded from the analysis, as this case does not include PIs or group leaders.

In Table 2.3 we have updated the figures on gender of centre leaders, performed for the previous PEAC report. The Table shows that the percentage of female centre leaders is higher in 2013 than in 2011 in all the countries except Norway (the new figures include 234 centres active in 2013). Overall, 15 per cent of the centres in the four countries have a female leader in 2013 (compared to 12 per cent in 2011). Sweden is the country with the most notable increase: 21 per cent of the Swedish centres were led by a woman in 2013, compared to 8 per cent in 2011. Moreover, Sweden is the only country where the proportion of female centre leaders is not lower than the proportion of female professors (in 2012, 20 per cent of professors in Sweden were women, see note to Table 2.3).

The table also shows significant differences between the different kinds of centre schemes. In Denmark, the regular CoE scheme (with scientific rationales) has the highest proportion of female centre leaders, whereas in Norway and Sweden the centre schemes with strategic rationales have the highest proportion. Moreover, not a single one of the 21 centres in the Norwegian SFI scheme (economic/innovation rationale) was led by a woman in 2013.[5]

[4] In the Nordic countries the average age for a PhD-degree varies between 34.3 in Denmark to 38.3 in Finland. Taking into consideration that researchers might apply for ERC starting grant in the eight following years after completion of their PhD, group leaders at 45 and younger are included as 'young' in the table.

[5] One of the SFIs has a female director on leave in 2013; the acting director is a man.

Table 2.3 234 active CoEs in 2013: Gender of centre leader by country and type of centre scheme (2011 figures in brackets). Per cent.

Gender (leader)	DK	FI	NO	SE	Total
Female leader	10.5	21.2	11.3	20.8	15.4
	(7.4)	(18.7)	(13.2)	(8.2)	(11.9)
Male and female*	-	-	-	1.4	0.4
	-	-	-	(2.7)	(0.7)
Male leader	89.5	78.8	88.7	77.8	84.2
	(92.6)	(81.3)	(86.6)	(89.0)	(87.4)
N centres active in 2013	**76**	**33**	**53**	**72**	**234**
(N centres mapped in 2011)**	(68)	(75)	(46)	(73)	(269)
Per cent female centre leaders by type of centre scheme 2013					
Scientific schemes, % female leaders	12.2	21.2	14.3	12.5	14.8
N	41	33	21	40	135
Economic/innovation schemes, % female leaders	0.0	-	0.0	27.8	12.2
N	2	0	21	18	41
Strategic schemes, % female leaders	9.1	-	27.3	35.7	19.0
N	33	0	11	14	58

Source: The web sites of the funding agencies and the centres. 2011 figures from Table 3.8 in Aksnes et al. 2012.
*Shared leadership.
**In addition to active centres, the mapping in 2011 included some terminated Finnish centres.
Percentage of female professors: The percentage of female centre leaders is below the overall percentage of female professors in all countries. 17 per cent of the professors in Denmark, 24 per cent of the professors in Finland, 21 per cent of the professors in Norway and 20 per cent of the professors in Sweden are women.

3 Challenges and dilemmas in excellence policy

Below we present some policy reflections, emphasising dilemmas and challenges for excellence policy. Based on the empirical data, five issues are found to have particular relevance for further and future consideration in policy debates and analytical work on research policy and organisation: (1) the risk profile of CoEs and the extent to which centre schemes aim at altering research practices and collaboration patterns; (2) the importance of centre identity, organisation and institutionalisation; (3) the recruitment profile of the centres and the opportunities for young researchers, female leaders and foreign researchers; (4) the need for concentration of resources versus avoiding negative local impact; (5) host institutions' strategies and implications for institutional autonomy; (6) the need for direct dialogue between the funding agencies and the CoEs and their host institutions.

3.1 Different emphasis on risk and altering research practices

A key goal behind CoE schemes is to propel cognitive change by directing the focus of researchers towards broader/new goals, involving more than one area of specialisation, in intense collaboration with the possibility of fostering new intellectual combinations. However, the schemes should also foster excellence and the selection of candidates for CoE schemes should fulfil criteria of scientific visibility and impact. How do these two forces – renewal and track record – blend?

High risk research

We have seen that a CoE scheme may serve multiple and divergent purposes, in terms of funding centres with different kinds of objectives – both high impact research in well-established fields of research and high risk/blue sky research with little measurable academic impact. In most cases a very solid track record and high probability for success will be essential for a successful CoE application. What would be the conditions for selecting centres doing high risk/blue sky research? Should centre schemes consider funding at least one 'wild card', or do high risk/blue sky research not deserve long-term generous funding? Should CoE funding rather provide the opportunity to do some high risk/blue sky research for those who obtain a CoE based on a track record of high impact research in well-established fields of research? Or are CoE schemes a type of instrument that essentially favours the well-established, due to the extremely competitive selection process, so that other instruments should be used for stimulating high-risk research?

Interdisciplinarity and altering research practices and collaboration patterns

In most cases, the forming of a CoE implies enhanced/new collaboration between established research and/or new research groups and facilitating increased interdisciplinary work. The key motivation for applying for CoE funding is often the need for long-term generous funding to facilitate interdisciplinary and cross group collaboration in order to engage in new research questions. Informants at the centres also emphasise this as the main added value of the CoE schemes. What is needed to pursue a research question – in terms of personnel, organisation and infrastructures – differs from case to case, and a major asset of the CoE schemes is that they are flexible funding instruments and capable of fulfilling these different needs. Moreover, when selecting CoEs it may be difficult to assess the extent of new research dynamics and new interdisciplinary collaboration, and compare between fields of research.

3.2 The importance of centre identity, organisation and institutionalisation varies

One of the ambitions behind the CoE schemes is to stimulate organisational experiments, and foster synergistic collaborations between related groups. Hence, a central goal is to stimulate organisational change within universities/other research organisations and within the template of disciplinary specialisations. Organisation and infrastructure producing cohesion and team spirit/centre identity are said to be essential for some of the centres, and to add to their success. Others seem to do well with very little 'centre structures' and without co-location of the involved researchers. Infrastructure and organisation for close collaboration are particularly important where new groups and new interdisciplinarity are needed to tackle the research tasks. Hence, there are different opinions on whether CoE schemes should target only research efforts needing 'centre structures', or be open for all kinds of research in need of long-term flexible funding in order to succeed.

The study of the experiences in the Nordic countries gives no straightforward answer to this, but indicate that formal centre structures may be 'ornamental' with limited impact on cohesion and integration of the research activities. As seen in Chapter 2, the requirements for centre structures vary between the four countries, but seemingly only partly in accordance with the degree of centre identity and integration found in the studied cases: the Swedish CoE scheme have the same requirements for formal centre structures as the Norwegian CoE scheme, but the studied Swedish CoEs appear more loosely coupled than the Norwegian CoEs. It should be added that the centre model seems to be spreading in Denmark and Norway: the CoE schemes add to a 'centre trend' where centre organisation is adopted both in new national schemes and/or at the universities. No such trend appears in Finland, and Sweden seems to go in the opposite direction: In Sweden centre schemes are currently given less priority, and funding for individuals – in line with ERC grants – seems to be the main concern.

Moreover, centre structures may both facilitate and impede positive local impact of the CoEs. On the one hand, centre structure requirements may entail higher expectations in the CoEs for the host to provide space and infrastructure for a centre, and for local visibility in general, which easily cause frictions and conflicts concerning allocation of local resources. On the other hand, centre structures may be important for obtaining added value and success for the centre, a precondition for any positive local impact (concerning impact on host institution, see Section 3.5).

3.3 Recruiting young researchers, female leaders and foreign researchers

Much of the CoE funding is spent on recruitment, is important for new dynamics and a boost of the research field, and may be a vitamin injection for a new or previously deprived path of research. The recruitment to the CoEs is handled by a small group of people and is often faster and less bureaucratic than within ordinary university structures. Hence, a CoE is a golden opportunity for recruiting young researchers, female leaders and important foreign expertise and whatever is missed in fixed/rigid academic structures. The temporary nature of the centres induces a certain flexibility to their operations and we do witness a more flexible and less path-dependent approach to recruitment. As illustrated in Chapter 2, the studied centres have to varying degrees seized this opportunity in terms of recruiting younger and female group leaders.

In many cases the CoEs have enabled extensive international recruitment of researchers. In this way the CoE schemes facilitate boosting research in areas where there is limited potential for recruiting at the national level, as well as contributing to a general strengthening of international networks. Centres seem inclined to recruit more internationally than groups without centre grants, and they have the financial resources to do so. However, there is no guaranteed outcome of investing in international recruitment. If there are no attractive positions available at the end of the centre period, it is unlikely that the foreign researchers will remain in the country. Hence, international recruitment accentuates the dilemmas concerning temporary centres and maintaining competencies and activity after the centre period. It should be added that the international recruitment, even when temporary, is reported to be important for the centres' success and international network.

3.4 Concentration, reallocation and elitism

The amount of added value of CoEs may depend on local co-funding, the size and terms of the CoE scheme, and the individual CoEs' possibilities of obtaining additional external funding. In addition, the size, duration and academic scope (narrow or broad / degree of relevance for other research groups) of the CoEs may condition different kinds of local impacts – ranging from impacts on local resource allocation, to impacts on working climate, collaboration, norms and attitudes. These impacts may be positive or negative: the CoE may enrich or impoverish its environment in terms of research resources and/or in terms of working climate and attitudes. On the positive side, we may find additional external funding, more positions and more students not only for the CoE, but also for its environments. On the negative side, we may find less funding, positions and students for groups operating in the shadow of one or more CoEs. On the positive side, we may find higher motivations, ambitions and more interdisciplinary collaboration in research environments which are inspired by the success of CoEs and/or interact with CoEs. On the negative side, we may find envy and demotivation in research environments which find the selection of CoEs unfair, have no hope of obtaining long-term flexible funding for their research topics/fields, or more generally dislike elitist research policy.

Hence, it is hard to predict the impact on the research environment. Moreover, impacts may be mixed. For instance, envy may not necessary go along with demotivation. It may also heighten ambitions and trigger fruitful dynamics in the research environments. The CoE may result in a few new permanent positions at the host department – in research fields which parts of the environment appreciate, while others disapprove.

The dilemma for the policy-makers remains: added value for the selected groups/CoE is important for their success, but may have negative consequences for neighbouring research fields and groups. How best to adjust the terms of the CoE schemes, demands for local co-funding, the size, duration and academic scope of the CoEs, in order to promote positive and avoid negative local impact? Or may

negative impacts be counted as acceptable 'collateral damage' of policies which aim at resource concentration and redistribution as well as strategic profiling?

It should be added that the relative importance of the centre schemes depends on the national policy context and terms for research funding. The availability of other longer-term flexible funding and the relative amount of core funding versus demands for external project funding, obviously impact upon the potential for added value and local impacts. It may be argued that the Swedish CoE scheme has a lower symbolic value than the CoE schemes in the other studied countries, because of more decentralised and pluralistic sources for research funding. Moreover, Swedish universities have relatively low core funding and a higher level of competitive funding – diminishing the importance and status of one particular scheme. In addition, the Swedish CoE scheme is relatively new and its future is uncertain, further diminishing its status. In contrast, the Norwegian context with fewer alternative funding sources – more centralised funding and one research council promoting one (regular) CoE scheme – has produced CoEs with higher symbolic value, and according to our data far more added value than the Swedish cases. This is further enhanced by the larger centre appropriation in Norwegian schemes than in the other countries. As noted in Chapter 2, this finding may reflect that the Norwegian policy context better enables accounting for the added value of one singular funding source.

3.5 Host institutions' strategies

One of the ambitions behind the surge of CoE schemes has been to foster strategic thinking among Scandinavian universities – enhancing their (purportedly) weak capacity for priority-setting, concentration and resource concentration around research strongholds. Centres cannot operate outside the confines of faculties and departments; their temporary lifespan necessitates articulation between centre strategies and host institutions strategies. However, our material indicates that the host institutions primarily respond to the demands of the CoE schemes without much prior strategy work. A large part of the host institutions do not have a strategy for prioritising CoE applications or groups with CoE ambitions – their strategy is often reactive (financial and other support to obtained CoEs) or non-existent (no particular support to active CoEs). For some of the major universities, the 'CoE strategy' seems not much more than a part of a strategy to maximise external funding in general. Most/all host institutions are concerned to support successful groups after the CoE period – but have different abilities and strategies for this. Are the centre schemes an asset or drawback in terms of institutional autonomy? We have, however, noted in some cases that more coherent strategies by host institutions have emerged over time, as learning has taken place and opportunities for strategic development have been perceived and exploited.

The CoEs are temporary units, but would be considered failures if their competence was not maintained and their research topics and implications not pursued when the CoE period terminates. In short, the CoEs are supposed to have some lasting impact on the research activities and priorities at the host institutions. Hence, the choice between a reactive or proactive strategy for CoEs may impact upon the allocation of resources within the organisation and the 'future' of research fields. And the question up for discussion is whether support to 'all groups' which succeed in major external competitions is sufficient as an institution's research strategy.

3.6 Different policy levels – uniting different challenges

In general, the CoE schemes in the studied countries seem to reinforce the strengths of the major universities, and help them adapt to more competitive environments. In this respect CoE schemes may be powerful policy instruments both in national research policy and at the institutional level. When

formulating excellence initiatives, it should be noted that the different policy levels have separate perspectives, interest and challenges.

In the Nordic countries, national research funding agencies are concerned to help the CoEs and the host institutions to fulfil the aims of the CoE schemes, as well as helping the host institutions to fulfil the overall aims of national research policy, such as gender balance, internationalisation and improved opportunities for young scholars. At this level, host institutions' co-funding of the CoEs is seen as an important means to ensure host commitment to the CoEs and their success. More generally, the national funding agencies are concerned to help the universities to develop strategic capacities to organise and prioritise research efforts, and become more competitive research institutions.

The research institutions, on the other hand, are in general concerned to maintain their institutional autonomy and room for manoeuvre, as well as ensuring flexible funding instruments. Funding instruments which imply long-term binding of institutional resources for sponsoring activities introduced by others, have obvious disadvantages in this respect. In addition to reducing the room for manoeuvre and for local efforts to strengthen research, the binding of institutional resources may impoverish adjacent research environments and increase local conflict over the allocations of scarce resources. Concerning the flexibility of funding instruments, experienced researchers have skills in formally adjusting their proposals to various funding instruments, terms and calls, while maintaining their current research interests and needs. There are still limits to such adaptations and the research community is concerned that research funding instruments are flexible and fitting all fields and kinds of research.

These partly divergent perspectives imply different interests and challenges concerning the terms and implementation of CoE schemes. A main challenge for the funding agencies is to ensure measurable success and impact of their funding schemes. The research institutions obviously share the aim of success and impact of the CoEs. However, their challenges also include maintaining good opportunities for all their research groups and areas, and ensuring research-based education.

Interaction and dialogue

At the PEAC-conference (Appendix 4), several actors underlined the need for more direct dialogue between the funding agencies and the CoEs and their host institutions. The Danish National Research Foundation reports good experiences with their annual follow-up meetings where the leadership of the Foundation discuss research progress and financial and organisational matters with each of the CoEs. Such dialogue with awarded centres could also involve representatives of the host institutions, and include discussion of specific as well as general challenges, and how the funding agency and the host institution may best help in facilitating positive and avoiding negative effects of the CoEs. A dialogue approach may stimulate better understanding of the challenges of CoE schemes and their possible solutions – and provide an arena for balancing top-down and bottom-up research policy formulation, to some extent uniting the different policy perspectives. This approach is furthermore in line with 'soft management', also supported at the PEAC conference. A particular example of soft management of CoE schemes reported to be successful, was the Swedish Research Council's policy for encouraging the CoEs to work for gender balance. At least in the Swedish context, the chosen soft approach for encouraging gender balance seem to have had some effect: the proportion of female CoE leaders in Sweden more than doubled from 2011 to 2013 (Table 2.3 in Chapter 2).

The 'Main issues' section at the beginning of this report lists some relevant issues for dialogue between the funding agencies and the CoEs and their host institutions.

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Appendix 1 Case summaries

Case	Scheme	Name of centre	Centre-period	Field
D1	DG CoE	Centre for Epigenetics	2007-2012	Molecular biology
D2	DG CoE	Center for Quantum Optics (Quantop)	2001-2012	Physics, interdisciplinary
D3	DSF Centres	Strategic Electrochemistry Research Center (SERC)	2007-2012	Electrochemistry, energy
F1	AKA2, AKA5	CoE in Molecular and Integrative Neuroscience Research	2000-2005, 2008-2013	Neurosciences
F2	AKA3, AKA5	SMARAD - CoE in Smart Radios and Wireless Research	2002-2007, 2008-2013	Radio engineering, communications, signal processing
F3	SHOK	Finnish Bioeconomy Cluster FIBIC	2007-	Interdisciplinary, including chemistry, biosciences, physics, nanosciences, mathematics
N1	SFF	Centre for Cancer Biomedicine (CCB)	2007-2016	Biomedicine, cancer research
N2	SFF	Bjerknes Centre for Climate Research (BCCR)	2003-2012	Geosciences, meteorology, oceanography, mathematics.
N3	SFI	COIN - Concrete Innovation Centre	2007-2014	Engineering, materials/concrete
S1	SRC Linnaeus	Organizing Molecular Matter	2006-2015	Physical chemistry
S2	Vinnova Vinn Exc	Chase - Chalmers Antenna Systems Excellence center	2006-2015	Antenna technology, mobile communications.
S3	SRC Linnaeus	The Neuronano Research Center	2006-2015	Neuroscience, nanotechnology

D1 Centre for Epigenetics

The Centre for Epigenetics aims at unveiling basal mechanisms of epigenetic gene regulation fundamental to all eukaryotic organisms. Epigenetics has a large potential to increase our understanding of both normal cell development and diseases such as cancer.

Scheme	Danish National Research Foundation (DNRF)
Field	Molecular biology
Host	Biotech Research and Innovation Centre (BRIC), University of Copenhagen
Partners	Department of Biochemistry and Molecular Biology, University of Southern Denmark
Size	5 research groups (in total 74 persons in 2011)
Period	2007-2017
Location	Most of the staff are located at BRIC, the rest in Odense.
Funding from centre scheme	23% (2012-2017), 42% (2007-2012)
Funding from host	21% (2012-2017), 34% (2007-2012)
External funding	56% (2012-2017), 23% (2007-2012)
Total budget	343 MDKR (sum for 10 year period)

Centre for Epigenetics, which is part of Biotech Research & Innovation Centre (BRIC), has a special history. BRIC was established in 2003 with its own board. The background was a research policy committee suggesting that Denmark should establish a kind of Max Planck institute within the field of biotechnology. The institute should be located outside the university sector in order not to become influenced by classic university leadership (or lack of same) traditions. The director appointed at BRIC, a Dane recruited from abroad, was also expected to be able to attract competitive research funding for his own research programs, including from DNRF.

The director fulfilled the expectations and in 2007 BRIC received a five year grant from the Danish National Research Foundation for the Centre for Epigenetics. In 2010 Epigenetics went through a midterm evaluation and as a result of this the centre contract was prolonged for the period 2012-2017. Today BRIC is a centre for excellence in biomedical research as a part of University of Copenhagen. It is located outside the faculty structure, the director having direct reference to the vice chancellor. Staff at BRIC has no teaching obligations at the bachelor or masters levels.

The Centre for Epigenetics is organised with five research groups, four of these located at BRIC, one at University of Southern Denmark. The research groups are the main production units. The DNRF grant is split between them and all groups have substantial other sources of funding. The DNRF grant has been important in order to recruit PhD students and postdocs. The first grant financed 7 PhD students and 6 postdocs for 5 years. The second grant makes it possible to recruit 6 PhD students and 6 postdocs, but only for 3-4 years. 50% of the PhDs are recruited from abroad and the share is even higher regarding the postdocs.

The role of the centre is to facilitate collaborations on common scientific topics, and discussion of research results, ideas and strategies. Meetings are arranged every third month. Typically, there are 8 to 10 presentations for discussion at each meeting. Members from research groups not funded by the centre also participate in these meetings. Very important is also the personal networks and daily contact across research groups. Epigenetics is a very competitive research field. It is important to get result published quickly, before the competitors and preferably in high impact journals such as Nature.

According to informants there are two important characteristics of DNRF grants. They are flexible and the time horizon is long. This gives room for manoeuvre and possibilities to act strategic beyond other types of grants. The DNRF grants are to some extend used by the research groups as a kind of buffer, making it possible to act meaningful across a variety of smaller and more “frozen” grants.

Even though epigenetics is basic research, there is a short way to commercialisation. Three patents have been applied for and based on one of these a biotech company has been established. These activities are not directly linked to the DNRF grant, but results of research just prior to the establishment of Centre for Epigenetics.

The centre-host relations have generally been good and the University of Copenhagen has contributed by co-financing activities.

As external funding has increased across time, the challenge of the future beyond the DNRF grant is not expected to be related to maintaining the level of funding and thus activities as such, but more to be related to attracting grants which are as flexible as the DNRF grant. According to informants the DNRF centre scheme is the only Danish scheme really in top in relation to flexibility and possibilities for thinking strategic and long-term.

D2 Center for Quantum Optics (Quantop)

Scheme	Danish National Research Foundation (DNRF)
Field	Physics
Host	Niels Bohr Institute, University of Copenhagen
Partners	Department of Physics, University of Aarhus
Size	4 research groups (in total 44 persons counting from homepages in 2012)
Period	2001-2012
Location	Two groups located in Copenhagen, two in Aarhus.
Funding from centre scheme	36% (2006-2012)
Funding from host	37% (2006-2012)
External funding	27% (2006-2012)
Total budget	80,6 MDKR (sum from DNRF for 10 year period)

Quantop aims at doing research in the fields of quantum optics and quantum information science, burgeoning interdisciplinary areas in natural sciences. Physical systems within the research interests are: photons, atoms and solid state devices.

The Quantop idea was developed in the late 1990s by three physicists at the University of Aarhus. Quantum optics was a new research field. By attracting a grant from the Danish National Research Foundation, they would get the possibility to develop the field by establishing collaboration between experimental and theoretical physicists. They succeeded and the centre began its activities in 2001 supported by the university, which provided labs and offices.

In 2003 the centre director and thus also the centre moved to the University of Copenhagen. Since then it has been located at the Niels Bohr Institute. In 2006 the centre went through a mid-term evaluation and as a result of this the centre contract was prolonged.

The research groups have been the main production units in the centre. The number of participating research groups has differed across time. In 2012 there were four groups, two in Copenhagen and two in Aarhus. The DNRF grant has been split between the groups and all groups have had other sources of funding. In experimental physics 50% of available funding typically is used for equipment. Besides this the DNFR grant has been important in order to recruit PhD students and postdocs typically from abroad in a balance of 50-50.

The research groups have worked relatively autonomous. The role of the centre has been to facilitate discussion of research results and ideas. Meetings including visits to group labs have been arranged twice a year. Most of the research is done in the labs. In experimental physics it is difficult to collaborate across geographic distance. Theoretical physicists are more flexible in relation to collaboration across distance. Besides being an arena for discussions of ideas and research results, some PhD students have been exchanged across the Copenhagen-Aarhus divide. This has caused fruitful dynamics.

According to informants there are two important characteristics of DNRF grants. Their time horizon is long and they are flexible. With normal three-year grants it is not possible to build complex experiments and deliver the results. This has been possible within the DNRF grant. Also the flexibility is important both in relation to changing priorities when scholarly arguments dictate this and in relation to budgetary decisions. For example, when a post.doc. has been able to attract funding from another source, it has been possible to make resources available for equipment. Most other grants and especially EU framework grants are much more “frozen”. In this regard the DNRF grant has to some extend been used by the research groups as a kind of buffer making important strategic priorities possible.

According to the informants, resources at the host departments are very sparse. They co-finance by providing labs, offices and group leader salaries. There is however not much help offered in order to cope with the continuity challenge related to maintaining stability in funding streams.

The centre grant ran out by the end of 2012. The possibilities of attracting other funds for maintaining the centre has been discussed but the conclusion is that this is not possible. One of the informants expressed the view that it is a pity that the strong brand is just thrown away. The challenge for the

group leaders in this situation is to attract funding in order to keep activities in the groups up and going. Some group-leaders have succeeded with this others are working hard to succeed.

D3 Strategic Electrochemistry Research Center (SERC)

Scheme	Strategic Research Council
Field	Electrochemistry, energy
Host	DTU Energy Conversion, Department of Energy Conversion and Storage, Technical University of Denmark (DTU)
Partners	8 industrial partners, University of Lund
Period	2007-2012
Location	DTU, mostly Risø campus but also Lyngby campus
Funding from centre scheme	App. 50%
Funding from host and industry	App. 50%
Total budget	App. 50 MDKR (some of this in kind from industrial partners)

SERC was a research centre in strategic and fundamental aspects of electrochemical cells with the aim to extend the understanding of materials limitation, which impede a widespread commercialisation of the technology. One main purpose of the technology is conversion and storage of renewable energy such as wind and solar. Other applications are cleaning of exhaust gasses and oxygen sensors.

The application for SERC was prepared by researchers at Risø National Laboratory in 2006. The researchers had collaborated for some years and had contacts to potential industrial partners, especially to Haldor Topsøe. At the time when the grant was received, Risø was merged into the technical university. This caused several rounds of re-organisation. The shifting host-institution relations have however supported SERC all along the way.

The plan was that the grant of 25.7 MDK should fund 10 PhD students and 2 postdocs. All in all, the plan has been followed, although difficulties related to recruiting PhD students at some periods in time have caused some temporary delays and two planned PhD student positions were changed to postdoc positions. Education of PhD students has been one main activity of the centre. Another main activity was regular research including training of postdocs by senior researchers at the universities and the industrial partners. All PhDs have had two supervisors recruited from the 'educational participants', that is senior researchers primarily affiliated with DTU departments, and from a number of 'industrial participants'. Especially the collaboration with the three industrial partners Haldor Topsøe A/S, Topsoe Full Cell A/S and PBI-Dansensor A/S has been important. The networks of supervisors have constituted the glue in the centre. By boosting PhD activity in this way, the centre has enlarged cooperation in the field and attracted guest PhD students and master students.

Besides this, the role of the centre has been to facilitate discussion of research results and ideas. Meetings have been arranged twice a year. Participation in these has been good and the meetings have attracted researchers not directly affiliated with the centre.

In addition to the possibility of changing two PhD student positions to postdoc positions, there has been flexibility in the handling of the grant also in the way that the program committee in the research council has had the attitude, that the centre along the way should prioritise what was important from a scientific point of view and not necessarily what they had promised from the beginning. Good ideas produced along the way should be realised. There has been a good dialogue between the centre leader and the program committee about progress and experiences in the yearly meetings. All in all, the most important effect of the centre grant is that it has made it possible to boost activities and thereby collaborate more actively and realise synergies. Productivity in paper production has increased significantly and two patents have been filled. Up to February 2013, 71 peer review articles and book chapters have been produced and more is underway.

The centre leader has tried to raise new money in the strategic research council in order to continue the most promising activities. This has not been possible as priorities in the council have changed. Anyway, DTU Energy has been able to continue the most promising activities in a number of smaller projects financed by other funding agencies.

F1 Finnish Centre of Excellence in Molecular and Integrative Neuroscience Research

Scheme	Centre of Excellence (Academy of Finland)
Field	Neuroscience
Host	University of Helsinki
Partners	-
Size	72 scientists (7 principal investigators)
Period	2000-2005, 2008-2013
Location	All groups are located at Viikki campus of the University of Helsinki
Funding from centre scheme	17 % of total budget (calculated from figures for 2008-2010)
Funding from host	48 % (includes all funding from the University budget, 2008-2010)
External funding	35 % (in 2008-2010)
Total budget	~11 M€ (for 3-year period 2008-2010)

The Centre of Excellence in Molecular and Integrative Neuroscience Research aims at world class basic research in neuroscience with also a strong focus on practical applications in the prevention and treatment of neurodegenerative brain diseases. The original approach of the CoE was to combine molecular cell biology and electrophysiology for studying neuronal development for the first time in Finland. This took place at a time when similar scientific developments were taking place also in Europe and USA. Originally, the CoE was established on the basis of existing and emerging collaborations between the key researchers with the aim to enhance the cooperation through CoE funding. The centre presents a strong consortium of autonomous research groups that engage in close collaboration with each other in the CoE. For the research groups, the CoE represents a long-term commitment for mutual collaboration. The CoE funding from the Academy of Finland is however considered very small and insufficient by the representatives of the centre.

Overtime, the core of the centre has been formed around eminent researchers who have been involved in the centre since the beginning. This core has been supplemented with younger group leaders who have brought their own expertise to the CoE. The integration of these younger group leaders has also been a way to foster and promote their future career development by the senior group leaders. Despite several attempts the centre has had trouble in recruiting female group leaders. The administrative structure of the centre is light and informal. The CoE has a scientific advisory board that has been regarded as very useful. All the groups are located in the same campus which has been a clear advantage in the CoE's work.

During the CoE period the cooperation between the groups has strengthened although the intensiveness of collaboration has to some extent varied between the groups. In this respect, the CoE grant has provided an opportunity to promote common scientific interests in collaboration. According to the interviews, the main benefits of the CoE scheme have been long-term funding and flexibility. As science is unpredictable it is important to be able to redirect research in a flexible way according to the results obtained. Compared to 'normal' funding, CoE funding has provided the centre with more flexibility and enabled more risk-taking. Scientifically the CoE has been very successful which was evident e.g. in the recent research evaluation of the University of Helsinki. Similarly, the citation analysis carried out in this project shows that the publications of the centre have been 'extremely highly cited'. Besides high-level research, the centre has also been strong in attempts to commercialise research results through patenting, development of drugs and therapies and establishing a company.

In terms of further added value, a significant aspect is that the CoE has been a very important factor in that the University of Helsinki decided to establish the Neuroscience Centre – an independent research and teaching institute at the University of Helsinki – in 2002. The Neuroscience Centre was made permanent in 2011 and currently hosts 16 research groups (around 160 researchers). In addition, it seems that the CoE funding has had positive impact on acquiring funding from other sources. For instance, one of the principal investigators has just recently received an ERC advanced grant and according to the interviews, research carried out in the CoE has been very important in achieving the ERC grant. Furthermore, it seems that the CoE status may have provided some

advantage for the centre in local and national recruitments due to the high prestige of the CoE in Finland. In this view the CoE has increased the 'local prestige' of the unit.

The centre is highly valued by the host institution. For the host university department for instance, the CoE brings increased visibility for its research as well as substantial additional teaching capacity.

The Centre of Excellence in Molecular and Integrative Neuroscience Research also highlights discontinuity of the CoE policies. The Centre first received the CoE status for the period 2000-2005 but it was not able to renew its status and dropped out CoE programme. The Centre was then able get a new status in a new call for the period 2008-2013. In 2012, the Centre applied for a new period 2014-2019 but it was not successful which means that the CoE will be terminated at the end of 2013. The new situation will probably have diverging effects for the different research groups of the CoE.

F2 Centre of Excellence in Smart Radios and Wireless Research (SMARAD)

Scheme	Centre of Excellence (Academy of Finland)
Field	Radio engineering, communications, signal processing
Host	Aalto University (School of Electrical Engineering)
Partners	Nokia Research Center
Size	Around 90 scientists (5 principal investigators and 2 other professors)
Period	2002-2007, 2008-2013
Location	All groups are located at a same building in Otaniemi campus of Aalto University.
Funding from centre scheme	~10% of total budget
Funding from host	~30% of total budget
External funding	~60%
Total budget	~ 6-7 M€ annually

The Centre of Excellence in Smart Radios and Wireless Research aims at world-class research and education in radio engineering, communications and signal processing. Besides high-level basic research, many groups of the centre have long-term close industrial collaboration in particular with Nokia. The centre was established in 2000 to foster collaboration in particular between radio scientists and signal processing researchers. At that time radio technology and signal processing were the key technologies in ICT and the CoE was established to combine research in these two fields. Later a research group of microelectronics joined SMARAD.

The organisational structure of SMARAD is light with a scientific advisory board and a steering group which e.g. decides about the allocation of the CoE funding between the groups. The research groups are independent and have their own budgets. According to the interviews, the role of the leader of the CoE is important in particular in creating joint efforts, opening up new directions and maintaining good atmosphere. The location of all the groups in a same building is considered as an important asset in terms of frequent contacts among the researchers and the possibility of arranging meetings and discussions in a very short notice if necessary.

Although the CoE funding is not particularly large in itself, in the case of SMARAD it has had the impact of directing research activities towards larger research questions and problems that the individual groups would not have been able to tackle themselves. The collaboration between the groups has strengthened in particular through novel joint projects that have been applied for. In those groups that have previously been more focused on industrial collaboration, the CoE funding has shifted the emphasis more towards academic collaboration especially with the other groups of the centre. Furthermore, in some groups, in particular in those that have originally been more application oriented, the CoE funding has directed research towards far-reaching, basic research and enabled the exploration of more radical ideas and research lines. According to the interviews, in some groups the CoE funding has significantly contributed to the most important scientific results that have been achieved.

In addition, the interviewees maintain that the CoE funding tends to act as a ‘quality indicator’ and in this way it also helps in acquiring additional research funding. The CoE status has also brought increased international visibility which is reflected in international recruitments and in the high quality of applicants for vacant positions related to the centre. The CoE status has helped in attracting talented researchers and students. Furthermore, CoE funding also tends to provide an additional boost to the overall atmosphere and to the researchers' attitudes which is then reflected e.g. in the raising quality of publications. A very interesting aspect is also that the researchers have felt that the CoE status has improved the centre's position in negotiations with industrial partners. In particular it has provided them more influence in promoting right to publish on the basis of industrial research.

SMARAD is hosted by Aalto University which sees the centre as very important. The CoEs bring national and international visibility to the host university, promote the overall development of university's research environment, open up new research opportunities and bring together the best forces of the university. They are important in the university's promotional efforts. The current strategy of Aalto University is strongly focused on research excellence and this at least in principle tends to favour departments and units with CoE funding (and other 'excellence' funding).

SMARAD applied for a new CoE period for 2014-2019 but it was not successful. This means that the CoE funding will be terminated at the end of 2013. The group leaders have however expressed their commitment to continue the unit although the official CoE funding and status will be discontinued.

F3 Finnish Bioeconomy Cluster (FIBIC)

Scheme	Strategic Centre of Science, Technology and Innovation, SHOK (Tekes)
Field	Various fields of research including chemistry, biosciences, physics, nanosciences, mathematics etc.
Shareholders	Companies (8), research institutes (2) and universities (8).
Size	FIBIC "office" has a staff of four people: CEO, a research director, senior advisor and communications manager. Number of researchers involved in the projects: hundreds at least.
Period	Established in 2007 as the first SHOK.
Total budget	75 million euros for the 4-year period 2008-2011.35 million from Tekes and rest from companies.

FIBIC was established in 2007 as ForestCluster Ltd. as the first Strategic Centre in Science, Technology and Innovation (SHOK). The founders of the ForestCluster were key forest cluster companies and main research institutes and universities. In 2012, it changed its name into Finnish Bioeconomy Cluster to reflect a change in its strategy where the bio-based economy was seen as one of the most potential renewal routes for the Finnish forest sector. This implied an expansion of its activities from research focused on the forest industry towards the bio-based economy in a broader sense. At present, the objective of FIBIC is to integrate the different sectors of Finnish bioeconomy and promote collaboration that creates export-oriented innovations and thus leads to long-term competitive advantages.

The basic function of FIBIC is to find renewal paths for the forest industry through research. The main tool for achieving this is research programmes that are large-scale research efforts integrating companies, university researchers and research institutes.

The large-scale evaluation of the SHOK instrument, published in February 2013, presented rather critical conclusions about the SHOKs, e.g. in terms of the overall feasibility of the SHOK concept, the scientific quality of conducted research, unclear position of the SHOKs in the Finnish innovation system and lack of multidisciplinary research and internationalisation. In many respect however, the assessment of the FIBIC SHOK was substantially more positive. In particular, it has become evident that FIBIC has played a major role in the launch of a structural renewal of the Finnish forest sector and new ways of targeting research. This process is currently underway and FIBIC has significantly contributed to it by encouraging the industry to renewal, and by creating new ways of thinking. Furthermore, FIBIC has also clearly brought industry and research closer together and promoted a new kind of collaborative culture in the sector: in the forest sector there is a long-term tradition in collaboration among relatively few key players but through FIBIC this collaboration has become broader and included an important number of new actors. Concentration of scattered research at the forest sector and the shift towards the bioeconomy are also seen as an added value of the FIBIC SHOK.

Overall, it seems that research done in FIBIC has been valuable for both involved academic researchers and industry. For academic researchers, FIBIC brings new funding opportunities and provides industry-relevant research questions. In addition, the FIBIC programmes provide broader contact points with industry than perhaps previously has been the case. The programmes have increased contacts and interaction with companies and this is considered useful for academic research. Research at FIBIC is also important for the academic researchers in that it may bring up new interesting insights for basic research as well. In the interviewed research groups there have been several cases where research at FIBIC has opened new questions and issues for basic research which have then been further developed in the group. Similarly, the industry sees that the academic research is better linked to their research problems through FIBIC.

Research at FIBIC is a mixture of fundamental research and applied research and development work. According to the evaluation, the scientific quality of research has ranged from good to exceptionally good and world-class researchers are involved in the FIBIC research programmes. However, there seems to be very little room for 'blue sky breakthrough research' at FIBIC which is seen to be slightly problematic. Also the management of FIBIC feels that there should be a closer link between FIBIC and

academic research funded by the Academy of Finland, e.g. in the form academic research projects that would run parallel to FIBIC funded projects. Furthermore, according to the interviews, parts of FIBIC research have moved into more applied-oriented approach which may undermine the original goal of carrying out pre-competitive research. Further challenges are experienced in the management of IPR, finding a balance between providing tangible results (commercialisation) and carrying out pre-competitive research as well as the fact that competing companies are involved in the same programmes.

N1 Center for Cancer Biomedicine (CCB)

Scheme	Centre of Excellence (SFF) RCN
Field	biomedicine, cancer research
Host	University of Oslo, Oslo University Hospital (OUS)
Partners	6 research groups, 5 within Institute for Cancer Research, OUS, 1 within Institute for Informatics, UiO
Size	25 scientists, 65 PhDs/students and 25 postdocs (in total around 145 persons persons in 2011)
Period	2007-2016
Location	5 groups co-located at the Radium Hospital, one at Forskningsparken, Gaustand.
Funding from centre scheme	14 % of total budget
Funding from host	32% (UiO: 6%; OUS 26 %)
External funding	54%
Total budget	1 000 MNOK (est. sum for 10 year period)

CCB is a centre for cancer research. Its host institution is the University of Oslo (UiO), while the majority of the centre is located at the Radium Hospital/Oslo University Hospital (OUS). Its aim is to "unify basic and translational research for the benefit of the cancer patient". CCB unites five (initially 6) research groups located at the OUS, all of which were well-established and highly esteemed groups prior to the formation of the centre, but collaboration between the groups had been limited prior to their becoming part of one centre. A sixth group (bioinformatics) was added to the centre team during the planning process and its role was upgraded after the successful selection of the centre The leadership of the centre is formed by a director and a co-director, both also leading their own research groups, and the four research group leaders/PIs. The Executive Board of the center has four members, all appointed by and leaders at UiO and OUS, and a scientific advisory board whose five members are all esteemed foreign scientists. The centre has emphasised recruitment of postdocs and younger group leaders. A substantial part of the researchers are recruited from outside Norway.

The research groups that make up the centre were all well-known, hence also highly competitive research units, before becoming part of CCB, and the centre status has not been instrumental, nor necessary, for securing additional resources. Funding opportunities from national sources are good (South-East Regional Health Authority, Norwegian Cancer Society), and the centre and its groups are able to attract the resources required for their research. Similarly, given the prior, well-established status of the PIs and their groups, the added value of the centre in terms of international reputation and networks are considered to be limited.

One innovation of the centre is having included as partner a separate research group for bioinformatics. Collaboration between bioinformatics research groups and basic biomedical research in particular does not seem to be common, and the role of the bioinformatics groups within the centre is considered as essential, having contributed to enhanced quality of statistical analyses. The early re-organisation of the leader structure, assigning responsibility to two directors for basic and translational research respectively, is also considered as essential for having succeeded in connecting more closely these two strands of research of the center.

The state of limited collaboration between the groups continued some time into the period after the centre was established; cross-group collaboration increased after a couple of years, in response to, in particular, outspoken criticism and clear advice from the scientific advisory board (the board being generally considered to have played an instrumental role in the successful development of the CCB). This has led both to a rise in publications with co-authors from more than one group, and these publications are also, allegedly, the most frequently cited publications by the center. The closer connections between basic and translational research, facilitated *inter alia* by the re-organisation of the leader structure, has also led to applied results at an earlier stage of its life-cycle than initially envisaged.

The center appropriation provides a basis for flexibility and strategic action, roughly half being distributed to the six research groups (1 mill NOK per year per group) as discretionary funds, the rest used for common activities and strategic funds (annual conference; PhD/postdoc positions; bridge funding; infrastructure etc). Support of young researchers is a central part of centre policy, providing these researchers opportunities to gain experience as project leaders and, through an internal call planned this year, as leader of a research group of his/her own.

CCB, as other SFFs, are considered by the university and faculty as their “flagships” (expression used by faculty informant) and foci for strategic development. This is in particular expressed in the annual 2 mill NOK cash appropriation from the university and in the membership of faculty and institute leaders in the centre board as well as by the centre director being *ex officio* member of the joint cancer research board of UiO and OUS. Being a second generation SFF, CCB profits from an organisational streamlining based on earlier experience of the relationship between SFF centres and the regular faculty organisation. Part of the streamlining is the development and early application of a model for institutional in-phasing at the end of the centre period of its key scientific achievements. CCB is considered to be well-organised and -led, and collaboration between centre and faculty is without major problems.

N2 Bjerknes Centre for Climate Research (BCCR)

Scheme	Centre of Excellence (SFF) RCN
Field	Geosciences, meteorology, oceanography, mathematics.
Host	University of Bergen
Partners	Uni Research; Nansen Environmental and Remote Sensing Centre/NERSC; Institute of Marine Research/IMR
Size	72 scientists, 33 PhDs and 14 postdocs (in total 140 persons in 2011)
Period	2003-2012
Location	Part of the staff are co-located in a building at UiB, the rest are at involved departments and institutes in Bergen.
Funding from centre scheme	15% of total budget
Funding from host	26% (partners 19%)
External funding	45%
Total budget	848 MNOK (sum for 10 year period)

As a research centre dedicated to climate modelling and scenarios, the Bjerknes Centre aims both at addressing global challenges and at research excellence. The 'Bjerknes collaboration' was initiated in advance of the first Norwegian SFF call, and was a strategic initiative aiming to build a platform to increase the chances of obtaining a SFF grant. It builds on a Bergen network with several strong groups in climate-related research. The centre has a high profile director who was a key actor in initiating the centre and has been a visible leader throughout the centre period. During its SFF-period (2003-2012) the formal structures included a board of directors with the four partner organisations represented, as well an international advisory board with scholars in climate research. The centre has emphasised recruitment of postdocs and younger group leaders. A substantial part of the researchers are recruited from outside Norway.

Addressing climate research, the Bjerknes Centre seized an important area with multiple funding sources. The combination of CoE long-term funding and branding, high profile leadership and a strategically important research field, seems to have given extensive added value. It has become a nationally and internationally renowned centre for climate research. The centre attracts much external funding apart from the SFF-funding (see fact box), including substantial funding from the EU framework programme. Still, their applications for ERC-grants have so far not succeeded. The most notable impact of the SFF in terms of additional funding is a generous long-term government grant (12 years) enabling the continuation of the centre after the SFF-period as national competence centre in climate system research.

Informants emphasise that the long-term core funding has enabled integrating and doing research that could not have been done on project-to-projects basis. Overall plans, leadership and long-term funding have been necessary for the results. Some of it could probably have been achieved also without the SFF-funding, but they would not have had the capacity and ability to further develop the climate model, recruit from top international institutions and obtain an international role (in IPCC).

Both the research profile and the collaboration patterns of the researchers are affected by the centre. Groups are put together across organisations and disciplines and the researchers are encouraged to collaborate across such boundaries. This collaboration is said to be crucial for the scientific success of the centre, and has at the same time been a major challenge. The research is funded by a variety of different funding sources and grants, and the day-to-day work of the researchers are organised by their individual projects (and project groups), and not by the larger research groups. Moreover, location in different institutions and lack of adequate facilities for daily collaboration has to some extent limited the scientific synergies of a crossdisciplinary 'centre'. Synthesising projects were given priority in the last part of the SFF-period to make up for such shortcomings.

The centre-host relations have generally been good. Informants emphasise that the Bjerknes Centre has contributed to enhancing UiB's research infrastructures, attracting international students and researchers, as well as a general drive for excellence that also impact the work at the departments. Still, battles for resources, space and autonomy have created some tensions. There have been discussions and disagreements regarding co-location, and the 'ownership' of external grants and publications. Such issues have been solved differently throughout the period, and partly dependent on changing leadership at the university. The complex organisational structures of the centre, where part

of the centre activity is organised in a separate unit for handling external research funding, has entailed some criticisms within the host organisation and also in the 2011 evaluation of Norwegian Earth Sciences. As a response to the critique, the centre is now more integrated with the university.

N3 Concrete Innovation Centre (COIN)

Scheme	Centre for researched based innovation (SFI), RCN
Field	Materials/engineering: Concrete
Host	SINTEF, Building and infrastructure
Partners	NTNU and 9 industry partners
Size	9 PIs, 13 PhDs
Period	2007-2013
Location	Staff located in their home-departments
Funding from scheme	31% of total budget
Funding from host	3,8%
External funding	NTNU: 23% Industry: 42,2%
Total budget	256 MNOK (sum for 8 year period)

COIN aims at creating more attractive concrete buildings and infrastructure through developing advanced materials, efficient construction techniques, new and sustainable design concepts and more environmental friendly material production. The centre is established on already tight relations between the research groups at SINTEF and NTNU and the industry partners, some relations dating back to the 70's and 80's when it was a high demand for concrete platforms in the oil industry. In the end of the 90's the demand decreased alongside with a close down of central funding schemes. Both industry and research institutions experienced a dry period and hence the SFI scheme was a very welcomed grant and represented a sort of new spring for the field.

Research questions and programme are developed in close collaboration with the partners. COIN members are used to work together and practices are as such institutionalised. All projects have representatives from industry and research partners, and two of the PIs are industry partners. The centre is rather multidisciplinary ranging from chemistry to construction techniques and the industry partners represent a large part of the value chain.

Initially the centre aimed at a wide range of research questions which resulted in somewhat fragmented and applied research. Hence, after two years the centre re-organised into three research areas with each having their own technical advisory committee (TAC) with representatives from research and industry partners. These evaluate all project proposals. COIN further reports to a board made up of representatives from host and partners contributing with over 1 MNOK in annual centre funding. It is headed by an industry partner.

Prior to the grant, both research and industry had difficulties recruiting master and PhD students. The field had a reputation for low degree of R&D, had few employees with PhD and they were striving to assert themselves in the competition with other more R&D intensive and perhaps more (perceived) dynamic fields. Hence the grant in itself represents an instrument for enhancing the R&D capacity within the research institutions and for industry partners with the main output being the PhDs, in total 17. The membership in COIN has for some of the industry partners rendered visible the importance of R&D and even levitated the internal R&D budget in the company. Another effect is that some of the international companies have kept their Norwegian offices and conduct core R&D in Norway. For the research institutions the grant offers the possibility to work within a long-term horizon, the possibility to publish (SINTEF) and to recruit master and PhD students (NTNU). COIN also represents a possibility for young researchers to become PIs and develop close contact with industry.

The grant has not had any significant organisational impact on the host institution SINTEF or on the organisation of research. The core of the centre is located at SINTEF Building and infrastructure in Trondheim in re-furbished offices. The research partner NTNU is in the next building, and the PhDs have their offices here. SINTEF and NTNU share laboratory facilities. The centre is a part of the concrete group at SINTEF, and has as such not become *the* concrete group. This integration has been important in order to reduce the propensity for organisational tensions. Hence, within the host institution the centre is somewhat loosely organised with researchers partly funded by the grant. This has received some critique, with one critical point being the benefits of co-locating the research groups for the quality of the PhD education. However, COIN has a clear identity for the industry partners and towards the external environment. It is considered as the national competence centre on concrete. It has also gained an international visibility and identity through membership in international committees and networks.

The future of the centre is still uncertain, but all involved parties agree upon continuity in some form – either through extending the centre or through an umbrella for smaller and more specialised projects.

S1 Organizing Molecular Matter

Scheme	Linnaeus grant
Field	Physical chemistry
Host	Lund University
Partners	-
Size	22 scientists, 59 PhDs
Period	2006-2015
Location	The department of Chemistry, Lund University.
Funding from centre scheme	~27% of total budget (80 MSEK)
Funding from host	~23% of total budget (70 MSEK)
External funding	~50 % of total budget (150 MSEK)
Total budget	~300 MSEK (for the 10-year period)

'Organizing Molecular Matter' (OMM) is a multidisciplinary group focusing on fundamental properties of colloidal (e.g. proteins, membranes, soft condensed matter) and the interface interactions of these materials in an aqueous environment. Studies focus across a broad range of spatial and temporal dimensions.

The centre was constituted in preparation for the first Linnaeus grant round, gathering researchers from three divisions with the Chemistry Department in Lund, but builds upon a long intellectual and collaborative tradition dating several decades back. It builds on a network with several strong groups in theoretical and physical chemistry at Lund. The centre has a high profiled founder who was a key actor in initiating the centre and has been a visible, yet mainly informal, leader throughout the centre period. The centre has a small board of directors, as well an international advisory board (activated after critique in the first evaluation round). The centre has emphasised support of postdocs and younger group leaders to sustain and enhance their groups. A key goal has been to create a coherent PhD programme, with joint supervision between groups and a collective and collaborative identity among the PhD students, a goal that the recent mid-term evaluation concluded had been reached.

The centre support has primarily targeted a renewal and rejuvenation of the area, in particular a generation shift from the highly successful founders to younger generations of scholars. The centre support also prepares the group and the field for the establishment of two central infrastructural facilities at Lund, MAX-lab and ESS (and vice versa, strengthens Lund University's research profile in preparation for these facilities). OMM has a rich network of European collaborations but so far no ERC-grants. It has had other examples of positive spin-offs (cumulative advantage): A few years after the Linnaeus grant, the centre was awarded a major infrastructural grant from the KA Wallenberg foundation (18 million SEK). The PI's of the centre are also generously funded in the national funding system, and in parallel with the OMM, it has received additional large-scale funding from the Foundation for Strategic Research (SSF, 18 MSEK 2009-2014).

The long-term core funding has enabled work modes that could not have been done on project-to-projects basis. As mentioned, it has enabled interaction primarily among the PhD students but also their supervisors (often relatively young post-docs).

Both the research profile and the collaboration patterns of the researchers are affected by the centre. Groups are put together across organisations and disciplines and the researchers are encouraged to collaborate across such boundaries. The research is funded by a variety of different funding sources and grants, primarily for the individual PI, and the day-to-day work of the researchers are organised by their individual projects (and project groups). However, the physical co-location and, in particular, the availability of facilities for daily collaboration has enhanced the scientific synergies of this centre.

The centre-host relations have generally been good, even though one pressing problem for the centre is the relatively weak support for salaries (around 40 per cent, also of the salaries of full professors, are paid for by the university, the rest has to be obtained from external sources). This hinders risk-taking and hampers the expansion of research groups; one of the goals of OMM is therefore to create increasing long-term security in particular for junior researchers. To sum up, the centre is not a traditional CoE where resources and recruitments are topped up to allow for intense activities in a specific time-frame, but rather intended to serve the function of a historical continuity and to allow for a successful regeneration of the environment. It is of vital importance for the centre that this is

acknowledged by the funding system and that resources are made available to create long-term stability for environments of OMM's kind.

S2 CHASE - Chalmers Antenna Systems Excellence Center

Scheme	Vinn Excellence Center
Field	Antenna technology, mobile communications.
Host	Chalmers University of Technology
Partners	Two sections within the department (S2), Ascom Tateco, Ericsson Microwave Systems, Flextronics Components, Geveko Industry, Micropos Medical, Perlos, Qamcom, Saab Bofors, Saab Ericsson Aerospace, Sony Ericsson, St Jude Medical and Telia Sonera
Size	9 senior scientists, 17 PhDs and postdocs (in total more than 40 persons in 2011)
Period	2006-2015
Location	Co-located in a building at Chalmers.
Funding from centre scheme	~33% of total budget (70 MSEK)
Funding from host	~20% of total budget (40 MSEK)
External funding	~47% of total budget (100 MSEK)
Total budget	210 MSEK (for the total period)

CHASE operates in the areas of wireless communications, antenna technology, and microwave technology. It is hosted by the Department for Signals & Systems (S2) at Chalmers, and has its roots in an earlier centre, CHARMANT (funded by the Foundation for Strategic Research, SSF). It is also sister centre to another VINN Excellence Center at Chalmers, GHz, devoted to microwave electronics and hosted by the MC2 department. CHASE, although with a somewhat more dedicated academic orientation, has a larger number of industrial partners, but the industrial funding is somewhat smaller than that in GHz.

The centre has a director primarily in charge of the administration of the centre. The formal structure comprises a 7-person governing board, primarily with industrial partners and one representative of Chalmers (a department head), and an international scientific advisory board (SAB) comprising four scientists. The key role for the governing board is to monitor the progress in the research projects, to approve new projects and to establish a sound strategic development of the centre.

In its activities, the centre has emphasised the recruitment of postdocs and PhD candidates. Project funding is allocated on a competitive basis where participants apply for funding internally. The project portfolio is approved by the partners in Chase, with inputs from the SAB.

CHASE was constituted in preparation for a Vinnova call, but builds upon long relations both within the research team and between scientists and industrial partners within a well-established environment. Indeed, the call fitted well with a structure already erected within an earlier centre, CHARMANT, with a quite similar structure and orientation to CHASE). The common denominator is S2 (the department). The project activities in Chase is an essential part of the research in S2, and the grant from Vinnova is indeed very important but not entirely essential for the future as S2 has many feet to stand on and a rich network of collaborators and partners. The group, and the individual PI's have very good industrial connections and also many opportunities for funding, including EU funding. Its members are also very successful for instance within the Swedish Research Council and one PI was recently awarded an major grant from the European Research Council. CHASE is otherwise not very 'branded' or marketed as such; the strong brand and internal and external signifier is the department (S2).

Informants emphasise that the long-term core funding has strengthened the pursuit of different research projects within S2 (giving financial support to project-based work). In particular it has enabled the interaction with a broad range of industrial partners and has become a platform for external interaction and collaboration. CHASE arranges a yearly event, primarily targeting the partners, which usually attracts around 70 or so participants and enables informal contacts, networks and information sharing. To sum up, Vinnova VINN Excellence funding forms an important financial platform for research activities, a platform for external interaction, and enables interaction between academic partners and the SAB in the formulation and selection of projects to be funded with Vinnova money.

A key challenge for CHASE (if not for S2) is the relationship with Vinnova, and it is a major concern for the CHASE board. Informants find Vinnova's practices unpredictable, both for the evaluations and the future plans: it was difficult to understand the results of the evaluations (changing with every round, in the first round CHASE was critiqued and GHz praised, in the second round it was the other way around). Vinnova uses too many criteria in its evaluations and has a high turnover for its project

managers. More fundamentally, Vinnova has not declared its future intentions, to the detriment of centre management and future planning. However, the academic strength of CHASE and its variegated sources of incomes and contacts form the most essential parts of S2's future and reduces the dependence of Vinnova's future strategies.

The centre-host relations are relatively uncomplicated as CHASE forms one of many parts of S2's general orientation and strategic planning. It also functions as a bridge to the adjacent MC2 department and its Vinnova centre, GHz (the chairman of MC2 is on the board of CHASE and the chairman of S2 is on the board of GHz). CHASE is part of Chalmers' strategic initiative in information and communication technology, but this is a relatively symbolic function as it is not linked to internal resource flows (it was primarily set up in preparation of the government's allocation of resources via the 'strategic research areas' in 2008/09).

S3 Neuronano Research Center

Scheme	Linnaeus grants
Field	Neuroscience, nanotechnology.
Host	Lund University
Partners	Dept. of solid state physics, Dept of electrical measurements, Dept. of theology, Dept. of biology, all at LU
Size	17 scientists, 17 PhDs and postdocs (in total more than 40 persons in 2011)
Period	2006-2015
Location	Part of the staff are co-located in a building at LU, the rest are at involved departments and institutes nearby.
Funding from centre scheme	~40% of the total budget (80 MSEK)
Funding from host	~20% of the total budget (40 MSEK)
External funding	~40% of the total budget (80 MSEK)
Total budget	~200 MSEK (for the 10-year period)

The vision of NRC is 'to develop brain machine interfaces (BMI) for groundbreaking neurophysiological research on memory and learning and clinical applications that will improve quality of life for disabled and individuals with neurodegenerative diseases'. To this end the NRC is doing research in the field of neural interfaces, focusing on three main medical and technical challenges: 1) Biocompatible electrodes (the elements in direct contact with the neural tissue), 2) Wireless communication (transmission of neural signals outside the body), and 3) Neuroinformatics (management and mining of neural data). These will be used for addressing critical neuroscience-based investigations, and in the future, to medical conditions related to the mechanisms of pain, learning and memory, and control of movement. Future clinical translation will be in the areas of drug-resistant pain, depression, Parkinson's disease and possibly epilepsy. In addition, NRC actively pursues an analysis of the upcoming ethical challenges related to interfacing the human mind to electronics and computers.

The centre has a high profile director who was a key actor in initiating the centre and has been a visible leader throughout the centre period, a role also acknowledged as pivotal for the success of NRC in the mid-term evaluation of NRC. The formal structure is elaborated with an 8-person steering committee representing the different parties involved, and an international scientific advisory board. In its activities, the centre has emphasised support of postdocs and, in particular, the creation of a coherent PhD programme.

While the NRC as such was constructed in preparations for the 2006 Linnaues round, it builds on earlier collaboration between neuroscientists, solid state physicists and clinicians, for instance on 'artificial hands'. The combination of Linnaeus long-term funding and the branding that follows from receiving such a grant, high profile leadership and a research field with potential for major breakthroughs (but also potential pitfalls and failures), seems to have given extensive added value and excitement over the collaboration. It has become a internationally renowned centre for neuronano research with, according to the mid-term evaluation, a potential for a globally leading role in the field. Success at this level is however, the informants stress, contingent upon continued prolonged support of the centre as it is not sufficient to pursue such painstaking interdisciplinary high-risk research (with limited short-term rewards) solely on the basis of single project-based grants.

The most notable parallel impact of the Linnaeus grant in terms of additional funding is a large infrastructural grant from the KA Wallenberg foundation, which preceded the Linnaeus grant (40 MSEK). The PIs are also generally successful in obtaining grants from the Swedish Research Council.

The neuronano research centre started as a completely new high potential - high risk initiative. Although many of the members had prior experience in interdisciplinary research (e.g. the art-hand project) there was no established strong milieu before the Linneaus grant. This is in sharp contrast to most other Linneaus milieus which were already well established at the start. Informants thus emphasise that the long-term core funding has enabled integration between different research fields and the pursuit of research that could not have been done on project-to-projects basis only. Furthermore, it has enabled the centre to secure the precious resource of a few research engineers, a resource that is normally difficult to motivate in a project applications (and something the university nowadays does not supply the groups with). Hence, the Linnaeus grant – together with the support from KAW – became something of a 'make or break' for the entire endeavour.

Both the research profile and the collaboration patterns of the researchers are affected by the centre. Groups are put together across organisations and disciplines and researchers are encouraged to collaborate across such boundaries, for instance through joint supervision of PhD students. The PhD programme is a particular cause of attention and collaboration and forms the de facto centre of much of the activities of the NRC. This collaboration is said to be crucial for the scientific success of the centre, and has at the same time been a challenge, as the centre is quite ambitious in its goals and 'requires' the attention and integration of quite distinct areas. Another challenge is the painstaking nature of research, which has meant that the publication outputs of research reports during the first years (in terms of quantity but also impact) were limited. In the second part of the Linneaus period this is now changing radically towards a high publication rate. It should be noted however that NRC has been to a large extent a combination of research and innovation. Hence, in addition to the publications of research reports NRC has published a number of patent applications some of which have been granted others are pending. The idea behind is to enable future collaborations with the medtech and pharmaceutic industries, thereby securing a clinical use. However, securing patents also add to the delay in publication of research reports. Hence, the benefits of the centre activities are long-term and somewhat insecure, which requires patience both among participants and funders

After the grants the centre has moved upwards on the faculty (and university) priority list, and the mid-term evaluation (which was a major boost to the centre and its future planning and which secured the NRC additional funding) its future looks bright. However, collaborative structures of this nature, with very ambitious plans for collaboration and integration of basic science, translation and clinical applications, is difficult to square with weak faculty support and project-based funding alone, and 'requires' the availability of funding of the sort provided by the SRC if it is to be viable in the long term perspective and competitive with similar schemes elsewhere (which generally are much better endowed with resources). Another challenge is the central role of the centre leadership, which has kept a strong control over activities to ascertain that they fit with the overall goals and ambitions of the centre as outlined in the original application despite the fact that for some of the participants NRC funding is marginal in comparison to other funding sources and engagements.

Appendix 2 Bibliometric analysis of the selected centres

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Summary

This analysis of the selected centres of excellence shows that almost all centres perform very well according to bibliometric indicators. Several centres have extremely high publication and citation rates. Moreover, most of the centres performed just as well also in the period before the CoE was established. It is difficult to identify any systematic changes in performance between the periods before and after the CoE inauguration. In the following sections, details are given for each of the centres.

Table 1 gives an overview of a few core bibliometric indicators for the centres, divided by periods before and after the CoE inauguration. As can be seen, most centres have a field normalised citation indicator significantly above the world average (=1.00). They also tend to publish in journals with higher than average citation rates (=1.00).

Table A2.1 Overview of bibliometric indicators for selected centres and periods

Centre	Period	Number of publications	Total number of citations	Citation index – field[1]	Journal profile[2]
D1: Centre for Epigenetics	2002-2005	70	7637	4.03	1.89
	2006-2010	149	8012	3.89	1.84
D2: Center for Quantum Optics	2001-2005	53	2598	2.12	1.60
	2006-2010	96	3159	5.14	1.94
D3: Strategic electrochemistry research centre	2002-2005	27	1347	3.07	1.68
	2006-2010	73	1229	2.69	0.96
F1: CoE in Molecular and Integrative Neuroscience Research	1995-1999	119	9422	3.71	2.14
	2000-2005	168	9898	2.08	1.52
	2006-2007	49	1690	2.26	1.72
	2008-2010	64	1284	3.10	1.65
F2: Centre of Excellence in Smart Radios and Wireless Research (SMARAD)	1997-2001	135	2208	1.60	0.78
	2002-2010	328	4739	2.34	0.97
N1: Bjerknes Centre for Climate Research (BCCR)	1998-2002	26	1284	2.90	2.89
	2003-2010	74	1810	3.25	2.23
N2: Concrete Innovation Centre (COIN)	2002-2006	16	187	1.25	1.01
	2007-2010	21	119	1.39	1.06
N3: Centre for Cancer Biomedicine (CCB)	2002-2006	156	11469	3.04	1.78
	2007-2010	124	4129	3.70	1.87
S1: Organizing Molecular Matter	2001-2005	220	5324	1.18	1.26
	2006-2010	215	3256	1.43	1.17
S2: Chase - Chalmers Antenna Systems Excellence centre	2001-2005	56	798	1.51	0.79
	2006-2010	43	341	2.49	0.94
S3: The Neuronano Research Center	2001-2005	119	2883	1.08	0.99
	2006-2010	90	1070	1.26	1.24

Data and methods: See section page 52 ff. For each centre, the publications of the PIs/group leaders – before and during the centre period – are included.

1) World average field = 1.00. 2) Average journal profile = 1.00.

Table 2 provides an overview of the number and proportion of the publications that involve collaboration with researchers from foreign institutions. There are quite large differences between the centres, but no systematic pattern of changes can be identified between the periods.

Table A2.1 Publications with international collaboration as share of total for selected centres and periods

Centre	Period	Int pubs	All pubs	Int pubs (%)
DK1: Centre for Epigenetics	2002-2005	50	70	71%
	2006-2011	111	176	63%
DK2: Center for Quantum Optics	2001-2005	22	53	42%
	2006-2011	78	117	67%
DK3: Strategic electrochemistry research centre	2002-2005	10	27	37%
	2006-2011	26	98	27%
FI1: CoE in Molecular and Integrative Neuroscience Research	1995-1999	63	119	53%
	2000-2005	88	168	52%
	2006-2007	21	49	43%
	2008-2011	43	90	48%
FI2: Centre of Excellence in Smart Radios and Wireless Research (SMARAD)	1997-2001	42	135	31%
	2002-2011	113	358	32%
NO1: Bjerknes Centre for Climate Research (BCCR)	1998-2002	22	26	85%
	2003-2011	66	94	70%
NO2: Concrete Innovation Centre (COIN)	2002-2006	10	16	63%
	2007-2011	18	27	67%
NO3: Centre for Cancer Biomedicine (CCB)	2002-2006	90	156	58%
	2007-2011	74	161	46%
S1: Organizing Molecular Matter	2001-2005	119	220	54%
	2006-2011	177	260	68%
S2: Chase - Chalmers Antenna Systems Excellence centre	2001-2005	20	56	36%
	2006-2011	31	55	56%
S3: The Neuronano Research Center	2001-2005	38	119	32%
	2006-2011	38	109	35%

Data and methods: See section page 52 ff. For each centre, the publications of the PIs/group leaders – before and during the centre period – are included.

Denmark

Centre for Epigenetics (D1)

Starting year: 2007. Publications from 2002-2011 have been investigated. Publications of 7 researchers, identified as PIs/group leaders, are included in the analysis.

Productivity: Increased from around 20 to around 30 publications per year.

Impact: Very high, also before the starting year: Three-to-four times above field and country average and almost twice the journal average.

Journal profile: Publishes almost only in top journals in their specialty, sometimes also in the most prestigious general journals. The journals most often used are *Journal of Proteome Research* (20 publications), *Molecular & Cellular Proteomics* (18 publications) and *Journal of Biological Chemistry* (15 publications).

International collaboration: The degree of international collaboration in publications is high with no significant difference before and after the starting year. All of the three most frequent institutions for collaborations are in Italy: European Inst Oncol (30 publications), FIRC Inst Mol Oncol (7) and Univ Turin (5).

Center for Quantum Optics (D2)

Starting year: 2001. Publications from 2001-2011 have been investigated. Publications of 5 researchers, identified as PIs/group leaders, are included in the analysis.

Productivity: Doubled from less than 10 to around 20 publications per year.

Impact: Very high: It was high already in the start and has doubled in all reference values since then.

Journal profile: Publishes almost only in top journals in their specialty, sometimes also in the most prestigious general journals. The journals most often used are *Physical Review A* (58 publications), *Physical Review Letters* (44 publications) and *Journal of Physics B – Atomic Molecular and Optical Physics* (9 publications).

International collaboration: The degree of international collaboration in publications was low in the first three years, but has increased to a very high level afterwards. The three most frequent institutions for collaborations are at Harvard and Max Planck: Harvard Univ (31 publications), Max Planck Inst Quantum Opt (12), Harvard Smithsonian Ctr Astrophys (8).

Strategic electrochemistry research centre (D3)

Starting year: 2007. Publications from 2002-2011 have been investigated. Publications of 2 researchers, identified as PIs/group leaders, are included in the analysis.

Productivity: Has more than doubled from less than 10 to more than 20 publications per year after the start.

Impact: Well above the field, country and journal averages before and after the start.

Journal profile: Decrease in the journal level after the start is coupled with increased productivity. Publishes mainly in the top journals for applied research in their specialty. The journals most often used are *Solid State Ionics* (38 publications), *Journal of the Electrochemical Society* (20 publications) and *Electrochemical and Solid State Letters* (8 publications).

International collaboration: The degree of international collaboration in publications is on the average for engineering research and varying from year to year with no clear trend. The two most frequent institutions for collaborations abroad are Lund University (5 publications) and Columbia University in the USA (4).

Finland

CoE in Molecular and Integrative Neuroscience Research

CoE in 2000-2005 and 2008-2013 (in 2000-2005 it was called "Programme of Molecular Neurobiology"). Seven persons have been identified as key personnel.

Productivity: The period 1995-2011 has been analysed. With one exception, all persons have been publicationally active during the entire period. The annual production has been in the range of 20 to 30 (unique) publications in most years, albeit with some annual fluctuations and no clear tendency over time. This holds both before and under the centre period.

Impact: The publications of the centre have been extremely highly cited. During the first CoE period (2000-2005) the publications were cited more than twice as frequent as the field normalised world average (citation index – field 2.08), and during the second period (2008-2010) more than three times as high (citation index field 3.10). Before the centre obtained CoE status (1995-1999), the citation index was even higher (3.71).

Journal profile: The key persons of the centre tend to publish in high impact journals; this is indicated by the journal profile which is 1.5-1.7 in the periods between 2000 and 2010, and even higher in the 1995-1999 period (2.14). Accordingly when compared to the average citation rate of the journals, the citation index is significantly lower than the field normalised world average. The journals most often used are *Journal of Neuroscience* (34 publications), *European Journal of Neuroscience* (28 publications) and *Electrochemical and Journal of Biological Chemistry* (23 publications).

International collaboration: The degree of international collaboration in publications is high with no significant difference before and after the starting year. The most frequent institution for collaborations is Karolinska Institute, Sweden (12 publications).

Centre of Excellence in Smart Radios and Wireless Research (SMARAD)

Unit established in 2000. CoE 2002-2007 and 2008-2013. Five persons have been identified as key personnel. The period 1997-2011 has been analysed.

Productivity: All persons have been publicationally active during the entire period and have a very high productivity. The annual production has been in the range of 20 to 45 (unique) publications in most years, albeit with some annual fluctuations. The productivity increased during the period before the CoE was established.

Impact: The publications of the key personnel have been very highly cited. This particular holds for the articles which have been published during the CoE period. In the latter period, the publications obtained a field normalised citation index of 2.34, meaning they have obtained 134 % more citations than the average publication within the field.

Journal profile: In the last period, the key persons of the centre tend to publish in journals with average impact factors, this is indicated by the journal profile which is 0.97. In the first period, the journal profile was lower (0.78). Accordingly in this period, when compared to the average citation rate of the journals, the citation index is significantly higher than the field normalised world average. The journals most often used are *IEEE Transactions on Antennas and Propagation* (52 publications), *Microwave and Optical Technology Letters* (48 publications) and *Electronics Letters* (35 publications).

International collaboration: On average, one third of the publications have been co-authored with researchers from foreign institutions. There are large fluctuations in the annual proportions, however. The most frequent institutions for collaboration are Russian.

Norway

Bjerknes Centre for Climate Research (BCCR)

Unit was established in 2003. Seven persons have been identified as key personnel. The period 1998-2011 has been analysed, where 1998-2002 is the five year period before the centre was established. However, not all persons have been publicationally active during the entire period.

Productivity: The annual production shows large fluctuations from 1-20 publications. The productivity is lower than the one found for most other centres analysed. The productivity has however increased during the CoE period, partly as a result of more key personnel being publicationally active.

Impact: The publications of the centre have been extremely highly cited. During the CoE period (2003-2010) the publications were cited more than three times as frequent as the field normalised world average (citation index – field 3.25). The publications from the years before the centre was established (1998-2002) was also very high (citation index – field 2.90).

Journal profile: The key persons of the centre tend to publish in very high impact journals, this is indicated by the journal profile which is 2.89 and 2.23 in the periods analysed. Accordingly when compared to the average citation rate of the journals, the citation index is significantly lower than when using the field normalised world average. The journals most often used are *Paleoceanography* (16 publications) and *Quaternary Science Reviews* (10 publications).

International collaboration: The degree of international collaboration in publications is very high with no significant difference before and after the starting year. The most frequent institution for collaborations is Max Planck Institute for Meteorology, Germany (16 publications).

Concrete Innovation Centre (COIN)

The centre was established as a SFI for the period 2007-2014. Nine persons have been identified as key personnel. The period 2002-2011 has been analysed, where 2002-2006 is the five year period before the centre was established.

Productivity: The annual production shows fluctuations from 2 to 8 publications. The productivity is lower than the one found for most other centres analysed. It should be noted, however, that this is a centre for innovation. Accordingly important parts of the activity of the centre may not be relevant for publication in scientific journals. Moreover, the engineering field is less well covered by the WoS database. For example, conference proceedings are not included which generally are important publication channels within engineering

Impact: The publications of the centre have been cited above average. During the CoE period (2007-2010) the publications were cited 39 per cent more frequent than the field normalised world average (citation index – field 1.39). The publications from the years before the centre was established (2002-2006) obtained a citation index – field of 1.25. The publications of the centre have also been higher cited than the corresponding Norwegian field normalised average.

Journal profile: The key persons of the centre tend to publish in journals with an average impact factor, this is indicated by the journal profile which is 1.06 and 1.01 in the periods analysed. The journals most often used are *Cement and Concrete Research* (17 publications), *Materials and Structures* (9 publications) and *Cement & Concrete Composites* (9 publications).

International collaboration: The degree of international collaboration in publications is quite high (53 per cent on average), but with large annual variations. The most frequent institution for collaborations is Technical University of Denmark (14 publications).

Centre for Cancer Biomedicine (CCB)

The centre was established as a CoE for the period 2007-2016. Six persons have been identified as key personnel. The period 2002-2011 has been analysed where 2002-2006 is the five year period before the centre was established.

Productivity: All persons have been publicationally active during the entire period and have a very high productivity. The annual production of the key personnel has been in the range of 25 to 35 (unique) publications in most years, albeit with some annual fluctuations and no clear tendency over time. This holds both before and under the centre period but in the two most recent years the productivity has been above 35 publications.

Impact: The publications of the centre have been extremely highly cited. During the CoE period (2007-2010) the publications were cited almost four times as frequent as the field normalised world average

(citation index – field 3.70). The publications from the years before the centre was established (2002-2006) was also very high (citation index – field 3.04).

Journal profile: The key persons of the centre tend to publish in high impact journals, this is indicated by the journal profile which is 1.8-1.9 in the periods analysed. Accordingly when compared to the average citation rate of the journals, the citation index is significantly lower than when using the field normalised world average. The journals most often used are *Journal of Cell Science* (14 publications), *Traffic* (14 publications) and *Molecular Cancer* (9 publications).

International collaboration: The degree of international collaboration in publications is quite high (52 per cent on average), with no significant difference before and after the starting year. The most frequent institution for collaborations are National Institute of Health, USA, and University of Copenhagen, Denmark, both with 22 co-authored publications.

Sweden

Organizing Molecular Matter (S1)

Starting year: 2006. Publications from 2001-2011 have been investigated. Publications of 7 researchers, identified as PIs/group leaders, are included in the analysis.

Productivity: Is generally high, but has not increased after the start.

Impact: Not high, but above field, country and journal averages and has increased after the start.

Journal profile: Publishes in main stream journals in their specialty. Also a few publications in more general and prestigious journals. The journals most often used are *Langmuir* (98 publications), *Journal of Physical Chemistry B* (79 publications) and *Journal of Chemical Physics* (23 publications).

International collaboration: The degree of international collaboration in publications is quite high and has increased since the start. The three most frequent institutions for collaborations abroad are University of Coimbra (87) and University of Porto (10) in Portugal and Haverford College in the USA (8).

Chase - Chalmers Antenna Systems Excellence centre (S2)

Starting year: 2006. Publications from 2001-2011 have been investigated. Publications of 5 researchers, identified as PIs/group leaders, are included in the analysis.

Productivity: Not very high, with a slight decrease after the start.

Impact: High and increasing after the start, relative to field, country and journal averages.

Journal profile: Publishes in relatively low impact, but relevant specialised journals and proceedings. The journals most often used are *Microwave and Optical Technology Letters* (17 publications), *IEEE Transactions on Antennas and Propagation* (16 publications) and *IEEE Antennas and Wireless Propagation Letters* (11 publications).

International collaboration: The degree of international collaboration in publications is relatively high and has increased since the start. The two most frequent institutions for collaborations abroad are JSC Radiophyzika in Russia (8) and University Carlos III Madrid in Spain (6).

The Neuronano Research Center (S3)

Starting year: 2006. Publications from 2001-2011 have been investigated. Publications of 8 researchers, identified as PIs/group leaders, are included in the analysis.

Productivity: Not very high, around 20 per year, with a slight decrease after the start.

Impact: Has improved from average to slightly above average after the start – relative to field, country and journal averages.

Journal profile: Turns from average to higher impact journals after the start. Most publications are in specialised and technical journals, a few are in more general journals or main neuroscience journals. The journals most often used are *Neuroreport* (17 publications), *Nanotechnology* (16 publications) and *Microelectronic Engineering* (16 publications).

International collaboration: The degree of international collaboration in publications is relatively low most years with no clear trends. The two most frequent institutions for collaborations abroad are University of Copenhagen (9) and the Technical University of Denmark (5).

Data and methods

The study is based on articles indexed in Thomson Reuters' Web of Science (WoS) authored by the persons who have been identified as key-personnel of the different centres. For each person we have searched for publications before and during the centre periods. First, we have analysed a five year period before the (first) inauguration of the Coe's. Then we have analysed the period the centres have had CoE funding up to and including the year 2011. The intention is to see whether differences can be identified in the performance of the centres measured bibliometrically. We have used CVs and other available information to verify the publications identified in WoS. Only regular journal articles and review articles are included in the study, i.e. not minor journal contributions like letters, editorials, abstracts, etc.

The fact that we have limited the study to the key personnel of the centres means that we have not analysed the entire publication output of the centres. The key personnel are expected to have a major role in the research activity of the centres and may appear as co-authors of many of their publications. Nevertheless, for most of the centres the number of affiliated persons is significantly higher than the number of key personnel. Therefore there may be many publications of the centres that are not included in the analysis.

The WoS database covers a large number of specialised and multidisciplinary journals within the natural sciences, medicine, technology, the social sciences and the humanities. The coverage varies between the different database products. According to the website of the Thomson Scientific company, the most well-known product, the Science Citation Index today covers 8,300 journals (Science Citation Index Expanded). The online product Web of Science covering the three citation indexes Science Citation Expanded, Social Sciences Citation Index, and Arts & Humanities Citation Index includes more than 12,000 journals. Compared to the large volume of scientific and scholarly journals that exist today, this represents a limited part. The selection of journals is based on a careful examination procedure in which a journal must meet particular requirements in order to be included (Testa, 1997). Even if its coverage is not complete, the WoS database will include all major journals within the natural sciences, medicine and psychology and is generally regarded as constituting a satisfactory representation of international mainstream scientific research (Katz & Hicks, 1998). With respect to the social sciences and humanities the coverage is more limited. Engineering fields are moderately well covered by the database. This is due to the particular publication pattern of engineering research where proceedings papers play an important role, and a significant part of this output will not be covered by the database. These factors need to be taken into account when interpreting the results of the bibliometric analysis.

The individual articles and their citation counts represent the basis for the citation indicators. In the citation indicators we have used accumulated citation counts (from year of publication to September

2012[6]) and calculated an overall (total) indicator for the periods. This means that for the articles published in 2006, citations are counted over a 6-year period, while for the articles published in 2008, citations are counted over a 4-year period.

The average citation rate varies a lot between the different scientific disciplines. As a response, various reference standards and normalisation procedures have been developed. The most common is the average citation rates of the journal or field in which the particular papers have been published. An indicator based on the journal as a reference standard is the Relative citation index – journal (also called the Relative Citation Rate). Here the citation count of each paper is matched to the mean citation rate per publication of the particular journals (Schubert & Braun, 1986). This means that the journals are considered as the fundamental unit of assessment. If two papers published in the same journal receive a different number of citations, it is assumed that this reflects differences in their inherent impact (Schubert & Braun, 1993). Below the indicators are further described.

Relative citation index – field

A similar method of calculation was adopted for the Relative citation index – field (also termed the Relative Subfield Citedness (cf. Vinkler, 1986, 1997). Here, as a reference value we used the mean citation rate of the subfields in which the centre has published. This reference value was calculated using the bibliometric data from the NSI-database. Using this database it is possible to construct a rather fine-tuned set of subfield citation indicators. The centres are usually active in more than one subfield (i.e. the journals they publish in are assigned to different subfields). For each centre we therefore calculated weighted averages with the weights being determined by the total number of papers published in each subfield/year. In Thomson Reuter's classification system some journals are assigned to more than one subfield. In order to handle this problem we used the average citation rates of the respective subfields as basis for the calculations for the multiple assigned journals. The indicator was subsequently calculated as the ratio between the average citation rate of the department's articles and the average subfield citation rate. In this way, the indicator shows whether the centre's articles are cited below or above the world average of the subfield(s) in which the centre is active.

Example

The following example can illustrate the principle for calculating relative citation indexes: A scientist has published a regular journal article in Mathematics of Computation in 2006. This article has been cited 6 times. The articles published in Mathematics of Computation were in contrast cited 4.00 times on average this year. The Relative citation index – journal is: 6/4.00 = 1.50. The world-average citation rate for the subfield which this journal is assigned to is 3.69 for articles published this year. In other words, the article obtains a higher score compared to the field average. The Relative citation index – field is: 6/3.69= 1.62. The example is based on a single publication. The principle is, however, identical when considering several publications. In these cases, the sum of the received citations is divided by the sum of the "expected" number of citations.

It is important to notice the differences between the field and journal adjusted relative citation index. A centre may have a publication profile where the majority of the articles are published in journals being highly cited within their fields (i.e. have high impact factors). This implies that the centre obtains a much lower score on the journal adjusted index than the field adjusted index. The most adequate measure of the research performance is often considered to be the indicator in which citedness is compared to field average. This citation index is sometimes considered as a bibliometric "crown indicator" (van Raan, 2000). In the interpretation of the results this indicator should accordingly be given the most weight.

The following guide can be used when interpreting the Relative citation index – field:

- Citation index: > 1.50: Very high citation level

[6] It should be noted that citations from part of 2012 are included, while 2012 citations are not included in the reference values. Accordingly, the centers have a certain "comparative advantage", although this should not be considered as a major flaw.

- Citation index: 1.20-1.50: High citation level, significant above the world average.
- Citation index: 0.80-1.20: Average citation level. On a level with the international average of the field (= 1.00).
- Citation index: 0.50-0.80: Low citation level.
- Citation index: < 0.50: Very low citation level.

It should be emphasised that the indicators cannot replace an assessment carried out by peers. In the cases where a centre is poorly cited, one has to consider the possibility that the citation indicators in this case do not give a representative picture of the research performance. Citations have highest validity in respect to high index values. But similar precautions should be taken also here. For example, in some cases one highly cited researcher or one highly cited publication may strongly improve the citation record of a group or even a department.

Journal profiles

We also calculated the journal profile of the centres. As basis for one of the analyses we used the so called “impact factor” of the journals. The journal impact factor is probably the most widely used and well-known bibliometric product. It was originally introduced by Eugene Garfield as a measure of the frequency with which the average article in a journal has been cited. In turn, the impact factor is often considered as an indicator of the significance and prestige of a journal.

The Journal profile of the departments was calculated by dividing the average citation rate of the journals in which the centre’s articles were published by the average citation rates of the subfields covered by these journals. Thus, if this indicator exceeds 1.00 one can conclude that the centre publishes in journals with a relatively high impact.

Appendix 3 International project collaboration before and during/after the centre period

Ernst Kristiansen, SINTEF

1. Methods

We have identified EU-funded projects (signed contracts) in FP5, FP6 and FP7 until 2012, which have connections to key personnel in the centres.

Information from the centres related to projects described in their WEB-pages and annual reports was the starting point.

We have access to signed contracts from Ecorda databases for FP5 (2004-04-26), FP6 (2007-05-07) and FP7 (2012-02-13). For FP6 and FP7 the contact person for each contract is identified. Often this is the project leader, but for some organisations it is an administrative contact. The Cordis WEB-pages have also been used.

The Ecorda databases give information about size of the projects, funding, starting point, duration and partners in addition to more administrative information.

Using this information we are able to see the EU-funding to the centres over the years and how collaboration has developed.

2. Main findings

During the study we analysed 12 centres in the Nordic countries, and it seems possible to put the centres into two main categories regarding EU-participation: centres that have increased or continued the EU-participation at a significant level (I), and centres with little or no EU-funding in the project period (II). Six of the centres are in the first category and five in the second. For the 12th, the SHOK-centre in Finland it is very difficult to do any analyses regarding EU-participation.

Table A3.1 Key researchers'/groups leaders' funding from the EU Framework programmes

Case	Name of centre	Before the centre period		During and after the centre period	
		# projects	EU funding (mill. euro)	# projects	EU funding (mill. euro)
D1 (I)	Centre for Epigenetics	3	1,9	5	3,9
D2 (II)	Center for Quantum Optics (Quantop)	*	*	2	0,2
D3 (II)	Strategic Electrochemistry Research Center (SERC)	2	1,0		
F1 (I)	CoE in Molecular and Integrative Neuroscience Research	*	*	3	0,9
F2 (I)	SMARAD - CoE in Smart Radios and Wireless Research	*	*	8	2,8
F3	Finnish Bioeconomy Cluster FIBIC				
N1 (I)	Centre for Cancer Biomedicine (CCB)	1	0,2	1	2,3
N2 (I)	Bjerknes Centre for Climate Research (BCCR)	13	3,4	17	12,5
N3 (II)	COIN - Concrete Innovation Centre				
S1 (I)	Organizing Molecular Matter	4	1,2	4	1,1
S2 (II)	Chase - Chalmers Antenna Systems Excellence center	4	0,8	1	0,0
S3 (II)	The Neuronano Research Center			1	0,4

*Missing data before the centre period: D2 started in 2001, F1 started in 2000 and F2 in 2002. Hence, FP5 data with first project staring in 1999 are not sufficient for comparing before and during/after the centre period.

The table above shows the distribution of EU-projects and EU-funding for the different centres before and during/after the centre period. The cases marked (I) are typical centres with stable or increased EU-funding, while the cases marked (II) have no/little or significant decreased EU-funding.

Project collaboration with partners from other countries

The centres with an increased EU-funding and participation (marked (I)) also seem to get partners from well-known institutions in Europe and increased both the number of partners and the number of countries involved.

Table A3.2 Key researchers'/groups leaders' collaboration profile in EU Framework programmes

Case	Name of centre	Countries with most participations before the centre period	Countries with most participations during and after the centre period	Mostly involved partners (number of projects)
D1 (I)	Centre for Epigenetics	DE(7), UK(6), DK(3), ES(3)	DE(15), UK(14), ES(9), SE(7), DK(6), IT(6)	UNIVERSITY OF CAMBRIDGE (0+3), CENTRE DE REGULACIO GENOMICA(0+3)
D2 (II)	Center for Quantum Optics (Quantop)			
D3 (II)	Strategic Electrochemistry Research Center (SERC)	DE(6), UK(5), CH(4), DK(4), FR(4)		
F1 (I)	CoE in Molecular and Integrative Neuroscience Research		FR(4), UK(4), DE(3), FI(3), HU(3), SE(3)	KAROLINSKA INSTITUTET(2), UNIVERSITY COLLEGE LONDON(2)
F2 (I)	SMARAD - CoE in Smart Radios and Wireless Research		FR(26), IT(18), SE(18), UK(18), ES(15), DE(12), FI(12)	CHALMERS(4), CNRS(4), KTH(4), Thales(4), UNISI(4), EPFL(3), SAPIENZA(3), TU Delft(3), UPC(3)
F3	Finnish Bioeconomy Cluster FIBIC			
N1 (I)	Centre for Cancer Biomedicine (CCB)			
N2 (I)	Bjerknes Centre for Climate Research (BCCR)	UK(22), NO(14), FR(13), DE(12), DK(4), SE(4)	UK(77), FR(59), DE(55), NO(44), NL(23), DK(22), ES(20), IT(20), CH(14), DE(13), SE(13), FI(11)	CNRS(3+13), MPG(4+9), CEA(2+9), NERC(1+9), UNI-HB(2+6), UPMC(3+5), UEA(4+4), UBERN(0+7), IFM-GEOMAR(0+7), READING(2+5)
N3 (II)	COIN - Concrete Innovation Centre			
S1 (I)	Organizing Molecular Matter	SE(7), DE(6), DK(4), UK(4), FR(3)	UK(10), SE(8), BE(5), DE(5), DK(4), FR(4), IE(4), NL(4)	LMU-Munich(3+1), UPS(3+1), KTH(1+2)
S2 (II)	Chase - Chalmers Antenna Systems Excellence center	DE(16), FR(14), SE(14), UK(14), IT(8), FI (8), ES(7)	IT(5), ES(4), FR(3)	CTTC(2+1), KTH(2+1), TKK(2+1)
S3 (II)	The Neuronano Research Center		DE(4), NL(2)	

The table above shows how many participations there have been from the different countries before the centre period and during/after. The brackets indicate the number of participations for the countries with most participations. The brackets for the partners indicate the number of projects for the partner. If there are two numbers in the brackets, the brackets show projects before and during/after the centre period.

The table below shows how many partners and countries that have been involved in the EU-collaboration for each centre. If a partner has participated in more than one project, the number of participations will be higher than the number of partners. Centre N1 has a decreased number of partners, but they got an ERC-grant and thereby got a significant increase in EU-funding.

Table A3.3 Key researchers'/groups leaders' partners in EU Framework programmes

Case	Name of centre	Before the centre period			During and after the centre period		
		# participations	# partners	# countries	# participations	# partners	# countries
D1 (I)	Centre for Epigenetics	33	33	15	74	58	12
D2 (II)*	Center for Quantum Optics (Quantop)				2	1	1
D3 (II)	Strategic Electrochemistry Research Center (SERC)	32	29	12			
F1 (I)*	CoE in Molecular and Integrative Neuroscience Research				33	30	17
F2 (I)*	SMARAD - CoE in Smart Radios and Wireless Research				163	93	22
F3	Finnish Bioeconomy Cluster FIBIC						
N1 (I)	Centre for Cancer Biomedicine (CCB)	11	11	8	1	1	1
N2 (I)	Bjerknes Centre for Climate Research (BCCR)	84	56	14	448	223	39
N3 (II)	COIN - Concrete Innovation Centre						
S1 (I)	Organizing Molecular Matter	34	25	12	60	54	18
S2 (II)	Chase - Chalmers Antenna Systems Excellence center	110	95	22	23	23	12
S3 (II)	The Neuronano Research Center				11	11	7

*Missing data before the centre period: D2 started in 2001, F1 started in 2000 and F2 in 2002. Hence, FP5 data with first project staring in 1999 are not sufficient for comparing before and during/after the centre period.

Project funding

The table below show the EU-funding to the centre before and during/after the centre period. The centres with an increased EU-funding and participation (marked (I)) in most cases also have got access to results from EU-funded projects with a value of 12-19 times the funding to the centre. The case N1 has increased the EU-funding, but not the collaboration. The increase is based on an ERC-grant. The case N2 has an impressive increase in EU-funding, and the EU-funding is in the same order as the funding to centre from the Norwegian Research Council.

Table A3.4 Key researchers'/groups leaders' project funding from the EU Framework programmes

Case	Name of centre	Before the centre period (mill. euro)		During and after the centre period (mill. euro)	
		EU funding to the centre	Total value of the EU-funded projects	EU funding to the centre	Total value of the EU-funded projects
D1 (I)	Centre for Epigenetics	1,9	17,2	3,9	64,4
D2 (II)*	Center for Quantum Optics (Quantop)		0,0	0,2	0,2
D3 (II)	Strategic Electrochemistry Research Center (SERC)	1,0	20,0		
F1 (I)*	CoE in Molecular and Integrative Neuroscience Research			0,9	14,0
F2 (I)*	SMARAD - CoE in Smart Radios and Wireless Research			2,8	33,1
F3	Finnish Bioeconomy Cluster FIBIC				
N1 (I)	Centre for Cancer Biomedicine (CCB)	0,2	2,6	2,3	2,3
N2 (I)	Bjerknes Centre for Climate Research (BCCR)	3,4	26,8	12,5	192,1
N3 (II)	COIN - Concrete Innovation Centre				
S1 (I)	Organizing Molecular Matter	1,2	9,1	1,1	20,6
S2 (II)	Chase - Chalmers Antenna Systems Excellence center	0,8	33,0	0,0	0,3
S3 (II)	The Neuronano Research Center			0,4	2,5

*Missing data before the centre period: D2 started in 2001, F1 started in 2000 and F2 in 2002. Hence, FP5 data with first project staring in 1999 are not sufficient for comparing before and during/after the centre period.

3. EU-projects from FP5, FP6 and FP7 for the centres

3.1 Denmark

D1 - The Centre for Epigenetics

Altogether eight EU-projects have been found. For all of these, key personnel of the centre have been identified as the contact person. The first project was from the period when the centre leader work in Italy before the centre started. There were no projects from FP5.

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	Centre partner in EU-project	EU funding to the partner	Project Start	Project End
INTACT	FP6	11	11 117 600	8 200 000	IEO Srl	1 333 400	01.01.04	31.12.07
DIAMONDS	FP6	10	3 153 068	2 498 574	KU	249 840	01.01.05	31.12.07
DNA ENZYMES	FP6	12	2 975 002	2 975 002	SDU	329 691	01.10.05	30.09.09
BLUEPRINT	FP7	42	39 867 279	29 996 664	KU	600 000	01.10.11	31.03.16
CHROMATIN REPLICATION	FP7	1	1 692 737	1 692 737	KU	1 692 737	01.11.11	31.10.16
4DCELLFATE	FP7	12	16 077 280	11 982 403	KU	804 300	01.12.11	30.11.16
PEPMIP	FP7	10	3 053 584	3 053 584	SDU	475 716	01.01.12	31.12.15
INGENIUM	FP7	10	3 662 880	3 662 880	KU	306 748	01.04.12	31.03.16

The total volume of EU-funded projects related to the activity of the centre is 5,8M€.

D2 - Center for Quantum Optics

Both the University of Aarhus and the University of Copenhagen have EU-funded projects related to the subjects for the centre. However, it is difficult to connect the projects to the centre. For most projects the contact persons at the universities are administrative persons at related institutes, but not necessary connected to the centre. The centre has not described funding from other sources except for ERC AG received in 2012 connected to the centre director. This ERC AG is not in the data base. In addition there are two MC-RG connected to Jacob Sherson.

D3 - Strategic electrochemistry research center (SERC)

It is found only two projects with reference to key persons from SERC, both are in FP6 before SERC was approved.

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	Centre partner in EU-project	EU funding to the partner	Project Start	Project End
HI2H2	FP6	4	1 767 080	1 106 887	KU	232 294	01.08.04	31.07.07
REAL-SOFC	FP6	28	18 259 430	8 999 000	KU	805 550	01.02.04	31.01.08

3.2 Finland

F1 - CoE in Molecular and Integrative Neuroscience Research
Eero Castrén has just received an ERC advanced grant, but his grant is not in the data base yet. Connected to key persons 3 projects have been identified.

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	EU funding to the partner	Project Start	Project End
CORTEX	FP6	8	2 556 137	2 556 137	386 900	01.01.06	31.12.09
CANCERGRID	FP6	10	3 847 425	2 804 075	204 865	01.01.07	31.12.09
NEMO	FP7	15	7 590 405	5 800 000	318 558	01.10.09	30.09.14

F2 - SMARAD - Centre of Excellence in Smart Radios and Wireless Research
The following projects have been identified related to the centre

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	EU funding to the partner	Project Start	Project End
ACE (I)	FP6	46	5 400 000	5 400 000	261 638	31.12.03	31.12.05
METAMORPHOSE	FP6	23	4 400 000	4 400 000	193 128	01.06.04	31.05.08
ACE (II)	FP6	52	5 100 000	5 100 000	208 755	31.12.05	31.12.07
SENDORA	FP7	9	5 635 649	3 846 702	457 300	01.01.08	31.12.10
ECONAM	FP7	9	666 699	600 000	126 875	01.04.08	31.03.11
TUMESA	FP7	6	2 525 477	1 850 000	674 601	01.06.08	30.09.11
METACHEM	FP7	9	5 436 413	3 699 990	303 004	15.09.09	14.09.13
RODIN	FP7	8	3 887 854	2 894 280	594 440	01.10.10	30.09.13

F3 – Finnish Bioeconomy Cluster (FIBIC) (SHOC)
It is difficult to find any projects related to the centre.

3.3 Norway

N1 - Centre for Cancer Biomedicine (CCB)
The annual reports give indications that there should be at least one Marie Curie action and one ERC-grant. Both projects are identified. Both projects are connected to the leader of the centre.

Project	Instrument	Framework	Partners	Funding (€)	Project start	Project end
ENDOCYTE	MCA	FP6	11	210 377	01.09.06	31.08.10
PI3K-III COMPLEX	ERC-AG-LS3	FP7	1	2 272 000	01.01.10	31.12.14

N2 - Bjerknes Centre for Climate Research
The WEB-site has a good overview of all projects, both running and finished projects. The EU-funded projects have been identified and found in the Ecorda databases. The project overview includes relevant project before the Bjerknes Centre was approved. All together 30 EU-funded projects have been identified, 13 in FP5, 7 in FP6 and 10 in FP7.

Project	Frame-work progr.	Partners	Total project cost	EU Funding to the project	Centre partner in EU-project	EU funding to the partner	Project Start	Project End
MAIA	FP5	6	2 393 050	1 183 500	IMR	166 700	01.01.00	31.12.02
PREDICATE	FP5	8	2 232 800	1 644 700	NERSC	194 900	01.03.00	28.02.03
SNEHILO	FP5	1	225 000	225 000	UiB	225 000	01.10.00	30.09.04
CAVASSOO	FP5	5	2 037 467	1 517 787	UiB	252 001	01.12.00	30.11.03
AICSEX	FP5	7	2 424 255	1 665 987	NERSC	464 897	01.01.01	29.02.04
HOLSMEER	FP5	13	2 082 589	2 010 563	UiB	220 417	01.01.01	30.06.04
TRACTOR	FP5	7	2 342 632	1 887 530	NERSC	152 699	01.02.01	31.01.04
					UiB	542 932	01.02.01	31.01.04
BJERKNES	FP5	1	180 000	180 000	UiB	180 000	01.03.01	31.08.06
QPALCLIM	FP5	1	250 000	250 000	UiB	250 000	01.03.01	31.12.05
CESOP	FP5	6	1 774 316	1 390 170	UiB	305 328	01.11.01	31.10.04
PRISM	FP5	20	8 419 393	4 604 983	NERSC	109 900	01.12.01	30.11.04
NOCES	FP5	12	2 324 197	1 582 774	NERSC	152 011	01.04.02	31.03.05
Phase rel	FP5	1	142 398	142 398	UiB	142 398	01.05.02	30.04.04
ENSEMBLES	FP6	71	22 793 436	15 000 000	NERSC	240 000	01.09.04	31.08.09
EUR-OCEANS	FP6	66	40 000 000	10 000 000	NERSC	322 200	01.01.05	31.12.08
					UiB	2 937 268	01.01.05	31.12.08
CARBOOCEAN	FP6	35	19 271 618	14 499 600	IMR	245 901	01.01.05	31.12.09
					UiB	245 901	01.01.05	31.12.09
DYNAMITE	FP6	13	3 122 214	1 999 998	NERSC	323 770	01.03.05	29.02.08
DAMOCLES	FP6	45	24 569 044	16 099 700	UiB	355 975	01.12.05	30.11.09
					IMR	280 120	01.12.05	30.11.09
					NERSC	961 670	01.12.05	30.11.09
LIMOCINE	FP6	1	148 484	148 483	UiB	148 484	01.11.06	30.04.08
NICE	FP6	12	2 618 044	2 599 550	UiB	226 451	01.01.07	31.12.10
ICOS	FP7	19	5 742 042	4 299 996	UNI RESEARCH	10 000	01.04.08	31.03.13
EPOCA	FP7	27	9 766 951	6 548 995	UiB	407 799	01.05.08	30.04.12
MEECE	FP7	22	8 577 985	6 499 745	UiB	656 135	01.09.08	31.08.12
MEGAPOLI	FP7	23	5 094 508	3 398 989	NERSC	101 997	01.10.08	30.09.11
THOR	FP7	20	12 948 294	9 274 427	NERSC	447 000	01.12.08	30.11.12
					UiB	892 115	01.12.08	30.11.12
PAST4FUTURE	FP7	22	9 233 878	6 647 909	UNI RESEARCH	540 527	01.01.10	31.12.14
EURO-BASIN	FP7	24	9 652 001	6 996 407	IMR	550 000	31.12.10	30.12.14
					UNI RESEARCH	275 000	31.12.10	30.12.14
GREENSEAS	FP7	9	4 483 906	3 476 469	NERSC	1 149 016	01.01.11	31.12.13
					UNI RESEARCH	759 300	01.01.11	31.12.13
ECLISE	FP7	11	4 477 194	3 408 671	UNI RESEARCH	138 060	01.02.11	31.01.14
CARBO-CHANGE	FP7	28	9 556 960	6 989 906	NERSC	280 417	01.03.11	28.02.15
					UiB	733 542	01.03.11	28.02.15

The total volume of EU-funded projects related to the activity of the centre is16.6 M€.

The total costs of the EU-funded projects are 219 M€, 13 times the EU-funding to the partners of the centre. The project volume has increased significant after the centre started.

N3 - Concrete Innovation Centre
There is only one Marie Curie action partly connected to the centre.

3.4 Sweden

S1 - OMM Organizing Molecular Matter (Center SRC Linnaeus)
Altogether 8 projects were identified to the centre, 6 in FP6 and 2 in FP7. It may be other projects later in FP7, but it has been difficult to connect the project to the centre.

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	EU funding to the partner	Project Start	Project End
CIPSNAC	FP6	6	1 377 631	1 377 631	220 983	01.01.04	31.12.07
BIOSCOPE	FP6	9	2 118 500	1 880 000	245 122	01.02.04	31.01.07
SOCON	FP6	14	3 158 522	3 158 522	344 694	01.01.05	31.12.08
NEONUCLEI	FP6	5	2 464 667	1 949 000	400 000	01.02.05	31.01.09
BIOCONTROL	FP6	16	2 618 044	2 842 101	125 878	01.10.06	30.09.10
NANOINTERACT	FP6	17	4 616 544	3 300 000	189 900	01.01.07	31.12.09
NANOS3	FP7	17	9 708 719	7 800 000	533 925	01.01.11	31.12.14
ESMI	FP7	10	3 619 626	3 619 626	247 697	01.04.12	31.03.16

S2 - Chase - Chalmers Antenna Systems Excellence Center (Vinn Exc)

Potential for EU-funding for the centre in FP7 have been good, so it may be projects for Chalmers that are connected to the centre but where we have not been able to identify the projects.

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	EU funding to the partner	Project Start	Project End
ULTRAWAVES	FP5	7	4 029 128	2 562 628	201 118	14.04.02	30.09.04
FOOT WOUND HEALING	FP6	8	1 379 900	689 700	170 400	01.02.05	31.01.07
ACE	FP6	52	5 100 000	5 100 000	104 377	31.12.05	31.12.07
WINNER II	FP6	46	22 445 575	12 499 999	335 984	31.12.05	31.12.07
ESOA	FP6	23	251 631	251 631	29 480	01.01.07	31.12.09

S3 - The Neuronano Research (Center SRC Linnaeus)

Project	Frame-work Program	Partners	Total Project Cost	EU Funding to the project	EU funding to the partner	Project Start	Project End
NEUROMODEL	FP7	11	2 544 492	2 544 492	405 034	15.10.08	14.10.12

Appendix 4 PEAC Conference 7th may 2013

Excellence initiatives in Nordic research policies

In response to the challenges of globalisation, a number of research policy efforts aim at excellence and better conditions of critical mass, international visibility and enhanced scientific competitiveness. The new policy instruments may have profound structural effects on the research landscape and the general conditions for performing research.

The PEAC project has studied the effects of excellence initiatives in Denmark, Finland, Norway and Sweden. At this conference we invite policy-makers and the research community to discuss the findings and policy implications.

Conference 7th May 2013, Oslo Airport/Raddison Blu Airport Hotel, Final programme

09:30-10:00	Registration, coffee
10:00-10:05	1. Welcome (Sveinung Skule, NIFU)
10:05-10:20	2. Backdrop 1: Excellence objectives in Norwegian research policy (Arvid Hallén, RCN - Research Council of Norway)
10:20-10:35	3. Backdrop 2: Excellence objectives in Danish research policy (Thomas Sinkjær, DNRF - Danish National Research Foundation)
10:35-10:50	4. Research excellence initiatives in the Nordic countries (Liv Langfeldt, PEAC)
10:50-11:30	5. Elitism and concentration of resources: Are the centers too successful? • Introduction by Liv Langfeldt and Gunnar Sivertsen, PEAC, prepared comments from Kari Melby NTNU and Ole Petter Ottersen University of Oslo, and plenary comments/discussion.
11:30	Lunch
12:30-13:00	6. Old boy's centres or opportunities for young scholars? • Introduction by Antti Pelkonen and Siri B. Borlaug PEAC, prepared comments by Curt Rice University of Tromsø and plenary comments/discussion.
13:00-14:00	7. CoEs and organisational change: Scientific renewal and host benefits? • Introduction by Hanne Foss Hansen PEAC, prepared comments by Einar Svendsen Institute of Marine Research, and plenary comments/discussion.
14:00	Break/refreshments
14:15-15:30	8. Rationales and impacts of excellence schemes: Emphasise on risk, interdisciplinarity, internationalisation and/or altering research practices? • Topic introduction: Egil Kallerud PEAC. • Panel discussion with head of funding agencies: Thomas Sinkjær (DNRF); Gunnel Gustafsson (Nordforsk); Marja Makarow (Academy of Finland); Arvid Hallén (RCN); Pär Omling (Lund University/formerly The Swedish Research Council). • Moderator: Mats Benner PEAC.
15:30-16:00	9. Wrapping up and end of conference (Anders Hanneborg, RCN)

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