Promoting Research Excellence

NEW APPROACHES TO FUNDING

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Foreword

This publication is the final report of the OECD Working Party on Research Institutions and Human Resources (RIHR) project on new forms of incentive funding for public research. National research systems face an increasingly competitive environment for ideas, talent and funds, and governments have turned to more competitive forms of funding to promote efficiency and innovation. They have shifted funds from institutional core funding to project funding, often on a competitive basis, or reward success in raising third-party funds in performance-based funding schemes. In this evolving situation, the question of the adequacy of current public funding instruments arises. And it is in this context that "research excellence initiatives" (REIs) have emerged. These are instruments designed to encourage outstanding research by providing large-scale, long-term funding to designated research units. They provide funds for research and research-related measures, such as the improvement or extension of physical infrastructure, the recruitment of outstanding researchers from abroad and researcher training.

The publication presents new evidence on how governments steer and fund public research in higher education and public research institutions through REIs. It can help inform discussions on future government policy directions by providing information on how REIs work and on the functioning and characteristics of institutions that host centres of excellence. The findings show some of the benefits to be gained through REIs and note some pitfalls to be avoided.

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Abbreviations and acronyms

Acronyms

AAAS	American Association for the Advancement of Science
AIMR	Advanced Institute for Materials Research
ALs	Associated laboratories
ARC	Australian Research Council
ATTRACT	Opportunities for Outstanding Young Researchers in Luxembourg
BIS	Bonus Incentive Scheme
BK 21	Brain Korea 21 Programme
CASE	Catalysis for Sustainable Energy
CDL(s)	Christian Doppler Laboratory(ies)
CEER	Centres for environment-friendly energy research
CERC	Canada Excellence Research Chairs
CoE(s)	Centre of Excellence(s)
CoEsLB	CoEs with larger budgets
CoEsSB	CoEs with smaller budgets
COMET	Competence Centres for Excellent Technologies
CoRE(s)	New Zealand Centre(s) of Research Excellence
CoRG	Alias given to a Norwegian CoE to protect the anonymity of respondents
CRC	Collaborative Research Centre
CRI	Centres for Research-based Innovation
CSET	Centres for Science, Engineering and Technology
DASTI	Danish Agency for Science, Technology and Innovation
DFG	German Research Foundation
DNRF	Danish National Research Foundation
DPJ	Democratic Party of Japan
EFRC	Energy Frontier Research Centres
ELSI	Earth-Life Science Institute
FAS	Swedish Council for Working Life and Social Research
FCT	Foundation for Science and Technology
FIRST	Funding Programme for World-Leading Innovative R&D on Science and Technology
Formas	Swedish Research Council
FP7	Seventh Framework Programme
FTE	Full-time equivalent
FWF	Austrian Science Fund
FY	Financial year
GCOE	Global Centres of Excellence Programme
GDP	Gross domestic product
GOVERD	Government Intramural Expenditure on Research and Development
HEIs	Higher Education Institutions

HERD	Higher Education Research and Development
HHMI	Howard Hughes Medical Institute
HI(s)	Host institution(s)
HIsHCoE	HIs hosting a higher than average number of CoEs
HIsLCoE	HIs hosting a lower than average number of CoEs
I2CNER	International Institute for Carbon-Neutral Energy Research
IAI	Institute for Academic Initiatives
IBET	Institute for Experimental Biology and Technology
IBS	Institute for Basic Science
iCeMS	Institute for Integrated Cell-Material Sciences
ICORG	Irish Clinical Oncology Research Group
iFQ	Institute for Research Information and Quality Assurance
IFReC	Immunology Frontier Research Centre
IGC	Gulbenkian Institute of Science
IIIS	International Institute for Integrative Sleep Medicine
IMD	International Institute for Management Development
INEGI	Institute of Mechanical Engineering and Industrial Management
IPMU	Institute for the Physics and Mathematics of the Universe
IST	Institute of Science and Technology Austria
IT	Information technology
ITbM	Institute of Transformative Bio-Molecules
ITQB	Institute of Chemical and Biological Technology
JSPS	Japan Society for the Promotion of Science
KNAW	Royal Netherlands Academy of Arts and Sciences
KNOW	Leading National Scientific Centres
KUF	Ministry of Education, Research and Church Affairs
LDP	Liberal Democratic Party
LG	Linnaeus grant
LOEWE	State Initiative for the Development of Scientific and Economic Excellence
MANA	International Centre for Materials Nanoarchitectonics
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MRC	Medical Research Council
NCI	National Cancer Institute
NGOs	Non-government organisations
NHMRC	National Health and Medical Research Council
NIFU	Nordic Institute for Studies in Innovation, Research and Education
NIH	National Institutes of Health
NRU	National Research University initiative
NSF	National Science Foundation
PBRF	New Zealand Performance Based Research Fund
PD	Programme director
PEARL	Programme Excellence Award for Research in Luxembourg
PhD(s)	Doctor(s) of Philosophy
PIs	Principal investigators
POs	Programme officers
PPP	Purchasing Power Parities
PRFS	Performance-based Research Funding Systems

PRI(s)	Public Research Institution(s)
PROs	Public research organisations
ProExcellence	Thuringian Agenda for Supporting Excellent Research "ProExcellence"
PRTLI	Programme for Research in Third-Level Institutions
R&D	Research and development
RCN	Research Council of Norway
REI(s)	Research Excellence Initiative(s)
RIHR	OECD Working Party on Research Institutions and Human Resources
RTG	Research Training Groups
SFB	Special Research Programmes
SFI	Science Foundation Ireland
SMEs	Small and Medium Sized Enterprises
SPIR	Strategic Platforms for Innovation and Research
SRA	Strategic Research Areas
STC	Science and Technology Centres
SWOT	Strengths, weaknesses, opportunities, threats
TODIAS	Todai Institute for Advanced Study
UNIK	Investment Capital for University Research
VINNOVA	Swedish Governmental Agency for Innovation Systems
WCU	World Class University Programme
WPI	World Premier International Research Centre Initiative
WR	German Council of Science and Humanities
WZW	Science Centre Saxony-Anhalt

Abbreviations

Countries

Australia	AU
Austria	AT
Denmark	DK
Estonia	EE
Finland	FI
Germany	DE
Ireland	IE
Japan	JP
Korea	KO
Netherlands	NL
New Zealand	NZ
Norway	NO
Poland	PL
Portugal	PT
Russian Federation	RU
Slovenia	SI
Sweden	SE
United States	US

Country groupings

EU	European Union

Currencies

AUD	Australian Dollar
DKK	Danish Kroner
EUR	Euro
JPY	Japanese Yen
KRW	Korean Won
NOK	Norwegian Kroner
NZD	New Zealand Dollar
PLN	Polish Zloty
RUB	Russian Rouble
SEK	Swedish Krona
USD	United States Dollar

Executive summary

National research systems face an increasingly competitive environment for ideas, talent and funds, and governments have turned to more competitive forms of funding to promote efficiency and innovation. They have shifted funds from institutional core funding to project funding, often on a competitive basis, or reward success in raising third-party funds in performance-based funding schemes.

In this evolving situation, the question of the adequacy of current public funding instruments arises. And it is in this context that "research excellence initiatives" (REIs) have emerged. This is an instrument designed to encourage outstanding research by providing large-scale, long-term funding to designated research units. REIs have elements of institutional and project funding. They provide funds for research and research-related measures, such as the improvement or extension of physical infrastructure, the recruitment of outstanding researchers from abroad and researcher training. They have become popular, with over two-thirds of OECD countries operating such schemes, of which a large proportion was established within the past decade.

This report is the result of efforts to obtain data and evidence on how governments steer and fund public research in higher education and public research institutions through REIs. It draws on the results of three surveys. The first, to government agencies responsible for administering REI funding for higher education and public research institutions, aimed to define the characteristics that differentiate REIs from other modes of support. In two subsequent surveys, one asked centres of excellence (CoEs) funded by REIs about their management structure, funding schemes, measurement of impact and sustainability, co-operation with the public and private sectors, and perceived long-term effects of their research. The second addressed the institutions hosting the CoEs about their administrative arrangements and financial and research objectives and about the impact of the REI-funded CoEs on these institutions. These responses were supplemented by six case studies.

The information collected can help inform discussions on future government policy directions by providing information on how REIs work and on the functioning and characteristics of institutions that host CoEs funded by REIs. The survey responses are not representative of all REIs in OECD countries, but these exploratory findings show some of the benefits to be gained through REIs and note some pitfalls to be avoided.

REIs provide CoEs with relatively long-term resources for carrying out ambitious, complex research agendas. This is particularly important for interdisciplinary and co-operative research and for high-impact, high-risk research (e.g. basic research). Their focus can be wide or narrow. Some countries operate a single excellence initiative while others operate several. The former may provide a boost to the broad research system, while the latter can target specific topics (including challenges such as climate change).

REIs can therefore lead to broad changes in the structure of the research system by pushing research centres and institutions to continually prove and develop their strengths, show their ability to build interdisciplinary networks, create links with the private sector and abroad, and generally enhance a country's overall research capacity.

REIs allow for greater flexibility than other forms of funding, notably in terms of managing resources and hiring researchers. CoEs' freedom for managing research funds is seen as crucial. They usually have faster and more flexible recruitment processes. In some cases, they offer professorships and tenure track positions with attractive packages in terms of research facilities. This may enhance their ability to attract talented researchers. However, strict financial rules, such as those that prohibit carrying funds over from year to year, may lead to inefficient use of the available resources.

Researcher mobility (both within national boundaries and abroad) is essential for scientific discovery and increasing productivity. REIs make it easier for CoEs to attract top scientists and foreign talent who in turn gain status and further career opportunities from their association with the CoE. The intake of foreign researchers also ultimately helps to form the long-run international linkages that foster innovation and knowledge creation at the international level.

An increasingly skilled workforce is fundamental for economic growth and is likely to have lasting effects on society. REI funding allows CoEs to enhance post-doctoral and doctoral programmes and training, thereby attracting and training future generations of leading scientists.

REIs concentrate exceptional researchers in well-equipped working environments to open up new lines of research, establish new patterns of interdisciplinary research, strengthen human capital, and generally enhance research capacities. However, fostering competition and structural change can create frictions. Competitive research funding and concentration of resources can mean that some groups are disadvantaged in the short term while others reinforce their position. Competition for scarce financial resources therefore requires a sound and transparent selection process, usually involving international panels of experts to judge the quality of applications. This can also counter political influence on the selection of research lines.

REIs raise the international reputation of domestic research institutions. Hosting a CoE increases an institution's visibility and helps it attract students, researchers and additional funding (further REIs, third-party, institutional funds). However, it also involves considerable administrative and overhead costs. The strong links that REI-funded CoEs generally establish with their host institution may lead to the integration of the CoEs into the host structures when the REI programme ends. This may present financial challenges for the host.

The activities of CoEs can spill over and create positive externalities that positively affect those of other departments in the host institution both directly, through the establishment of new networks and co-operative ties, and indirectly, through the overall reputational gains of the host institution. There is however some potential for CoEs to create divisions within university departments or research institutions.

The effects of concentrating research in excellent and large institutions deserve close inspection. Highly concentrated funding may undermine the competitive element of REIs in the long run by providing additional funds to well-established institutions. Funding centres rather than institutions may mitigate concentration. Ministries must also decide on selectivity: whether funding distributed through REIs should go to a small number of centres or be spread over a wider number.

Third-party funding is important to the success of many REIs. The increased visibility afforded by hosting a CoE can lead to a virtuous funding circle: hosts can integrate CoEs within their structures and CoEs can raise additional funds to extend their research

activities. Important sources of external funding include competitive project funding and private investment.

Responsible public funding bodies, CoEs and hosts view REIs positively. The objectives of these programmes are largely reported to have been achieved. New lines of research have opened up, new co-operative patterns of interdisciplinary research have been established, development of human capital has been strengthened, and concentration processes have generally led to enhanced research capacities. However, systematic impact assessments to quantify these positives effects on research systems, society and welfare are so far lacking.

Chapter 1

Research excellence initiatives: A new form of competitive research funding

Public research systems increasingly compete in an international market for talent and funds. At the same time, governments seek to promote efficiency and foster innovation. This chapter discusses "research excellence initiatives" (REIs) as a new type of public research funding instrument. It compares REI funding with institutional core funding and project funding and identifies the similarities and differences between these funding mechanisms. The chapter also presents a brief overview of current trends in government research funding. It discusses the scope of the project, which aimed to collect information on REIs in a systematic and comparable way. Finally, it draws together the main points emerging from the study, and provides an outlook on possible developments in terms of REIs as a funding instrument for research.

Introduction

National research systems face an increasingly competitive environment for ideas, talent and funds, and governments have turned to more competitive forms of funding to promote efficiency and innovation. They have shifted funds from institutional core funding to project funding (Lepori et al., 2007), often on a competitive basis, or reward success in raising third-party funds in performance-based funding schemes (OECD, 2010). At the same time, because research requires a degree of stable funding, national systems strive for a balance between competition and stability (OECD, 2012, p. 177f.).

It is in this context that "research excellence initiatives" (REIs) have emerged. The REI is an instrument designed to encourage outstanding research by providing large-scale, long-term funding to designated research units, with an emphasis on research of exceptional quality, and various countries with diverse funding systems have adopted REIs since around 2005 (Salmi, 2009). The phenomenon is difficult to explain on the basis of the data collected for this report; however, certain factors may have contributed:

- Globalisation presents a challenge to national science systems. World rankings of performance illustrate this competition. In the first half of the 2000s, two important and widely referenced university rankings were established: *The Academic Ranking of World Universities* (first published in 2003), known as the "Shanghai Ranking", and the *Times Higher Education World University Ranking* (first published in 2004). A host of similar rankings followed. The comparisons have led to a certain standardisation of the concept of excellence (Deem et al., 2009; Drori et al., 2002). REIs, with their emphasis on global competitiveness, can be seen as a policy response to this challenge: they are designed to attract, train and retain the very best researchers by offering them the most favourable working conditions in terms of equipment, staff, academic freedom and salaries in order to improve global performance.
- Higher education systems in many countries developed when there were far fewer students and less demand for research services outside of academia (Gibbons, 1999). After decades of constantly rising expectations in scientific research (Frank and Meyer, 2007) and strong enrolment growth in higher education, governments have sought to find ways to make the allocation of public funding more efficient while creating a stronger impact. To this end they have used clustering and smart specialisation, a set of policies increasingly part of science, technology and innovation strategies (OECD, 2012, p. 186f.). REIs are a possible instrument for achieving this goal by concentrating resources for research in specialised areas.

The REIs covered in this report share the following traits:

- government-level funding of selected research units and institutions
- exceptional quality in research and research-related activities
- long-term funding (a minimum of four years)
- funds are competitive and are distributed on the basis of peer-reviewed applications
- applicants are required to participate in selection processes with fixed time frames

- institutions or research units (instead of individuals) apply for the funds as a collective body
- funding is substantially larger than for individual project-based funding (a general lower limit of USD 1 million a year per centre).

The research activities funded by REIs reflect the objectives of the funding programme. The single most important goal is to raise the research and innovation capacity of national research landscapes. Besides the high degree of convergence of programmes in terms of goals and strategies, REIs often have a specific focus, promotion of early-stage researchers or recruiting top scientists from other countries; development of co-operation between research and industry; the renewal of physical infrastructure. The ambitious systemic objectives of central governments explain why REIs often have substantially more funding than project funding measures. The selection of research is science-driven via peer reviews and panel discussions of proposals with other academics, even though these programmes also have broader political goals.

The REIs discussed in this report are positioned conceptually between institutional core funding and project funding. On the one hand, they allow for relatively lengthy projects that often involve undefined outcomes or fundamental research and may include a more or less elaborate administrative environment to support the research activities. On the other hand, the funding is time-limited and linked to participation in application and selection processes, which brings them closer to typical project funding.

Choice of terminology

The term "(research) excellence initiative" may have gained popularity through the Programme by the German Federal and State Governments to Promote Top-level Research at Universities, which started in 2006 and is better known as the "Excellence Initiative". Since then, the scientific literature has used the term to describe funding schemes in other countries (Salmi, 2009; Sadlak and Nian Cai, 2009). For the purposes of this study, given the meaning of its three components, "research excellence initiative" is an appropriate term:

- **Research**: The schemes focus on the promotion of scientific research, although different REIs may focus on different aspects of research and, in some cases, further exploitation of the results (e.g. their potential economic value or their societal impact) is also important. Some REIs do not (only) fund research, but also measures to create favourable framework conditions for excellent research, i.e. through the acquisition of infrastructure, development of institutional research strategies or recruitment of outstanding researchers from abroad. Such initiatives are also discussed here.
- **Excellence**: All schemes aim at fostering research of the highest quality. The word "excellence" is widely used and is part of the title of many of the schemes (e.g. Centres of Excellence Programme). Use of the word in the title of the funding scheme or its official description was not, however, a criterion for selecting the initiatives covered. The term "research excellence initiative" was chosen as a convenient designation and is used in a purely descriptive way. The issue of what research excellence actually is or should be about is not part of this report.[1]

- **Initiative**: The schemes are designed to initiate changes in the national research landscape. Some countries have established their REIs on a more permanent basis, in which case the term "programme" is more common. A clear distinction between "programme" and "initiative" is often not made. In this study both funding schemes limited in advance to a certain period of time and schemes set up on a more lasting basis are included. Both are covered by REI and the term "(excellence) scheme".

The scope of the term "excellence initiative" as used here is more comprehensive than what is found in some contexts. To illustrate this point, there have been discussions in Austria on whether to implement an "excellence cluster";[2] this has not yet been done. Yet, Austria is included in this report, because it has a scheme that fits the criteria for an REI (given above).

REIs as research funding instruments

This section aims to clarify how REIs differ from other forms of research funding. It shows that REIs are positioned at the interface of excellence funding and programme funding. It then discusses how the funding of REIs differs from institutional core funding and more common forms of project funding.

REIs at the interface of excellence funding and programme funding

Excellence funding

The term "excellence" has achieved considerable popularity in science policy recently. This does not imply that striving for the highest quality in science is a recent phenomenon. On the contrary, this has always been a driving force behind scientific undertakings. It seems, however, that in recent years "excellence" has become the word most often used to describe the concern for quality in science.[3] Indeed, science policy makers across countries seem to agree that excellence does not necessarily emerge spontaneously from research systems. The recent spread of REIs testifies to a conviction that environments in which research excellence prospers can and should be actively encouraged and supported.[4]

It is equally important to note that REIs are by no means the only way in which research excellence is being promoted by national science funders (see Box 1.1). In fact, many public funding bodies with REIs, among other programmes, see it as their mission to support *only* excellent research, possibly through a variety of targeted measures.[5] In 2009, the European Commission's CREST (*Comité de la recherche scientifique et technique*) appointed a working group to investigate the various ways in which European governments promote excellence in research. The group's final report (European Commission, 2009) shows that countries use a broad range of measures to nurture and support research of exceptional quality. In general, excellence funding may target institutions or individuals; it may be in the form of programmes, collective or individual target agreements, performance-based allocation schemes, specialised foundations, etc. This report is about a specific measure to promote research excellence, not about excellence funding in general.

Box 1.1. Examples of excellence funding

As a political measure to foster research excellence, REIs are distinguished by establishing competition among institutions for large-scale grants. A different approach is to build excellence institutes from scratch. This route was taken in Austria, when the Institute of Science and Technology Austria (IST) was founded near Vienna in 2006 and opened in 2009. The institute is dedicated to cutting-edge research in mathematics, natural sciences and computer sciences. After its multi-year expansion phase, the IST is scheduled to employ 1 000 scientists from around the world. The Korean government adopted a similar strategy. The Institute for Basic Science (IBS) was launched in Daejeon in 2011. It is not attached to an existing institution, but will be built up gradually in the years to come. It was founded in an attempt to strengthen pioneering basic research in a country where applied sciences have long been dominant. The IBS is expected to employ 3 000 scientists by 2017. Its "role models" are the German Max-Planck-Institute and the Japanese RIKEN institute.

In smaller jurisdictions, neither REIs nor large-scale elite research centres such as IST and IBS may be attractive. In several German *Länder* (federal states), the national Excellence Initiative inspired new forms of excellence funding beyond the REI format. The state of Berlin established the Einstein Foundation in 2009. Out of the revenue of its endowment, the foundation finances a host of programmes in support of excellent science, from support for early-stage researchers to fellowships for top-level professors, to additional funding for existing research excellence centres based in Berlin. In the federal state of Rhineland-Palatine, the ministry uses target agreements with universities to support excellence projects in both their emerging and consolidated stages. The main principle of governance in this approach is not competition but negotiation. This may be a more efficient way of fostering excellence in jurisdictions with few eligible institutions.

Programme funding

Programme funding for research is well established in all OECD countries. The main function of a funding programme is to balance the interests of two parties: the community of researchers and the funding body. While the professional interests of researchers by and large do not change – to have sufficient amounts of resources, time and freedom to pursue their scientific endeavours – those of funding bodies vary. For funding programmes that target scientific excellence, the interests of the funding body seem to converge with those of the target group in that producing excellent research is an intrinsic motivation of scientists in the first place. The major tasks of the authority organising an REI are then:

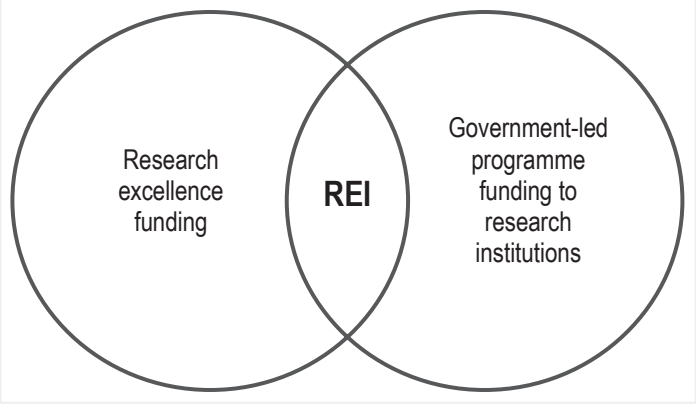
- to define scientific excellence, i.e. to specify the programme's goals
- to determine how excellence is best achieved (in a given setting), i.e. to operationalise the goal
- to establish mechanisms to ensure that funds go to applicants that are deemed, or have the potential to be, excellent, i.e. to determine the mode of allocation.

The bulk of this report will discuss how these three aspects are managed in various REIs.

As will become clear, REIs do not seek excellence for its own sake but to link scientific excellence to goals beyond the confines of academic science. These external goals may be integrated in the selection criteria, or their attainment may be a "secondary effect" of excellent scientific performance.

Figure 1.1 shows the scope of this report: REIs lie at the intersection of excellence funding (in whatever shape and form) and government-level programme funding to research institutions (for whatever purpose). As mentioned, excellence funding may take various forms. Similarly, government-level programme funding to research institutions may target scientific excellence, but it may also be designed to support regional research alliances, co-operation between academia and small and medium-sized enterprises (SMEs), early-stage researchers, gender equality, etc. Their combination situates REIs conceptually and operationally.

Figure 1.1. Schematic definition of REI



REIs in contrast to institutional core funding and project funding

This section compares REIs with two more prevalent forms of funding, institutional core funding and project funding. REIs share elements of both these forms of funding, but also combine them in view of a particular definition of objectives and further characteristics. They should therefore be viewed as a comprehensive funding instrument in their own right.

Institutional core funding

Institutional core funding (Box, 2010, p.86) is funding for universities and research organisations that is not directly tied to projects or programmes. It enables institutions to fulfil their core tasks. This form of funding is generally provided by governments to institutions as a whole, rather than to specific programmes or units, and it may have competitive elements. Institutional funding can be arranged in several ways, e.g. by line item budgeting with annual incremental adjustments, or by formula-based funding models, in which the block grant allocation is influenced by indicators, e.g. of equipment, of staffing, number of students enrolled, and research or teaching output. Generally speaking, the *ex post* measurement of performance is an important basis of assessment of institutional core funding.[6]

Further, funders and recipients of funding may use target and performance agreements to negotiate not only what and how they perform, but also what equipment and staffing they require. The tie-in between performance and funding may vary.

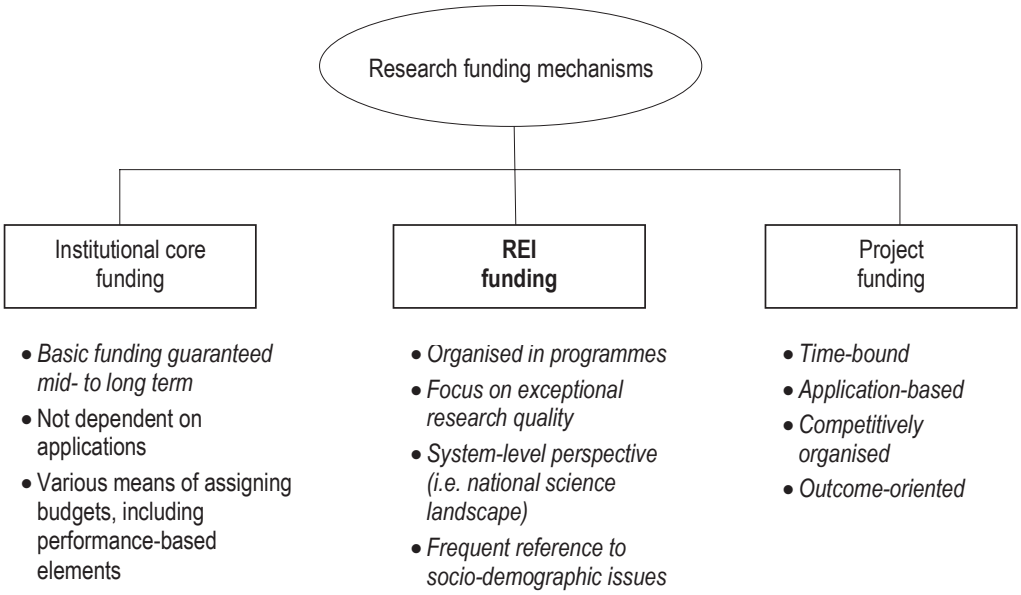
Institutional core funding (as described here) and REI funding share the fact that both tend towards funding longer-term research and can address institutions as a whole. However, they differ in that institutional core funding does not require formal application. All institutionally funded organisations are necessarily tied to annual (and sometimes

longer) budget rounds, whereas REI funding requires submission of an application and participation is not obligatory. Any clear-cut competitive elements in institutional core funding take the shape of mandatory quantitative schemes for measuring previous performance. Also, funding for research institutions via institutional core funding is not generally tied to any programme-like specifications, except in some cases via target agreements. REIs, in contrast, always set science-policy objectives for successful applications.

Project funding

This form of funding is aimed at individuals or groups receiving funds for specific projects over limited time periods (Box, 2010, p.86). The content of a proposed project is generally defined in the application process, although direct contracting is also possible. Project funding is provided by a government (or an associated body) or by private organisations, such as foundations or sponsors. Public and private funding may also be combined in a programme and involve so-called "matching funds".

Figure 1.2. Research funding mechanisms in comparison



Note: The characteristics in italics are shared by the respective funding mechanism and REIs.

Project funding and REIs are similar in several ways. Funding is based on competition and involves a formal application process. REIs can also be said to target project-like undertakings in the sense that a pre-defined objective must be achieved over a limited time period and with a limited budget. Unlike classic project-based funding, however, REIs are conceived as instruments to affect the performance of the research system as a whole; they call on institutions' capacities to develop and consolidate internationally competitive research profiles. The fact that large funds are involved and fixed time frames are binding for every applicant helps to create a sense of competition and mobilisation that are absent from the classic modes of project funding, where proposals can be submitted at any time or recurrently at short intervals. When funding opportunities are only provided once every couple of years, applicants must undertake careful and intense preparation and their success or failure may have an impact on the way institutions perceive themselves and are perceived by others.

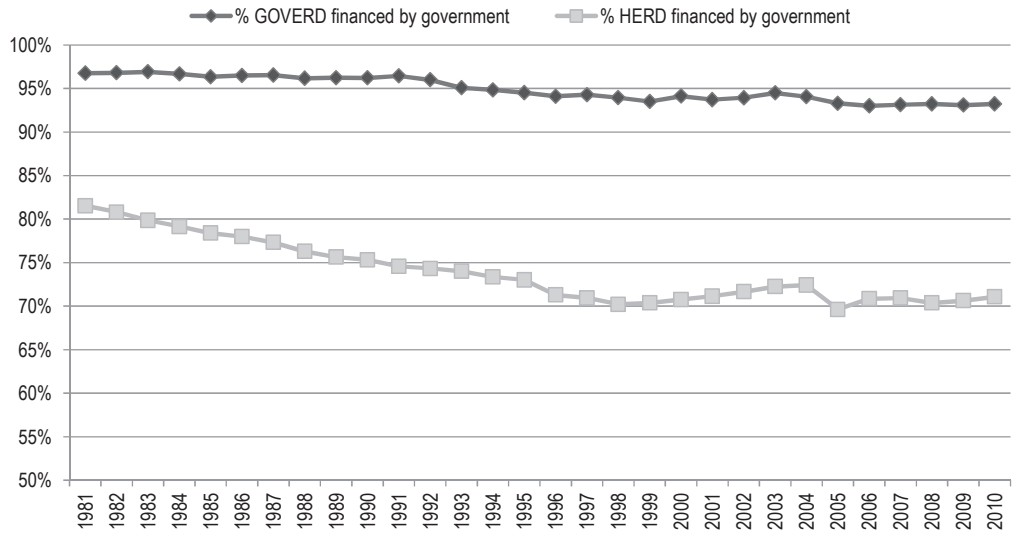
The descriptions of REIs furthermore suggest that, apart from large-scale funding, the explicit attribution of prestige is an important incentive. The terms "excellent", "top-level" or "world-class" that often accompany a successful proposal echoes this intention. Figure 1.2 summarises the main points of departure of the three funding mechanisms described.

In sum, there is no single criterion that distinguishes REIs from other forms of funding and there is some overlap. REIs do not exclude other forms of funding. Nevertheless, a multi-faceted description of the main dimensions of existing REI procedures helps to identify and analyse REIs as a specific form of funding, as will be seen in Chapter 2.

Characteristics of government research funding

REIs fit within a diverse country pattern of funding public R&D. Government accounts for a majority of R&D financing in the government and higher education sectors across the OECD, although the proportion of higher education research and development (HERD) financed by government has fallen over the past three decades (Figure 1.3). Government-financed HERD fell from over 80% in the early 1980s to around 70% in the most recent years. This compares to the higher, and largely stable, proportion of government intramural expenditure on R&D (GOVERD) financed by government.

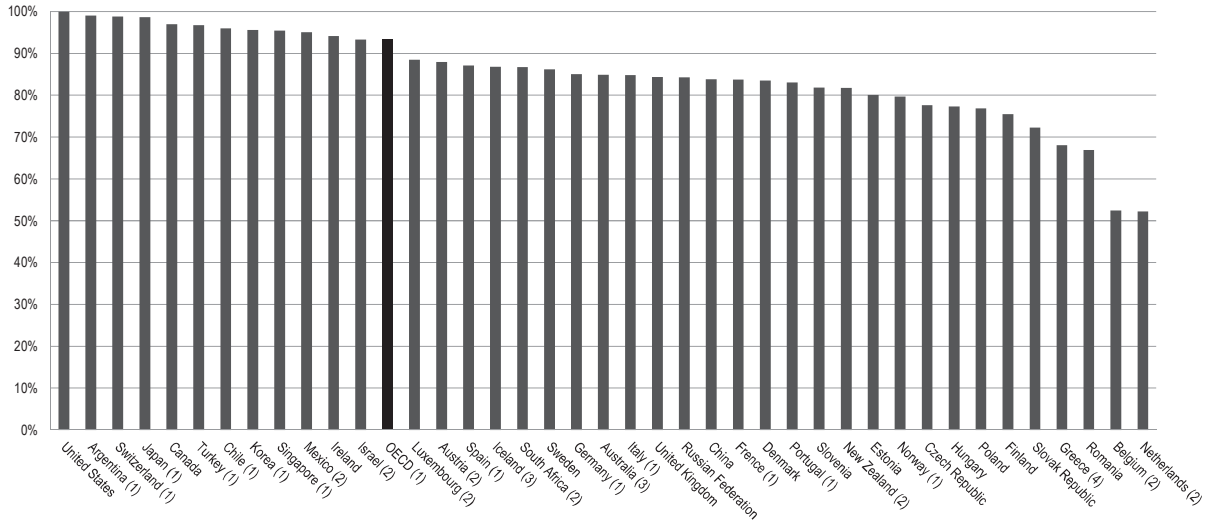
Figure 1.3. Percentage of GOVERD and HERD financed by government, OECD 1981-2010



Source: OECD Main Science and Technology Indicators (MSTI) Database, April 2013.

The pattern of government funding varies among countries. Figures 1.4 and 1.5 show the proportion of GOVERD and HERD financed by government for the most recent year for which data are available. Government finances most of GOVERD in all countries, ranging from 100% in the United States to just above 50% in the Netherlands and Belgium. The percentage of R&D in the higher education sector financed by government is slightly more varied. However, it is mainly financed by government in most countries – only in Turkey and Israel is the proportion less than 50%.

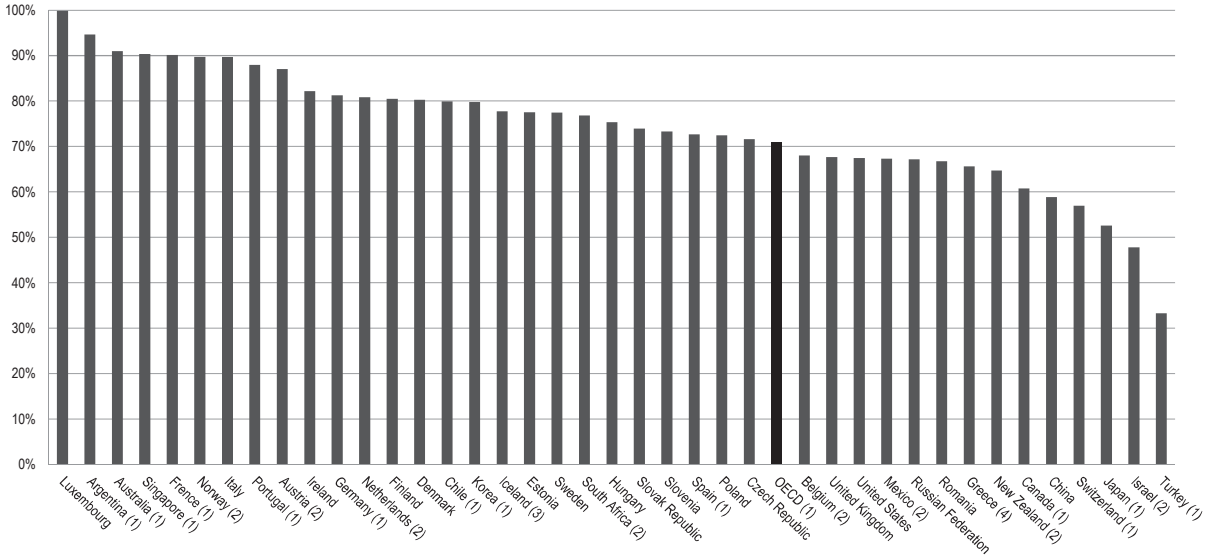
Figure 1.4. Percentage of GOVERD financed by government sector, 2011 or latest available year



Notes: 2011 unless labelled: (1) 2010; (2) 2009; (2) 2008; or (4) 2005.

Source: OECD Research and Development Database, April 2013.

Figure 1.5. Percentage of HERD financed by government sector, 2011 or latest available year



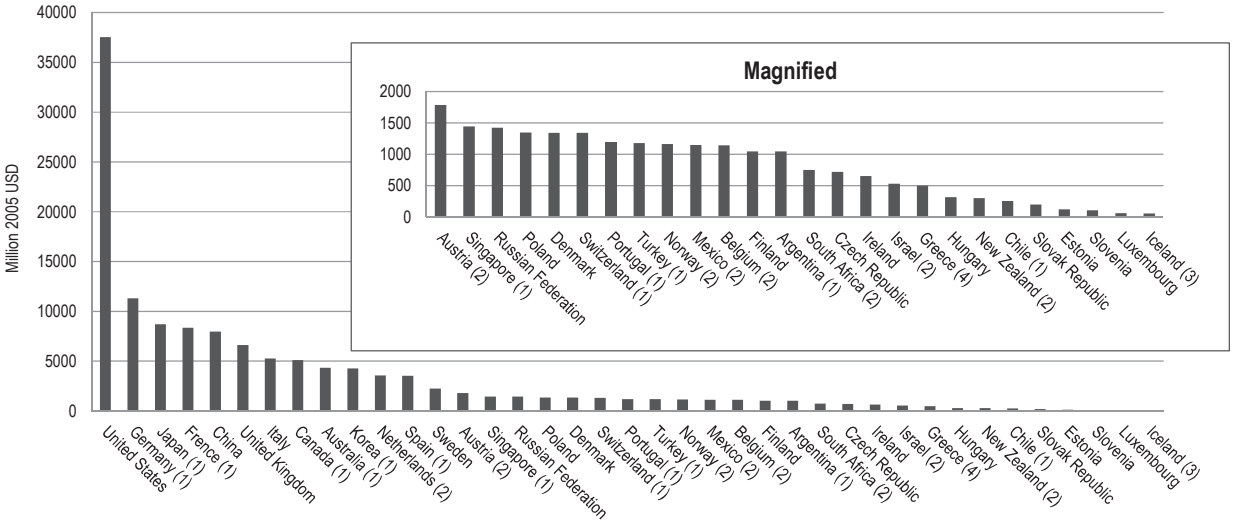
Notes: 2011 unless labelled: (1) 2010; (2) 2009; (2) 2008; or (4) 2005.

Source: OECD Research and Development Database, April 2013.

In terms of raw expenditure by countries, the largest OECD economies naturally dominate (Figures 1.6 and 1.7). OECD countries collectively spent USD 118 billion (in 2005 prices) on HERD and USD 100 billion on GOVERD in 2010.

Figure 1.6. Government expenditure on HERD, 2011 or latest available year

USD 2005 prices and PPPs million

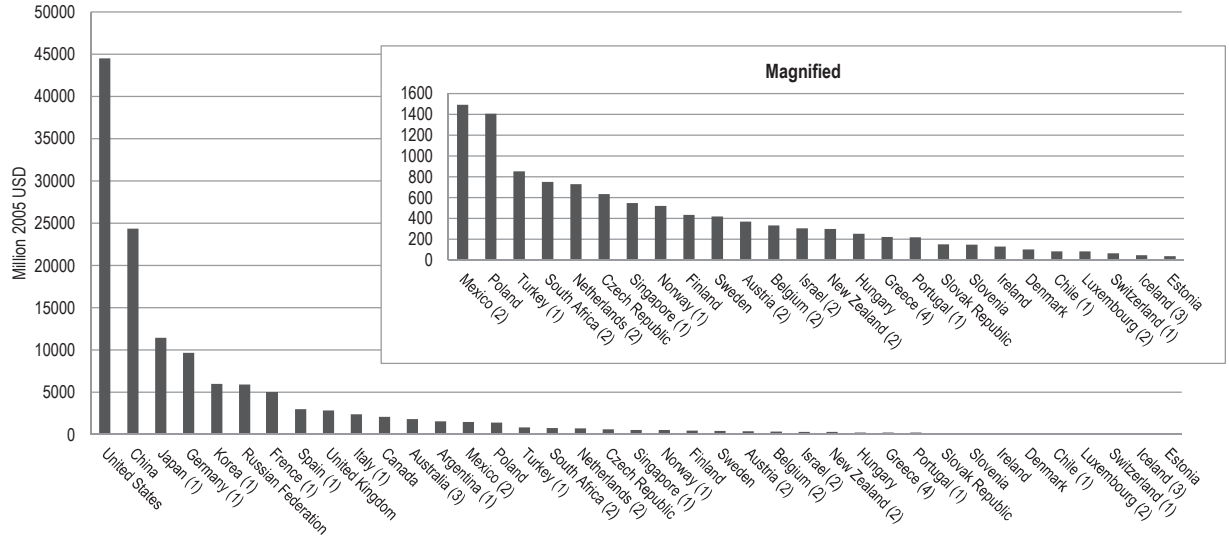


Notes: 2011 unless labelled: (1) 2010; (2) 2009; (2) 2008; or (4) 2005. Figures for Australia and China are calculated by multiplying the percentage of government-financed HERD by HERD expenditure in the previous year. Data for Iceland are provisional. The figure for HERD in Israel excludes R&D in the social sciences and humanities.

Source: OECD Main Science and Technology Indicators (MSTI) Database and OECD Research and Development Database, April 2013.

Figure 1.7. Government expenditure on GOVERD, 2011 or latest available year

USD 2005 prices and PPPs million



Notes: 2011 unless labelled: (1) 2010; (2) 2009; (2) 2008; or (4) 2005. Owing to data availability, figures for Argentina, China, the Russian Federation, Singapore and South Africa are calculated by multiplying the percentage of government-financed GOVERD by GOVERD expenditure in the previous year. Data for Iceland are provisional. The figure for GOVERD excludes defence. GOVERD for Germany and the Netherlands includes other classes and for Switzerland is federal government only.

Source: OECD Main Science and Technology Indicators (MSTI) Database and OECD Research and Development Database, April 2013.

Scope of the project and structure of the report

In an attempt to obtain new data and evidence on how governments steer and fund public research, the OECD's Working Party on Research Institutions and Human Resources (RIHR) launched a project, "New Forms of Incentive Funding for Public Research". The project focused on higher education institutions (HEIs) and public research institutions (PRIs). It aimed to capture a new type of public research funding, as relatively little is known in a systematic and comparable way about REIs.[7]

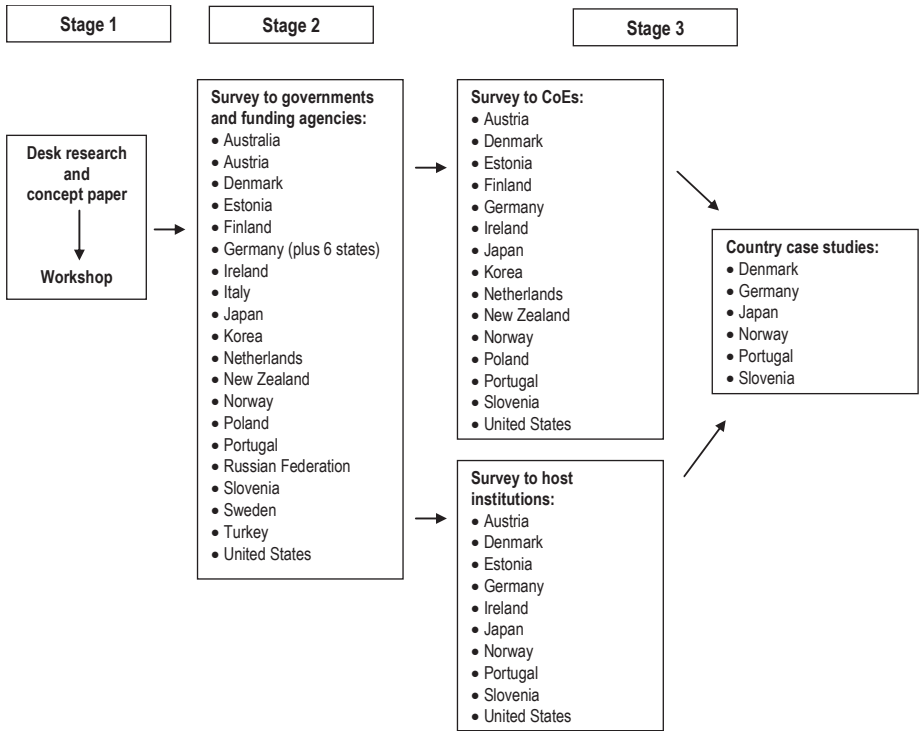
This report is the outcome of the RIHR project in OECD and partner countries. The research was carried out in several stages. In stage one, a literature review was conducted and a concept paper was prepared to provide an overview of REI models and identify specific features of this type of funding. The paper was discussed at an OECD workshop on 29 November 2012, which brought together policy makers, funding practitioners, national experts and leaders from centres of excellence (CoEs) funded by REIs.

In stage two of the project, a questionnaire to research ministries or departments responsible for administering REI funding in HEIs and PRIs was distributed by country delegates to the RIHR Working Party. Responses came from 20 countries: Australia, Austria, Denmark, Estonia, Finland, Germany (including six German *Länder*), Ireland, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Poland, Portugal, the Russian Federation, Slovenia, Sweden, Turkey and the United States. In all, 56 different funding schemes were reported. The results are presented in Chapter 2.

Following a preliminary analysis of the responses from the 20 countries, 28 schemes in 18 countries were found to fit the project definition.[8] These countries were invited to take part in stage three of the project, the distribution of an electronic survey[9] to CoEs and host institutions that receive REI funding. Responses were received from 304 centres in 14 countries and 99 host institutions in ten countries.[10] Chapter 3 presents the results of the survey to CoEs and describes their characteristics, including funding schemes and cycles, mechanisms used to foster networks and interdisciplinary research, research impact and perceived value of REIs. Chapter 4 describes the characteristics of the institutions that host CoEs, the funding schemes and the perceived effects of REIs on research activities.

In addition to the surveys, delegates were invited to conduct a country case study based on a common template. Case studies were provided by Denmark, Germany, Japan, Norway, Portugal and Slovenia. Chapters 5 to 10, "Country case studies", builds on the analysis presented in earlier chapters by providing a more in-depth analysis of the strategies followed by each country in establishing and supporting the activities of CoEs and host institutions. Figure 1.8 provides an overview of the project as well as country participation.

Figure 1.8. Project organisation and participation



Main messages from the study

The final section of this chapter draws together the main points emerging from the study to highlight key messages. It then raises some issues for the design of REIs, and provides an outlook on possible developments in terms of REIs as a funding instrument for research.

REI funding schemes and excellence in research

The results of this study highlight that the objectives of REIs are achieved through a variety of specific tools and management practices that aim, among others, at:

- enhancing interdisciplinary research and co-operation
- attracting foreign talent
- training young scholars through doctoral and post-doctoral programmes
- enhancing competition and increasing the visibility of research.

REIs are designed to ensure long-term funding and to provide research centres with more stable resources than other types, such as project funding, in order to carry out ambitious, complex research agendas. This is especially important for those novel lines of research that can lead to significant scientific developments, but are risky and may be difficult to develop through short-term project funding. REIs make it possible to fund such research.

The average funding cycle of the REIs examined in this study is around six years. This relatively long duration creates the stability needed to set up the required research infrastructures and hire talent from both national and international job markets and to establish the conditions required for research co-operation and interdisciplinary research and to achieve ambitious research goals.

REIs as a tool to boost interdisciplinary research, co-operation and attract human capital

REIs promote excellence in research by providing researchers with better opportunities to work across disciplines than in other research contexts. More than 90% of CoEs analysed in this study perform some type of interdisciplinary research, either within their own research field or cutting across the paradigms of other research fields.

Through interdisciplinary research, knowledge can be reshuffled to develop new scientific paradigms and innovations. CoEs funded by REIs engage in co-operation with other research bodies, either departments of the same host institution or external centres, to produce novel research that draws on different scientific backgrounds.

REIs enhance interdisciplinary research through the implementation of joint research activities but also by providing resources to attract talent with an interdisciplinary profile or to build interdisciplinary research teams where researchers with different backgrounds are pulled together with the objective of diversifying the research environment.

Unlike some traditional research funding schemes, REIs allow CoEs to have fast and flexible recruitment processes. CoEs' administrative and funding flexibility allow them to offer, in some cases, professorships and tenure track positions with very attractive packages in terms of research facilities. This may enhance their ability to attract talented researchers from abroad and to build high-quality interdisciplinary research teams.

Researcher mobility (both within national boundaries and abroad) is essential for raising scientific discovery and increasing productivity. REIs make it easier for CoEs to attract top scientists and foreign talent through their generally flexible use of funds. Similarly, the "excellence" status and the higher visibility of CoEs' scientific activity provide them with additional leverage to attract outstanding researchers from abroad either for temporary or permanent engagements. The intake of foreign researchers ultimately helps to form the long-run international linkages that foster innovation and knowledge creation at the international level.

Co-operation with the private sector is a fundamental driver of innovation and of its implementation. CoEs funded by REIs can establish new ties with the private sector or, when these ties already exist, strengthen them significantly. Co-operation between CoEs and the private sector leads to novel products and innovations and to their quicker and more efficient absorption by the market and final users.

REIs as a tool to boost competition and high-quality research

Competition for public financial resources calls for a sound and transparent selection process. At the same time, the broad and systematic enhancement of national research capabilities requires contributions from a variety of scientific disciplines. It is therefore of crucial importance that different research areas can participate in the REI selection process on equal terms. REIs usually rely on international panels of experts to judge the quality of research projects and applications for funding with "excellence" as a guiding principle. Concerns, however, have been sometimes raised about a possible bias towards the selection of projects in technical sciences or popular research areas.

REIs help to counterbalance political influence in the selection of research lines through transparent appraisal and selection procedures. This is especially important in view of the high-risk character of blue-sky scientific research and the need to pursue ambitious and innovative research goals.

The allocation of funds and the achievement of research goals is scrutinised through mid-term evaluations or annual progress reports. Evaluations are also used to assess whether a CoE's funding should be continued at the end of the programme.

Fostering competition and structural change can sometimes create friction. Competitive research funding and concentration of resources mean that some groups may be disadvantaged in the short term. Although the overall perception of REIs is generally positive, other evidence suggests that REIs can also create "insider-outsider" conflicts in universities and departments.

The links between hosts and centres of excellence and the issue of sustainability

The application for REIs funding relies on the interplay of several actors but is generally driven internally by the host institution management structure or the researchers in specific departments. When the application for REI funding succeeds, host institutions use a combination of tools and strategies to support the activities of the hosted CoE. They provide, for instance, substantial backing to CoEs through direct financial channels (start-up funding, coverage of running costs) and through the provision of physical infrastructures for research. In some cases, this is a condition for applying for REI funding.

Host institutions and CoEs establish strong links that might go beyond the REI's financing period. In some cases, these lead to the integration of the CoEs into the host structures when the host proposes labour contracts to CoE staff that extend beyond the lifespan of the REI. This long-term integration of CoEs into the host's infrastructures can present financial challenges for the host institutions when the REI programme ends.

The risks associated with establishing costly structures that cannot be easily dissolved at the end of the REI's grant period are usually tackled by raising additional third-party or institutional funds. The visibility of CoEs research activities spills over to their hosts and puts them in a better negotiating position with the main funding body to deal with the long-run sustainability issues associated to the integration of CoEs. Important sources of external funding include competitive project funding and private investment.

If the decision of supporting (and hosting) the research activities of a CoE might have resources implications for the host institution, it also represents a strategic choice given that the increased visibility afforded by hosting a CoE brings more attention from the media, it increases the chances to attract talented researchers and it offers easier access to funding in research-performance based competitions.

REIs long-run effects on national research systems

REIs are perceived to have achieved a number of their objectives. They have been able, in most cases, to reshape national research systems by providing the incentives and tools to enhance co-operation and interdisciplinary research and to create the conditions for attracting and developing highly qualified researchers.

REIs can lead to broad changes in the structure of the research system. Some changes can even positively affect institutions that were not selected for funding because they can trigger intensified co-operation between departments and interdisciplinary research and help raise the visibility and international reputation of the host institution.

Training an increasingly skilled workforce is fundamentally important for economic growth and it is likely to have lasting effects on society. REIs provide targeted funding to CoEs in order to enhance doctoral programmes and post-doctoral, thereby attracting and

training future generations of scientists that will form the human capital needed to pursue scientific discoveries.

Knowledge and intangible assets can spill over and create positive externalities that last in the long run. The activities of CoEs positively affect those of other departments in the host institution both directly, through the establishment of new networks and co-operative ties, and indirectly, through the overall reputational gains of the host institution.

Impact assessments of large, wide-ranging science and technology funding programmes is of crucial importance for policy makers. Yet comprehensive long–term evaluations of the outputs of REIs (and of how they affect society and welfare) are lacking. The general perception of REIs, as described in the OECD/RIHR surveys, is nonetheless very positive.

Outlook

This final section raises some issues that seem crucial for the design of REIs. It offers an outlook on possible developments in the context of REIs as a funding instrument for research.

The status of REIs in research policy: between one-off initiatives and permanent programmes

REIs have become a part of many national funding systems (e.g. in the Scandinavian countries and the United States). In others, they will be discontinued after the present cycle (Germany-federal, Ireland) or were recently terminated (Korea, Denmark-Investment Capital for University Research (UNIK)). The answer to the question of whether an REI is better used as a temporary tool to boost the system or whether it should be institutionalised as part of the policy portfolio is not clear. If it is a temporary tool, this raises the issue of maintaining excellence once the funds channelled into the system through the REI have stopped flowing. If it is institutionalised, the question is whether constant competition for excellence status will improve system performance in the long term. Moreover, if new REI centres are selected, others must be dropped, with all the negative effects this may imply. If instead the successful centres remain largely the same across funding cycles, the question becomes whether the expensive process of competition and selection is appropriate, or whether privileged funding for some outstanding institutions or research centre should be organised more simply. Whether or not an REI should be maintained in the long term also depends on the scheme's secondary goals. If, for example, the goal is to trigger structural reforms in HEIs (like Germany's Excellence Initiative to some degree) or to renew and reorganise infrastructure in a strategic manner (as in the Irish Program for Research in Third-Level Institutions (PRTLI)), there may be little reason to perpetuate the competition once this process is set in train.

Competition and concentration

Both in the "one-off" and the long-term approach to REI programming, strong concentration of funds may create difficulties in the long run because it may eventually undermine competition. This is particularly true if, as Merton (1968, 1996) argued, the perception of current research performance is systematically distorted by prestige acquired in the past. Applied to REIs, this may imply that institutions that have received excellence status in the past have better chances of maintaining this status, a conjecture

that would seem worthy of empirical scrutiny. A tendency to reward institutions that are already strong in terms of research capacity is inherent in the REI selection process, in that an appraisal of past merit is always important in review procedures.[11]

In most REIs, the danger of concentrating resources excessively on a few institutions is mitigated by the decision to fund centres instead of whole institutions. This allows for a broader distribution of funds across institutions and encourages (inter-institutional) collaborative structures. However, the influence of these factors is not obvious. On the one hand, most REIs do not limit how many centres an institution may host, so that concentration of centres and, therefore, large amounts of funds in one institution are not precluded *a priori*.[12] On the other hand, collaborative research structures do not *per se* prevent the concentration of prestige and resources in one place (usually the host institution); much depends on how the collaboration is actually set up. It has been suggested (e.g. Kaiser, 2009), that to avoid excessive concentration of funds, the concept of excellence in HEIs should be diversified to include education profiles, knowledge transfer and regional orientation, so as not to "disqualify" institutions whose structure or profile does not match the specific objectives of research excellence in most REIs.

Degrees of selectivity

Another topic linked to concentration is the degree of selectivity REIs allow. Should they fund a handful of units with very large sums, or should they support more units, possibly with fewer resources, as long as they are all judged excellent by the selection bodies? Experiences from Germany (Pasternack, 2008) and Korea (Gläser and Weingart, 2010) demonstrate that this issue can have serious political implications. In both countries, the national REIs were designed to provide funds to very few world-class institutions. After protests from political and scientific stakeholders, the schemes became more distributive in nature, funding 85 different centres in 37 universities in Germany, and 519 research units in 74 universities in Korea. In Finland, there was a tendency in the opposite direction when an impact evaluation of the Finnish CoE scheme (Hjelt et al., 2009) advised the Academy of Finland to support fewer centres, each with more funds. This was seen as necessary to achieve permanent benefits from the REI. In Denmark, only four UNIK centres were selected for funding although the ministry had initially planned to fund five to eight units (Gläser and Weingart, 2010, p. 245). The Japan Society for the Promotion of Science sets a strong focus on selectivity though its WPI scheme, which funds no more than six large institutes for top-level research. However, in parallel, its Global COE scheme is much less selective, with less funding per centre. It supports 140 centres at 77 universities with a focus on researcher training. In addition, the very fact of selectivity can influence the international visibility of successful research units. Whereas the monetary resources are decisive for building "critical mass", the act of awarding a relatively rare accolade (that of being excellent) ensures gains in reputation and thus credibility and access to resources (Weingart, 2010).[13]

One REI or many?

The survey results that will be presented in Chapter 2 show that some countries organise one REI, whereas others have several. In the first case, the REI is usually open to all sorts of research (with a tendency to favour basic research), whereas in the second, each REI has a different focus. Disregarding Germany, with its federal structure, Norway and Sweden have the most REIs, and the purpose of each scheme is clear. The Norwegian CoE scheme and the Swedish Linnaeus Grants are typical examples of an open competition for excellent basic research with a strategic impact on the host institution; the Norwegian

Centres for Research-based Innovation (CRI) scheme and the Swedish Berzelii Centres emphasis linkages between academic and industrial partners; and the Norwegian and Swedish Strategic Research Areas (SRA) schemes are about funding national priority areas. In other countries, these three components are often intertwined within a single scheme. Which of the two approaches is more effective cannot be deduced from the data analysed in this report, and it certainly depends on each country's research funding structures. It may be assumed that one comprehensive initiative is better able to provide an effective boost to the research system (this was observable in Germany), whereas a multitude of specialised REIs can address political needs in a more targeted way.

REIs, individual funding, and institutional core funding

REIs are described in this report as being located between institutional core funding and traditional project funding. Many REIs certainly build on experience with other forms of project funding, adding aspects such as the requirement to concentrate resources and to build on strategic liaisons with the host institutions. Traditional funding of individual researchers or small teams has the advantage of being less susceptible to excessive concentration of resources, and, depending on how the allocation of funds is arranged, that it may not run the risk of funding those that are already most successful. Indeed, Aksnes et al. (2012, p. 13) report that in Norway and Sweden, this small-scale funding is being increased, partly as a consequence of the criticism levelled against REIs. Italy had a scheme called Centres of Excellence in two cycles from 2000 to 2006; since then, excellence funding through the ministry has focused less on structures and more on schemes in which the development of individual talent and research in areas of national interest are paramount. In a study of the Korean BK 21 scheme, Seong et al. (2008) propose directing excellence funds not to whole departments, but to "smaller groups or individual projects to increase competition both between and within universities" (Seong et al., 2008, p. 202).

In the case of the Swedish SRA, there is a move in the opposite direction, away from project funding and towards increased institutional core funding. Institutions will receive REI funds in addition to their core funding if their REI-funded activities are evaluated positively after five years. Elsewhere, however, increasing institutional core funding as an alternative to competitive measures does not appear to be discussed. This is understandable in view of the priority accorded to competitive forms of governance in the new public management approach (Wespel et al., 2012). However, as Salmi (2013) notes, becoming a world-class research university is "a marathon, not a sprint". Salmi observes that most HEIs located at the top of global university rankings have taken a long time to get where they are now: "Developing a strong culture of excellence, especially in research, is the result of incremental progress and consolidation over several decades, sometimes centuries." From this perspective, REI funding periods of five or even ten years do not seem overly long. Altbach (2011, p. 25) argues that internationally competitive research universities are expensive institutions that must have adequate and sustained budgets and cannot succeed if funding fluctuates severely over time.

As regards individual funding, REI funding and institutional core funding, the question does not seem to be which one is better suited to supporting high-quality research, but rather how all three should be balanced to optimal effect. There does not seem to be a consensus among countries on the correct balance, nor is it to be expected in view of the many factors that enter the equation.

Notes

1. More information on the subject of scientific excellence can be found in the online documentation of the 2012 conference "Excellence Revisited" held in Aarhus in conjunction with the Danish Presidency of the Council of the European Union in 2012 (www.excellence2012.dk, viewed 20.02.2013).

2. Cf. the 2006 concept paper of the Austrian Science Fund (FWF), www.fwf.ac.at/de/downloads/pdf/exzellenzinitiative-wissenschaft.pdf, accessed 20 February 2013.

3. It is indicative in this regard that the European Union's eighth "Framework Programme for Research and Technological Development" (2014-20) reserves the biggest share, USD 32.7 billion, for "Excellent Science", http://ec.europa.eu/research/horizon2020/pdf/press/horizon_2020_budget_constant_2011.pdf, accessed 20 February 2013.

4. A recent anthology discussing the German REI from a policy perspective captures this conviction in its title, *Making Excellence* (Keller, 2008).

5. One example, the National Health and Medical Research Council of Australia (NHMRC), states that "NHMRC will only support excellence in research because the best outcomes flow from the best research" www.nhmrc.gov.au/_files_nhmrc/file/grants/apply/programs/2012_program_grants_funding_rules_for_funding_in_2014.pdf, p. 7, accessed 20 February 2013.

6. A set of indicators for both monitoring and performance-based funding of research has been developing over the last decade. See European Commission (2010) for a review.

7. A notable exception is the PEAC project which is focussing on research excellence schemes in Denmark, Finland, Norway and Sweden (see Langfeldt et al. 2013).

8. Italy's REI did not fit the project definition and Turkey is considering introducing a special funding programme for excellent research institutions (further details are provided in Chapter 2).

9. The electronic survey contained multiple choice questions and fields for open-ended comments. All questionnaires are available from the OECD Secretariat.

10. The electronic surveys were returned directly to the OECD Secretariat.

11. The German Excellence Initiative may serve as evidence. In the first funding cycle, the universities that succeeded in the third, most prestigious line of funding, were those that had been most successful in raising public third-party funds in the years preceding the REI (Bloch et al., 2008, p. 103f.).

12. Aksnes et al. (2012, p. 59) report that in Scandinavia, each country has one or two universities that distinguish themselves by hosting a considerably above-average share of centres.

13. The Finnish CoE scheme was at first (1995-96) only about reputation. No specific funding was provided for the centres; the competition was exclusively about receiving official excellence status (Aksnes et al., 2012, p. 26).

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PART I

OECD/RIHR SURVEY RESULTS ON FUNDING FOR RESEARCH EXCELLENCE INITIATIVES

Part I presents the results of three surveys to:

- *Research ministries or departments responsible for administering research excellence initiative (REI) funding in higher education institutions (HEIs) and public research institutions (PRIs). In all, 56 different funding schemes were reported from 20 countries. The results are presented in Chapter 2.*
- *Centres of excellence (CoEs) that receive REI funding. Responses were received from 304 centres in 14 countries. Chapter 3 presents the results of the survey to CoEs and describes their characteristics, including funding schemes and cycles, mechanisms used to foster networks and interdisciplinary research, research impact and perceived value of REIs.*
- *Host institutions that receive REI funding. Responses were received from 99 host institutions in ten countries. Chapter 4 describes the characteristics of the institutions that host CoEs, the funding schemes and the perceived effects of REIs on research activities.*

Chapter 2

Research excellence initiatives and government ministries

This chapter presents the results of a survey to government agencies responsible for administering research excellence initiative (REI) funding for higher education and public research institutions. REIs provide funds for research and many research-related measures, such as the improvement or extension of physical infrastructure, the recruitment of outstanding researchers from abroad and the training of researchers. The survey results show that ministries and public funding bodies responsible for REIs judge them positively and report that they reach the objectives of the programmes. New lines of research have opened up, new patterns of interdisciplinary research have been established, human capital has been strengthened, and concentration processes have generally led to enhanced research capacities.

Introduction

This chapter presents the results of a survey to government agencies responsible for administering research excellence initiative (REI) funding for higher education and public research institutions. It begins by discussing the data sources and methodology used and describes the criteria used to identify REIs. It presents the REIs in responding countries and discusses the similarities and differences among them, in particular in terms of their objective, the disciplinary and thematic focus, the selection process, the concentration of REIs, performance assessment and system evaluations.

Data sources and methodology

Desk research and survey of government ministries

The information presented in this chapter comes from two sources. In a first phase, desk research was carried out in an attempt to formulate a concept of what is here termed a "research excellence initiative". The result was a description of the common characteristics and differences among REIs worldwide (Orr et al., 2011). This was used to design a questionnaire for government agencies that would provide more information on REIs in OECD member and Partner countries. The survey aimed to confirm and elaborate on the information gained through desk research. This survey was only exploratory; it can provide insights and contribute to understanding but can offer only tentative results. The survey first described the criteria chosen for identifying an REI. The criteria were tentative and not completely clear-cut owing to the hybrid nature of the REIs, with funding somewhere between institutional core funding and project funding.

This meant that the second phase of the project, which consisted of analysing the responses to the questionnaires, began with a review of submissions in the light of the qualifying criteria. The criteria used to distinguish REIs from other categories of research funding are thus largely based on the survey definitions. However, some of these have been further specified in order to better identify REIs as a particular form of research funding.

The following analysis largely relies on the survey responses. However, the desk research of the first phase of the project is used to confirm key facts from the surveys, where possible, and to elaborate on certain issues that were not adequately covered by the survey.

Defining criteria for REIs in this report

The criteria used to identify REIs are as follows, with explanatory comments:

- **REIs are a form of government-level funding provided to selected research units and institutions**. This distinguishes REI funding from institutional core funding, as it is not provided to all institutions, and from forms of funding that go to individuals, e.g. project funding for individual researchers.
- **REIs foster exceptional quality in research and research-related activities**. Funding is not provided to all research units, but only those considered exceptional on the basis of an assessment of excellence. In most cases other criteria are also applied in the selection process, e.g. provisions for the application of results or a specific focus on young researchers.

- **Funding is long-term**. It was agreed that the duration should be a minimum of four years.[1] Successful research units receive a secure grant for a prolonged period of time on the assumption that this will help create an environment in which excellent research can flourish.
- **REI funds are competitive and are distributed on the basis of peer-reviewed applications**. Judgements of excellence are made by peers and are not, for instance, solely based on metrics. The peers assess competing applications for funding.
- **Applicants are required to participate in selection processes with fixed time frames**. The selection process distinguishes REIs from institutional core funding. The criterion of "fixed time frames" sets REIs apart from forms of funding for which proposals can be submitted at any time. The competitive aspect of REIs implies that application rounds are rare, so that direct comparison of a large number of applicants is possible. In this study, only schemes in which calls for application are issued once every two years, or more rarely, are considered.[2]
- **Institutions or research units (as opposed to individuals) apply for the funds**. It is an explicit or implicit goal of REIs to strengthen institutions' ability to take strategic action, particularly with respect to the areas of research that receive special attention and to the organisation of research within the institutions. For this reason, and in order to be able to distinguish REIs from traditional forms of project funding, only funding schemes for which applications had to be approved by the executive management were considered.
- **Substantially more funds are provided than for individual project-based funding**. The research units funded under REIs, often called "centres", are designed to encompass large groups of researchers, often from different disciplines and different institutions. From this it follows that the funds provided are also more substantial. As will be seen, the large-scale funding of REIs is tied to the intention to affect the national science system as a whole. It can be assumed that a minimum amount of funding must be provided to supported units to reach this goal. As it is difficult to operationalise the criterion "substantially more funds than in project-based funding" in a case-specific manner, a general lower limit of USD 1 million of funding a year per centre was set.[3] Typically, the funds are significantly larger (see Table 2A.1.2 in Annex 2.A1).

Other funding instruments may also use these criteria, particularly target agreements and large-scale project funding. However, it is the combination of all of the criteria and the selection of exceptional research units for the strategic, long-term development of excellence in a national research landscape that make REIs a specific instrument.

REIs covered in this report

The questionnaire was drawn up by the OECD Science and Technology Policy Division Secretariat and project steering group.[4] Delegates to the OECD Research Institutions and Human Resources (RIHR) working group distributed them to the appropriate expert(s) in their respective countries. Answers were received from 20 countries (Australia, Austria, Denmark, Estonia, Finland, Germany, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Slovenia, Sweden, Turkey and the United States), as well as six German *Länder* (federal states), which described regional funding schemes run in parallel with Germany's national REI.

The questionnaire also included a free-text category for countries that have considered or were considering introducing an REI. Turkey was the only country answering in this category. The responsible ministry is considering introducing a special funding programme for excellent research institutions in the areas of natural sciences, technology and engineering, based on experience in other countries.

Turkey aside, 56 different funding schemes were reported. However, not all reported funding schemes fulfilled the criteria that would identify them as REIs. Finally, 28 schemes from 18 countries (17 OECD countries and the Russian Federation) were classified as REIs. These 28 schemes represent the descriptive basis of the present chapter. All generalisations about REIs and statements regarding proportional shares in this study must be understood as confined to these REIs. A list of schemes that were reported but excluded is given in Annex 2.A1, with the reasons for exclusion.

Table 2.1 lists the 28 REIs discussed. The third column lists official acronyms (if they exist). If official acronyms exist, they are used in the text. The fourth column specifies the year in which funding through the REI started, and the fifth column states the maximum funding period for an individual research unit per funding cycle (the option of applying repeatedly in different cycles is not considered).

Table 2.1. Overview of REIs in responding countries

Country	Name of REI	Official acronym/ short form	Start date	Maximum funding period for individual research unit
Australia	ARC Centres of Excellence		2003	7 years
Austria	Competence Centres for Excellent Technologies	COMET	2008	K1: 7 years K2: 10 years[1]
Denmark	Investment Capital for University Research	UNIK	2009	5 years
Estonia	Development of Centres of Excellence in Research		2001	7 years
Finland	Centres of Excellence (2008-13)	CoE	1995	6 years
Germany	Excellence Initiative (Programme of the German Federal and State Governments to Promote Top-level Research at Universities)		2006	5 years
Germany-Hesse	State Initiative for the Development of Scientific and Economic Excellence	LOEWE	2008	6 years
Germany-Saxony-Anhalt	Networks of scientific excellence		2005	5 years
Germany-Thuringia	Thuringian Agenda for Supporting Excellent Research "ProExcellence"	ProExcellence	2008	5 years
Ireland	Programme for Research in Third-Level Institutions	PRTLI	1998	6 years
	Centres for Science, Engineering and Technology	CSET	2003	10 years

.../...

Table 2.1. Overview of REIs in responding countries *(continued)*

Country	Name of REI	Official acronym/ short form	Start date	Maximum funding period for individual research unit
Japan	Global Centres of Excellence Programme	Global COE	2007	5 years
	World Premier International Research Centre Initiative	WPI	2007	15 years
Korea	Brain Korea 21 Programme	BK 21	1999	7 years
	World Class University Programme	WCU	2009	5 years
Netherlands	Bonus Incentive Scheme	BIS	1998	No maximum set (will change in future)
New Zealand	New Zealand Centres of Research Excellence	CoRE	2002	6 years
Norway	Norwegian Centres of Excellence	CoE (SFF)	2002	10 years
	Centres for Research-based Innovation	CRI (SFI)	2007	8 years
	Centres for environment-friendly energy research	CEER (FME)	2009	8 years
Poland	Leading National Scientific Centres	KNOW	2012	5 years
Portugal	Multi-Year Funding Programme		1996	5 years
Russian Federation	National Research University initiative	NRU	2008	10 years
Slovenia	Centres of Excellence		2009	4 years
Sweden	Strategic Research Areas	SRA	2010	5 years
	Linnaeus Grants		2006	10 years
	Berzelii Centres		2006	10 years
United States	Science and Technology Centres	STC	1989	5 years

Note: 1. The COMET scheme is divided into funding lines; line "K1" has a slightly different structure than line "K2".

Source: OECD/RIHR questionnaire to government ministries, Q1.1: What is the organisational structure of REIs in your country? Q1.2: When were REIs first implemented in your country (i.e. received funding)?

It should be emphasised that this study does not claim to provide an exhaustive account of all REIs in OECD countries. Several countries have REIs that were discussed by the RIHR Working Party but are not included because they did not respond to the survey. They are:

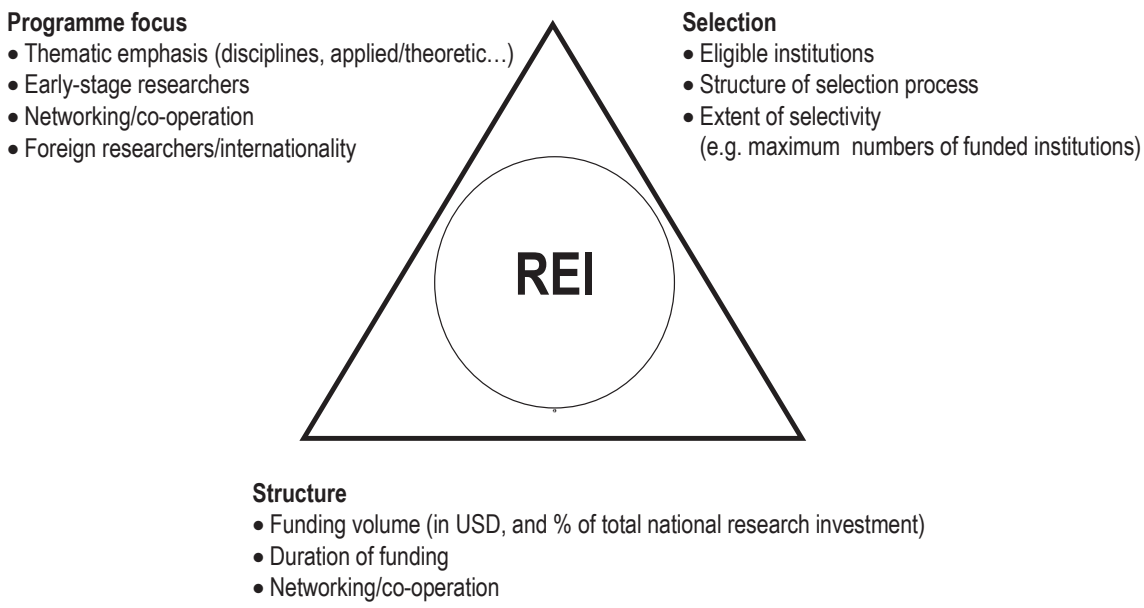
- Canada: Canada Excellence Research Chairs (CERC), 2010
- Denmark: Centres of Excellence (CoE), a programme run by the Danish National Research Foundation, 1993; Strategic Research Centres, administered by the Danish Council for Strategic Research, 2006; and Strategic Platforms for Innovation and Research (SPIR), a programme managed by the Danish Council for Strategic Research and the Danish Council for Technology and Innovation, 2010

- France: *Initiatives d'excellence* ("Excellence Initiatives"), one of several branches of the broad national programme *Investissements d'Avenir* ("Future Investments"), 2009
- Luxembourg: Programme Excellence Award for Research in Luxembourg (PEARL) 2009, Opportunities for Outstanding Young Researchers in Luxembourg (ATTRACT) 2007
- Spain: Severo Ochoa Centres of Excellence, 2011.

Description of REIs

The initial desk research on existing REIs found similarities among national schemes, but also specific differences to be captured through the questionnaire. These differences involved programme focus, selection regulations and processes, and structural characteristics (Figure 2.1). The following description of REIs is based on insights into these dimensions gained from the questionnaire results and the initial desk research. This section starts with a first look at the start dates for national REIs and their presence in OECD countries over time. Next it deals with programme focus, with selection and with structure. The section ends with information on REIs' links to research and development policies, which also emerged from the survey results.

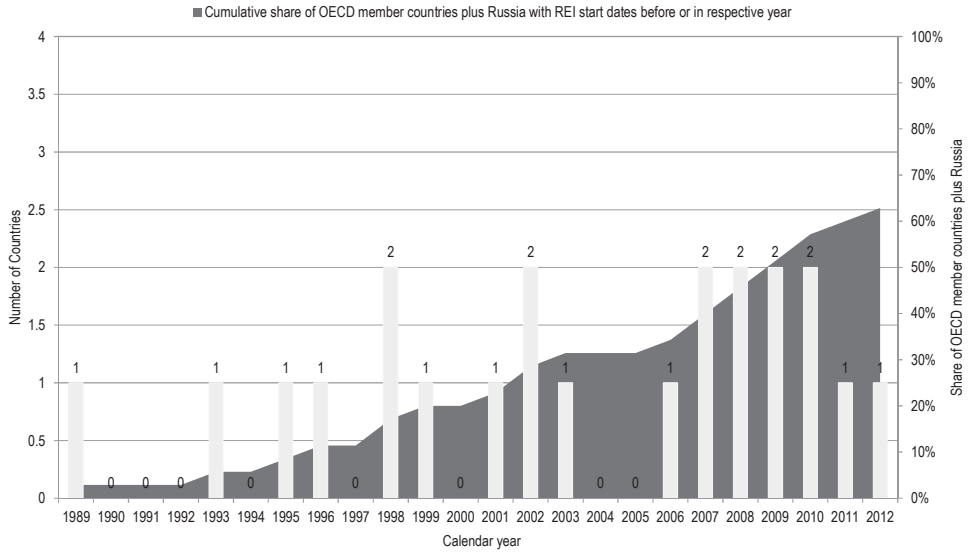
Figure 2.1. Dimensions in which REIs may differ



REI start dates and OECD coverage

REIs are a relatively new funding instrument. Figure 2.2 charts the development of the number of countries running REIs from 1989 to 2012 (including four other known countries that did not respond). The number of countries with REIs has clearly increased over time. Over half of the countries in the survey introduced REIs since 2006 and two-thirds of OECD countries now operate such schemes.

Figure 2.2. Share of OECD countries (plus the Russian Federation) with REIs, by start date



Note: Includes countries that did not respond to the survey, but have or have had REIs to the authors' knowledge, Canada, France, Luxembourg, Spain.

Source: OECD/RIHR questionnaire to government ministries, Q2.1: When were REIs first implemented in your country, i.e. received funding?

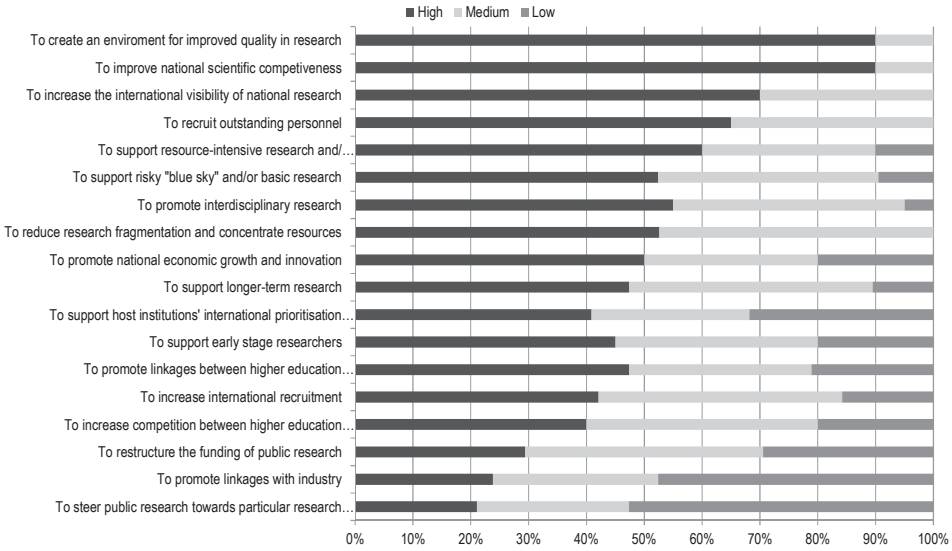
Objectives

REIs may be established for many reasons. Typical of REIs is a multitude of declared goals, often without clear hierarchies among them. The following quote from the programme description of the Finnish CoE illustrates this in a nutshell:

> "The aim of the Finnish Programme for Centres of Excellence in Research (CoE) is to create favourable framework conditions for consortia of research teams and create potential for attaining scientific breakthroughs. Another aim is to promote collaboration and the application of novel approaches at the interfaces of scientific disciplines and fields of research. The CoE programme further boosts the use of research infrastructures, networks CoEs both nationally and internationally, increases the social impact of research and raises the quality standards, international competitiveness, visibility and esteem of Finnish science and research."[5]

In the survey, government agencies were offered a list of 18 reasons for establishing REIs and were asked to rate their importance by high, medium and low priority. Respondents were able to choose multiple priorities. The results are shown in Figure 2.3. Of note is the fact that in the section of the questionnaire on programme rationales, respondents tended to respond from a national perspective rather than specifically for each REI in their country.[6] The five most important of these rationales, measured by the number of times it was classified as having high priority in more than half of the responses, are discussed in more detail below.

Figure 2.3. Rationales for REIs by assessment of importance



Source: OECD/RIHR questionnaire to government ministries, Q2.1: What was the purpose of establishing REIs in your country? (multiple responses possible). Several priorities could be specified for each REI. Ranked by "high" priority rationales.

Improve national scientific competitiveness

In REIs competition is an essential principle. Ability to compete at the international level is ascertained through competition among national institutions. The notion that not only institutions, but also national science systems, compete has been reinforced as global markets for workforce, goods and services have become increasingly integrated and therefore permeable. The fact that higher education institutions (HEIs) and public research institutions (PRIs) affect national (and regional) economies favourably (OECD, 1996), is less prominent in REIs, since they tend to focus on the place of the national science system within a global context.

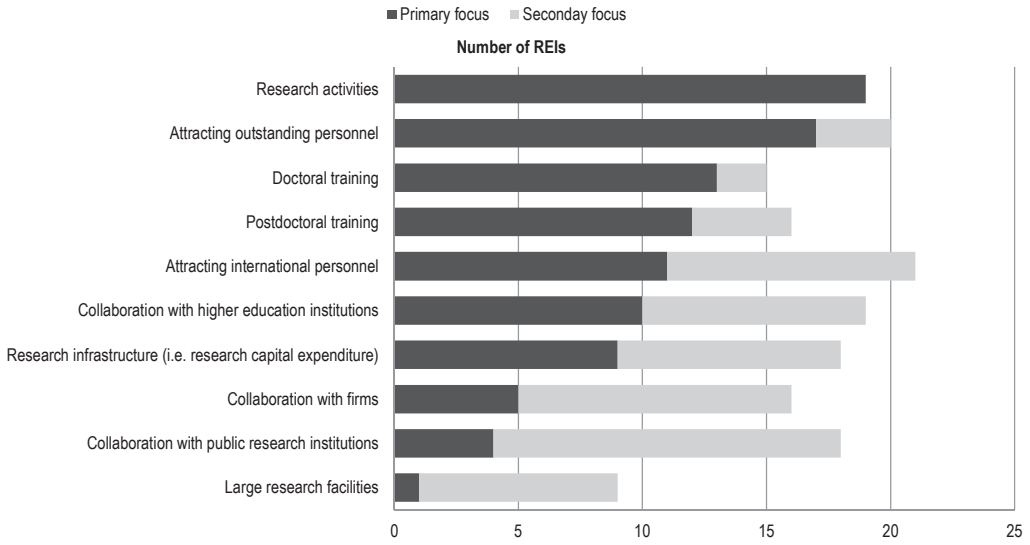
In the available programme descriptions, a country's scientific competitiveness is rarely demonstrated by specific measures of competitiveness. Korea is an exception in that it ties measurably specific objectives to its REIs. The BK 21 initiative aims at putting Korea among the world's top ten in the Science Citation Index as well as the IMD World Competitiveness Yearbook (for knowledge transfer from universities to industry).[7] Moreover, with the help of the WCU initiative, Korea aims to have three of its universities among the world's top 30 by 2015.[8]

Create an environment for improved quality in research

This is a fundamental goal of REIs. In general, an REI's strategy is to foster the concentration of exceptional researchers in exceptionally well-equipped working environments. The way this is achieved depends on the prevailing conditions in specific national research systems. In some REIs, such as the Irish PRTLI and the Russian Federation's NRU, upgrading of physical infrastructure plays an important role. In New Zealand, Slovenia and the United States, the incentive to cross the boundaries of institutions (HEIs, PRIs, business and others) is a key element. The Estonian Development of Centres of Excellence aims to strengthen the links between basic and

applied research, and the Japanese Global CoE scheme highlights structural reforms in the training of early-stage researchers. These specific operational goals are often found in the specification for activities eligible for funding (Figure 2.4). As might be expected, there is a close relationship between an REI's goals and the activities funded. For example, in the Slovenian CoE scheme, in which linkages between sectors are an important objective, collaboration with firms is a priority in terms of financial support. Training of early-stage scientists is also one of the primary activities eligible for funding and is seen as conducive to excellent research performance. In the Japanese Global CoE scheme, with its focus on training early-stage researchers, support to doctoral and postdoctoral candidates is a primary activity.

Figure 2.4. Activities eligible for funding in REIs



Source: OECD/RIHR questionnaire to government ministries, Q3.2: What types of activities are supported by REIs? (multiple responses possible). Ranked by activities with priority focus. Multiple primary and secondary focuses could be specified for each REI.

Increase the international visibility of national research

This goal is tied to competitiveness, and the fact that it is so highly ranked shows again that REIs are designed with a focus on the national research landscape as a whole, even though the funding may only reach a fraction of all institutions. Like competitiveness, the notion of "visibility", despite its frequent presence in REI descriptions, is rarely tied to quantitative measures in official REI descriptions. It is however plausible to link the production and dissemination of top-level research to international visibility in scientific communities, so that visibility might in principle be measured by established bibliometric measures or related instruments. For research institutions (and their main public funding bodies), what is important about visibility is that it generates new and alternative opportunities in terms of researcher and student recruitment, co-operation partners and sources of funding (Friedrichsmeier and Fürst, 2012).

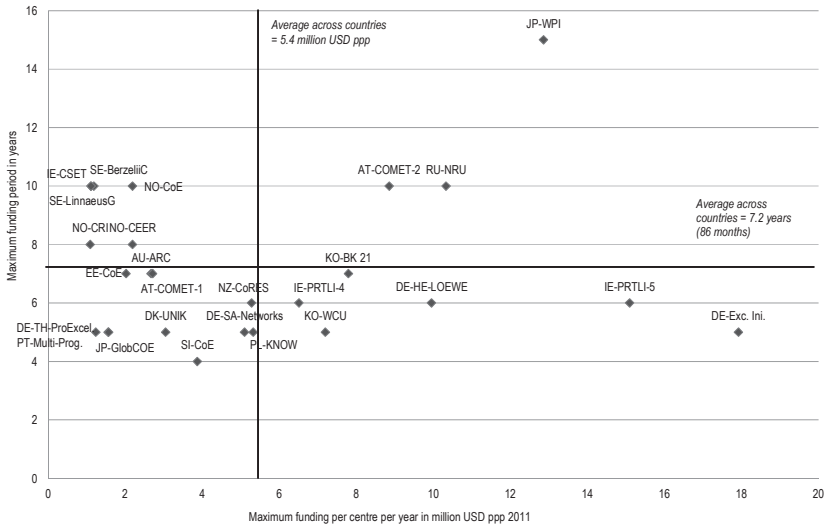
Recruit outstanding personnel

This goal shows that governments are eager to attract human resources from other countries or from non-academic positions. Outstanding scientists are clearly needed to conduct excellent research. REIs seek to achieve this goal by offering favourable conditions, e.g. through long-term grants, generous funding or new pathways of collaboration that may be difficult or even impossible through other programmes. The recruitment of outstanding personnel is a particularly salient feature of the Korean WCU programme; the scheme is based on the idea of having Korean HEIs invite internationally renowned researchers to co-operate with the faculty and to establish new academic programmes.[9] REIs such as the Australian ARC Centres of Excellence, the Estonian Development of Centres of Excellence or the Russian NRU schemes also explicitly fund the recruitment of international and outstanding personnel.

Support resource-intensive research and build research capacity

REIs are built around the notion that excellence is not only a matter of individual effort, and that research units must have a certain size, strategy and indeed culture of excellence to perform at high levels and trigger innovation. One of the most frequently used terms in REI descriptions is "critical mass". The idea is that to achieve certain beneficial effects in terms of quality, a quantitative threshold must first be crossed, whether in terms of the number of researchers assembled in one centre, the infrastructure to which they have access, or both (depending on the goals of the scheme). Accordingly, REIs offer large sums over prolonged periods of time to support large initiatives such as interdisciplinary centres of excellence on big topics like climate change.

Figure 2.5. Investment and stability, maximum funding period and maximum investment per funded research unit



Note: It is important to note that funding for REIs is not uniform across countries. For example, some REIs support capital expenditure while others do not. This figure shows the maximum funding per centre and does not distinguish between activities supported. In addition, it can be misleading to consider only direct REI funding when studying the financial situation of REI centres, given that many also attract considerable funds from other sources.

Source: OECD/RIHR questionnaire to government ministries, Q4.1: Please describe how the government funds REIs in your country by completing the following table. All monetary values in USD PPP 2011. For each country the two-digit country code is supplemented with an abbreviation for the specific REI. Data unavailable for: FI-CoE, SE-SRA, US-STC. See Table 2A.2 in Annex 2.A1 for full data.

Figure 2.5 shows how different schemes endeavour to create such research clusters. The vertical axis shows that the maximum period of funding (in a particular round) is on average around seven years, although a number of schemes have a longer duration. The Japanese WPI scheme provides funding for a period of 15 years, nearly double the average. On average USD 5.4 million (PPP) are set as the maximum annual funding of a centre. Higher amounts are provided in Austria, Germany, Ireland, Japan, Korea and the Russian Federation. These countries would appear to be attempting to create large-scale clusters of excellence in research. Austria's Comet scheme, the Russian Federation's NRU and Japan's WPI have exceptionally high funding per centre over an exceptionally long period of time.

Disciplinary and thematic focus

Most REIs are open to all fields of science. The relative predominance of natural science, engineering and technology and medical science shows, however, that some REIs have restricted eligibility (Table 2.2).

Table 2.2. Fields of science eligible for funding in REIs

Field of science	Number of REIs in which eligible
Natural sciences	26
Engineering and technology	26
Medical sciences	24
Agricultural sciences	19
Social sciences	22
Humanities	18

Source: OECD/RIHR questionnaire to government ministries, Q3.1: What fields of science and technology are covered by the REIs? Multiple responses were possible for each REI.

This is due in part to the fact that some REIs address topics that can only be dealt with by certain sciences. For instance, the Norwegian Centres for Environment-friendly Energy Research (CEER) is only open to engineering and technology and the social sciences. Similarly, the Slovenian CoE scheme defines five mainly technological priority areas.[10] It may be asked whether such targeted funding schemes should not be considered separately. Since the questionnaires did not address this issue, thematically specialised excellence schemes were included as long as they conformed to the stated criteria. From the point of view of the Research Council of Norway, what aligns the CEER with Norway's other excellence schemes (CoE and CRI) is that they all aim to "advance basic research of high international calibre and to promote internationalisation", and that "all the centre schemes represent a long-term investment in research with the aim of developing dynamic research communities."[11]

Other thematic restrictions result from the mission of the responsible funding body. For example, the mission of Science Foundation Ireland (SFI) is to promote research in (natural) science and engineering, and its CSET excellence scheme is restricted to applications from those fields. Similarly, because the United States' National Science Foundation (NSF) is not responsible for funding medical sciences and humanities, these fields are excluded from its Science and Technology Centres scheme.

Specialisation may also exist if the REI is linked to a national strategy with scientific priority areas, such as Slovenia's Centres of Excellence initiative, which developed from the National Research and Development Programme. The programme identified areas of special interest, mainly in the natural sciences, engineering and technology, and medical sciences, and the REI also focuses on these areas.

Other REIs refer to national priorities without setting restrictions in terms of eligible fields of science. For example, New Zealand's Centres of Research Excellence initiative states that "applicants should also be aware of the three themes that constitute government priorities: economic transformation, families – young and old, and national identity",[12] but the REI is open to all fields of science. Similarly, the Swedish Strategic Research Areas scheme has 20 areas of special national interest, as defined in a government bill on research policy from 2008,[13] but their diversity appears to allow participation from every field of science. Likewise, the German-Thuringian REI ProExcellence supports projects in nine research areas, but the call for applications does not explicitly exclude applications from other fields or subject areas.[14]

For its part, the Irish PRTLI has strategic rather than thematic priorities. It has had five funding cycles to date, each of which had a special emphasis. The first cycle focused on strategy development and physical infrastructure, the second gave incentives for collaboration, and the fifth and final cycle focused on "capacity, concentration, consolidation and coherence".

Many countries have both REIs that specialise in certain areas of science or topics and others that are open to all. Some examples:

- The thematically unrestricted Irish PRTLI runs parallel to the more specialised CSET scheme.
- In Norway, the CRI initiative, which focuses on academic-industrial co-operation, developed out of the more general CoE in 2006. The CEER scheme is still more specialised and was launched after the other two were already under way. All three schemes are run by the Research Council of Norway.
- In Sweden, the Berzelii Centres are oriented towards co-operation between public and industrial research and commercial applicability; the Linnaeus Grants are open to all fields of science and do not require collaboration with business.
- The German, Korean and Japanese REIs that focus on training next-generation researchers are complemented by more "general" REIs.

An REI may also vary between thematically open and topic-focused approaches. The Japanese WPI scheme was open to applicants from all fields except social sciences and humanities in the first round (2007), but the second call in 2010 was for a centre for a low-carbon society. The third call in 2012 was again open to various subjects.

Even if an REI is open to all fields of science, there is evidence that REIs may not be equally suited to all types of research. The Dutch Bonus Incentive System was open to all fields of science, but only research units from the natural and life sciences actually received funding. Over 60% of funded centres in the Australian Centres of Excellence scheme are in the physical sciences (Coleman, 2011). When a similar bias against the humanities and creative arts was claimed to have influenced the first selection phase of the German Excellence Initiative, funding bands were introduced, partly to facilitate the participation of "book-based" disciplines with less extensive funding needs. In the ensuing application phase, humanities and social sciences fared better.[15] It is not certain

whether this is a result of the altered funding rules, or whether the underrepresented disciplines learned to adapt to the system. It has been suggested (Zürn, 2010) that disciplines with relatively straightforward and unified evaluation criteria (e.g. publication in top journals) are at an advantage in the selection procedures typical of REIs. Moreover, if representatives of a given field are underrepresented in the final selection committee, proposals in that field are more likely to be turned down because of a lack of support and expertise (Burchard and Warnecke, 2012). Such concerns could be resolved if the entire selection process were conducted separately for different fields of science, but this would ignore the issue of measuring excellence appropriately across disciplines. The Polish KNOW programme announces calls for applications for different areas of science each year, so that competition is between representatives of the same field.

Selection

Funded units

One of the features that distinguish REIs from other types of excellence funding is their emphasis on the institutional perspective. However, it is usually not institutions as a whole that receive the financial support, but rather research units hosted by the institution (normally an HEI). This is consistent with the observation that REIs encourage institutions to identify their strongest research areas and prepare REI applications accordingly. Since the application process is costly and time-consuming and requires the approval of the executive level, the decision to submit an application is not an easy one. It is plausible that either the success or failure of an REI application will have repercussions on the host institution's research strategy as a whole.

The units funded by REIs are most often called centres. Generally speaking, a centre (of excellence) is a structure in which several groups of individuals from various (sub-) disciplines work together on a commonly agreed project or programme. Compared to spontaneously formed research groups, a centre has a long-term outlook; a formally defined organisational structure that distinguishes it from its institution and subsumes individual researchers; and a functional distribution of tasks among principal investigators, managing directors, advisory and executive boards, junior research group leaders, etc. Other terms used for this type of structure in REIs can be found in Table 2.4, column 3. The units funded by REIs are called "centres" if they fit this general description.

The precise structure of REI centres varies among initiatives but also within a single REI. Although this topic was not dealt with in the survey, the documents published by funding bodies indicate that REIs do not set detailed regulations for the internal governance of centres. This appears reasonable, as the organisation of eligible host institutions differ markedly and the centres must harmonise their administration with that of the host institution. Imposing detailed regulations on a centre's structure might therefore cause problems. Indeed, it is part of the appeal of many REIs that they give researchers more freedom to organise their research. From this perspective, excessively detailed regulations might inhibit research. However, an argument in favour of greater regulation of REI centres would be that the funds provided are consequential and that centres often have long time frames for projects with undefined outcomes. The German Excellence Initiative therefore found a compromise solution between external regulation and autonomy. The German Science Foundation issued "model statutes" for centres that stipulate the basic organisational outlines of the funded units but leave room for individual centres to accommodate those statutes in their own way.[16]

Three REIs emphasise graduates: the Korean BK 21 scheme, the Japanese Global COE scheme and the German Excellence Initiative in its first funding line, Graduate Schools. They are based on research centres, but focus on providing excellent training for doctoral students and post-doctorates. Other REIs with a strong emphasis on training early-stage researchers are Australia's ARC Centres of Excellence, Germany-Saxony-Anhalt's Networks of Scientific Excellence, Norway's CoE, New Zealand's CoRE, and the US STC. All the other schemes also cover training of young researchers in REI centres in some way.

Two REIs fund the institutions themselves: the third line of funding of the German Excellence Initiative and the Russian NRU initiative. The relevant line of funding in the German initiative is called Institutional Strategies and supports universities with innovative approaches to building a research profile. It covers a variety of strategic measures to increase the university's international visibility but does not fund research activities. In most other REIs, institutional strategies play a role in the assessment of proposals but are not rewarded in a separate competition. The Russian NRU initiative requires applicants to propose a development programme for their institution, but contrary to the German initiative, a large part of the funds is for the modernisation of physical infrastructure and for new approaches to training early-stage scientists. In the range from institutional to project funding, the NRU initiative, with its ten-year grants directed to the institution as a whole, comes closest to institutional core funding among the REIs discussed in this chapter. The Swedish SRA scheme has another noteworthy regulation in this context: if the funded centres are evaluated positively after five years, the grants are converted into permanent funds for the host institutions.[17] In this case, REI funding merges into genuine institutional core funding.

Host and partner institutions

All REIs allow HEIs as host institutions of REI-funded projects, but only about half allow PRIs as hosts. A host institution is the institution responsible for filing the application, and it is generally also where the centres are physically located. Hosting a centre comes with special responsibilities, e.g. to provide infrastructure and co-funding, to administer the centre's resources, or to employ its researchers when REI funding ends. The desk research on REI programme descriptions found that many REIs make a synergetic relationship between an REI-funded centre and its host institutions a pre-condition of funding. Table 2.3 lists the status of HEIs and PRIs as host and partner in different REIs. REIs in which neither HEIs nor PRIs are allowed as partners appear in the column "neither".

In a number of REIs, PRIs and firms are also eligible as partners. In fact, in the Irish CSET and the funding line K2 of the Austrian COMET, collaboration between academic and industrial partners is mandatory. The same is true for the Norwegian CRI, which aims to encourage companies to innovate through a greater focus on long-term research; in this scheme, private companies may also host centres. Even when the rules of application do not provide for co-applications, inter-institutional co-operation is encouraged or required in virtually all REIs. Eligibility for co-application is thus more of an administrative issue, although the possibility of writing co-applications indicates that collaboration is encouraged.

Table 2.3. Eligible hosts and partners in REI applications

		As partner			
		Only higher education institution (HEI)	Only public research institution (PRI)	Either	Neither
As host	Only HEI	• Sweden, Berzelii Centres • Sweden, Linnaeus Grants	• Germany, Excellence Initiative • Germany-Saxony-Anhalt, Networks of Scientific Excellence	• Australia, ARC Centres of Excellence • Ireland, PRTLI • New Zealand, CoRE • Poland - KNOW • Sweden, SRA	• Denmark, UNIK • Japan, Global COE • Korea, BK 21 • Korea, WCU • Russian Federation, NRU • Slovenia, CoE
	Only PRI	--	--	--	--
	Either	--	--	• Austria, COMET • Estonia, Development of Centres of Excellence • Finland, CoE[1] • Germany-Hesse, LOEWE • Germany-Thuringia, ProExcellence • Ireland, CSET • Netherlands, BIS • Norway, CoE • Norway, CRI • Norway, CEER • Portugal, Multi-Year Funding Programme • United States, STC	• Japan, WPI

Note: 1. In the Finnish CoE scheme, researchers apply on behalf of their host institution.

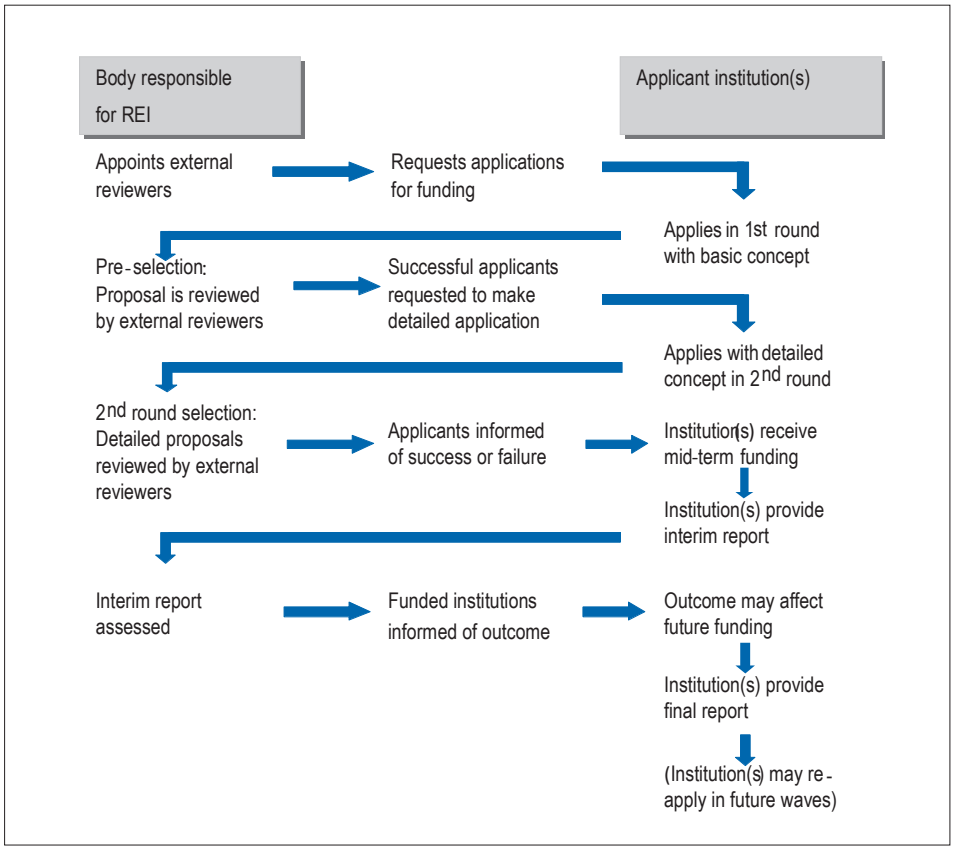
Source: OECD/RIHR questionnaire to government ministries. Q4.3: Who is eligible to apply for REI funding? (multiple responses possible).

Both host and partner institutions may be required to contribute financially to the REI centres. The survey revealed that among respondents to the questionnaire, 17 REIs require host institutions to contribute, and 11 REIs require partner institutions to do so. In ten cases, the requirement for the host institution to provide co-payments entailed a similar requirement for partner(s); in seven cases, it did not. Nine REIs had no co-financing requirements for host or partner institutions. The amount of co-funding required varies from 5% (Estonia, Development of Centres of Excellence) to 25% (Germany-Saxony-Anhalt, Networks of Scientific Excellence; Sweden, Berzelii Centres), and up to 50% (Russia Federation, NRU; Sweden, Linnaeus Grants). In many cases, no definite limits are set, and host institutions are expected to make part of their infrastructure available to the centres as a sort of in-kind contribution. Co-funding from partners is required in all schemes involving industrial research and development (R&D).

Selection process

Although the individual award processes vary to some degree, a general pattern emerges from the descriptions given in the survey and official online sources. The organisation of the procedure is similar to the process for research project funding and quality assessment (Orr, 2004). Figure 2.6 sketches a generic procedure.

Figure 2.6. General organisation of REI funding procedures



Besides the two-stage selection model sketched in the figure, multi-phase selection models also exist: Germany's Excellence Initiative, New Zealand's CoRE, Korea's WCU and Australia's ARC Centres of Excellence initiative have all adopted a three-phase model.[18] The Norwegian CRI scheme employs a five-phase model;[19] its complexity is partly due to the fact that both academic and industrial stakeholders are involved and proposals are reviewed by representatives of both sides.

The different selection processes allow for varying degrees of interaction between selection panels and applicant institutions. Denmark's UNIK, for example, has several feedback phases, in which applying universities can influence parts of the process, such as the choice of reviewer, and can comment on expert reviews.[20] Normally, applicant institutions can only provide feedback in the second selection phase, if at all. Norway's CoE and CRI allow applicant institutions to suggest possible external reviewers of their applications.[21] In the Finnish CoE initiative, the final nominees engage in individual negotiations with the funding body about the actual levels of funding.

Almost all REIs include internationally recruited experts in peer reviews and selection panels. Because the ambition of REIs is to select research units with the potential to compete among the world's best, international experts in the field seem well equipped to judge whether an applicant is likely to meet this goal. International recruitment of reviewers also reduces potential prejudice and bias, particularly in smaller countries.[22] It is also useful when an REI is so big that a large share of domestic researchers is involved in applications.

The final decision-making panels usually include a larger share of national experts. This may be because this stage in the selection process requires not only expert scientific knowledge but also judgements about how well the application conforms to the REI's strategic development plans. This requires a good understanding of the national science system, which domestic specialists are more likely to possess. New Zealand's CoRE scheme, for example, has a three-stage selection process, the first two of which involve international reviewers; the final panel consists of eminent New Zealand researchers and officials, who are presumably able to judge proposals' strategic focus against New Zealand's future development needs, which is one of the REI's selection criteria. Likewise, in the Estonian Development of Centres of Excellence in Research scheme, both national and international experts review the scientific value of the submitted proposals, but only national experts are involved in assessing how effectively the proposals contribute to the socioeconomic development and culture of Estonia and the European Union, one of the three main criteria.

To summarise, the selection procedures of REIs are complex, with a view to picking the best candidates. The careful consideration of proposals through several stages can be an important means of assuring the legitimacy of the resulting funding decisions.

Selection criteria

When setting up selection criteria, funding bodies must weight past performance against future prospects. Past performance is easier to judge and can be represented by indicators such as publication numbers, success in acquiring third-party funds, etc. Future prospects are more difficult to evaluate but are essential: REIs aim at achievements that cannot (solely) be judged on the basis of past performance. The REI programme descriptions show that to limit the risk of funding overly ambitious projects with few chances of attaining their goals, REIs commonly include non-scientific criteria for assessing the probability of success. One is the robustness of the centre's governance and management model; another is proof of ability to exploit funding sources in addition to the REI funding. Finally, applicants usually have to show how REI centres will be integrated in participating institutions, particularly the host institution. In addition to the research criteria, reliable internal governance, ability to acquire additional funds, and structural inclusion in host institutions are the three main selection criteria.

Number of funded centres and selectivity

Table 2.4 shows the number of research units funded by each REI for all cases for which data were given. The terms used for these units are indicated as specified in the questionnaire responses (centres, initiatives, focuses, etc.). The table also gives the numbers of applicants (in the first round of application, unless otherwise indicated elsewhere) and grants awarded in the most recent funding rounds. It also indicates the degree of selectivity or success rate (the share of projects funded compared to the number of applications).

Table 2.4. Number of centres funded by REIs and selection rates in most recent funding cycle

Country	Name of REI	Number of research units / centres funded in 2011	Number received (r)	Number selected (s)	Success rate (s/r)
Australia	ARC Centres of Excellence	25 centres	111	13	12%
Austria	COMET Competence Centres for Excellent Technologies	5 K2-centres, 16 K1-centres, 25 K-projects	93	46	49%
Denmark	UNIK	4 initiatives	28	4	14%
Estonia	Development of Centres of Excellence in Research	12 centres	17	5	29%
Finland	CoE	41 centres[1]	135	15	11%
Germany	Excellence Initiative	39 graduate schools, 37 clusters of excellence, 9 institutional strategies	227	99	44%
Germany-Hesse	LOEWE - State Initiative for the Development of Scientific and Economic Excellence	21 focuses[2] and 8 centres	23	5	22%
Germany-Saxony-Anhalt	Networks of scientific excellence	6 centres	6	6	100%
Germany-Thuringia	Thuringian Agenda for Supporting Excellent Research "ProExcellence"		70	27	39%
Ireland	Programme for Research in Third-Level Institutions (PRTLI)	44 programmes	56	32	57%
Ireland	Centres for Science Engineering and Technology (CSET)	9 centres	-	-	-
Japan	Global COE	140 centres	145	9	6%
Japan	World Premier International Research Centre Initiative (WPI)	6 centres	9	1	11%
Korea	Brain Korea 21 Programme (BK21)	517 units	969	569	59%
Korea	World Class University Programme (WCU)	119 units	621	162	26%
Netherlands	Bonus Incentive Scheme (BIS), from 2013 continued as "Gravitation"	6 top research schools	34	6	18%
Norway	Norwegian Centres of Excellence (CoE) [SFF]	21 centres	98	8	8%
Norway	Centres for Research-based Innovation (CRI) [SFI]	21 centres	86	7	8%
Norway	Centres for environment-friendly energy research (CEER) [FME]	11 centres	8	3	38%
Poland	Leading National Scientific Centres (KNOW)	(n.d.)	25	6	24%
Portugal	Multi-year Funding Programme (Excellent Centres and Associate Laboratories)	58 research units, 26 associate laboratories	378	55	15%
Russian Federation	National Research University initiative	29 universities	32	15	47%
Slovenia	Centres of Excellence (2009-13)	8 centres	61	8	13%
Sweden	Strategic Research Area (SRA)	43 milieus.	112	43	38%
Sweden	Linnaeus grant (LG)	40 centres.	106	20	19%
Sweden	Berzelii centres	4 centres	22	4	18%
United States	Science and Technology Centres (STC)	17 centres	45	5	11%

Notes: 1. In 2011, 41 centres were funded in Finland via a number of REI funding rounds. Table 2A.1.2 in Annex 2.A1 focuses on CoE *2008-13* only, and thus 18 centres funded through this particular REI round. 2. A "focus" is a research unit funded through LOEWE to become an externally funded centre in the medium term, whereas a "centre" gets more extensive funding for units that have already demonstrated their research strengths, http.//verwaltung.hessen.de/irj/servlet/prt/portal/prtroot/slimp.CMReader/HMWK_15/HMWK_Internet/med/5c8/5c870ac7-6c65-1d31-f012-f312b417c0cf,22222222-2222-2222-2222-222222222222,true, accessed 20 March 2013.

Source: OECD/RIHR questionnaire to government ministries, Q8.1: Please provide further details on each individual research excellence initiative in your country by completing the following table; Q3.5: During the latest REI funding call, how many applications for research units/centres were received and what was the average success rate of proposals? No data: New Zealand CoRE.

The results show, not surprisingly, that REIs differ considerably with respect to the number of centres funded and degree of selectivity, or success rate. In two of Norway's REIs (CoE and CRI) less than one in ten applications were successful. The most rigid selection according to the figures took place in Japan's Global COE, where only 6% of applications received funding. However, earlier selection results[23] shows the scheme had success rates of just over 20% in 2007-08, demonstrating that the above "snapshot" data are not necessarily representative of the schemes in their entirety. In general, however, the degree of selectivity should not be considered a measure of an REI's quality standards. In the Networks of Scientific Excellence scheme in Germany-Saxony-Anhalt, six proposals were submitted in response to the most recent call, and all were accepted. The respondent explained this unusually high success rate as a result of very specific requirements for applications[24] and a pre-selection of only six eligible host institutions.

In the Irish PRTLI, the numbers in Table 2.4 have to be interpreted slightly differently since the selection procedure differs from the standard process sketched above. In the first phase, institutions can apply as host institutions for (possibly many) REI centres. In the second phase, institutions that are short-listed in the first phase can submit proposals for centres (or programmes, as they are called in PRTLI). In the scheme's most recent cycle, 14 out of 26 applying institutions were shortlisted. The numbers for PRTLI in Table 2.4 refer to the number of project proposals.[25]

Japan's WPI had only nine applicants and one selected unit in the 2010 call. The low numbers are due to the targeted call; in the thematically open call in 2007, five centres were chosen out of 33 applicants (roughly a 15% success rate). The low number of applications for the Norwegian CEER scheme is presumably also due to the relatively targeted call.

Responsibility for managing REIs

While REIs are initiated by national governments, the management of the selection process as well as the budgeted funds is frequently the responsibility of specialised public funding bodies. These bodies, often called "research councils", specialise in administering scientific and academic programmes of various types, of which REIs are usually only one. Consequently, although REIs are singled out as a separate type of funding in this report, they are usually components of a broader funding rationale, which is embodied in the programme portfolios administered by these agencies. A comprehensive understanding of REIs would require an analysis of their place in these funding portfolios, which is beyond the scope of this report. However, a few examples of the organisational integration of REIs are given to sketch various possibilities.

- *One agency, several REIs*: In Norway, all three REIs discussed in this report (CoE, CRI and CEER) are run by the Research Council of Norway, which has wide-ranging responsibilities for research funding in Norway. All three REIs form part of a designated sub-category of the Council's funding portfolio, called "centre schemes". In Japan, both the *Global COE* and the *WPI* scheme are run by the Japan Society for the Promotion of Science, although due to the different goals of the two, they are presented as belonging to distinct types of funding: Whereas the *Global COE* scheme is presented in a family of programmes called "Support for University Reform", the *WPI* scheme is in a solitary category named "Support for Establishing Top World-level Research Centres".

- *Several agencies, several REIs*: In Ireland, the CSET scheme is run by Science Foundation Ireland, which deals with the country's priority areas of research (biotechnology, information and communication technology, and sustainable energy and energy-efficient technologies). Ireland's more general REI, PRTLI, is administered by the Higher Education Authority, the general funding and advisory body for universities and other HEIs.
- *Several agencies, one REI*: In some cases, the launch of an REI gives rise to new co-operation among funding bodies. In Germany, both the German Research Foundation (mainly a science funding body) and the German Council for Science and Humanities (mainly an advisory body) are involved in managing the Excellence Initiative. The division of labour between the two is organised in terms of separate responsibilities for different funding lines. In Sweden, the SRA scheme is the result of co-operation by five organisations: the Swedish Research Council, the Swedish Energy Agency, the Swedish Council for Working Life and Social Research FAS, the Swedish Research Council Formas, and the Swedish Governmental Agency for Innovation Systems VINNOVA.[26] This shows that even if competitive research funding is decentralised, a central REI may still be established through collaboration by funding bodies.
- *REIs under direct supervision of the ministry*: In eastern Europe (Estonia, Poland, the Russian Federation, Slovenia) and in the German federal states of Thuringia and Hesse, the ministries in charge of the REIs do not delegate the task to a funding agency but appoint a programme committee to conduct the selection of centres directly.

Internal structure of REIs

REIs can be differentiated according to their administration but also their internal structure. They can be a stand-alone scheme with only one line of allocation; they can have several lines of funding; or they can be building blocks in a more comprehensive funding scheme.

REIs as stand-alone scheme with no sub-divisions

REIs in this category have a separate funding scheme with only one set of criteria and regulations applicants must adhere to. This is the most common type in the present survey and covers all REIs except those mentioned in the following two categories. Even if an REI is a "stand-alone" scheme, it is often just one element in a jurisdiction's overall research funding strategy.

REIs with several lines of funding

An REI might have several lines of funding, each serving a special purpose in reaching the REI's overall goal. Korea's WCU programme, for example, distinguishes three lines of funding, depending on whether foreign scholars are invited to Korea to establish a new academic department, to join an existing department as full-time faculty members, or as part-time members active in research and teaching.[27] Each of these lines of funding has different regulations concerning the amount and duration of funding, among other things.

The Austrian REI, COMET, has three funding lines. For K1 and K2, the centres are obliged to co-operate with research institutes and industry, but differ in terms of size and duration: K1 centres have a seven-year funding period, and the government contributes at most EUR 2.3 million a year; K2 funding is for ten years, and the annual contribution is at most EUR 7.5 million a year. The third line, K-Projects, supports the same type of co-operation as K1 and K2, but funding is on a smaller scale, and the potential for practical implementation is particularly important. Moreover, unlike K1 and K2 centres, K-Projects are not separate legal entities.

Germany's Excellence Initiative is sub-divided into a hierarchy along funding lines. The line of funding called Institutional Strategies is above the other two lines, so that inclusion in the other two funding lines is a precondition of eligibility for Institutional Strategies. The rationale is that to qualify for the best-endowed line of the REI, a university must first give proof of its excellence by succeeding in the first two.

Another form of hierarchy is found in the Portuguese Multi-Year Funding Programme. Research units that have been awarded excellence status can subsequently be named Associate Laboratories if they succeed in achieving sufficient critical mass to justify this status.

REIs integrated into more comprehensive funding schemes

REIs can be components of funding schemes. In Portugal, the Multi-Year Funding Programme, run by the Fundação para a Ciência e a Tecnologia (Foundation for Science and Technology), is linked to two other funding schemes. If an HEI succeeds in its application to the REI, it may apply for funds in the programmes CIENCIA 2007 (now called Investigador FCT) and WELCOME. Both of these programmes aim at attracting outstanding post-doctorates to Portuguese HEIs. The recruitment of excellent researchers, usually an integral part of an REI, is thus "delegated" from the REI to two separate programmes.

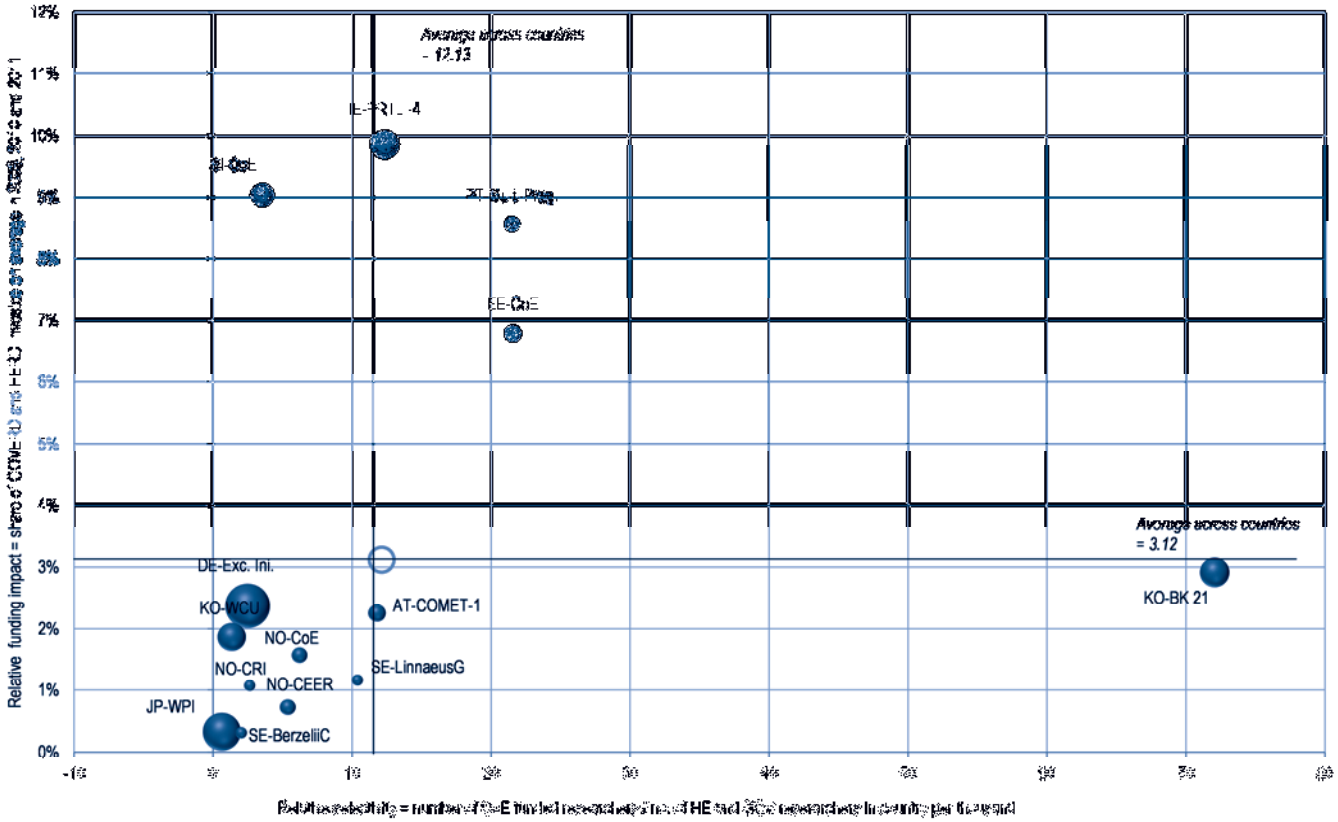
In some jurisdictions, REIs have more than one line of funding, only one of which would qualify as an REI based on the criteria applied in this report. For instance, the LOEWE scheme in Germany-Hesse has three lines of funding, but only the LOEWE Centres meets the definition of REIs, because the other two lines of funding, LOEWE Focuses and LOEWE Joint SME Projects, have three-year funding periods. The difference in the three lines of funding concerns the size of the research units (Focuses are generally smaller than Centres), and the kind of research conducted (Joint SME Projects focus on collaboration between HEIs/PRIs and firms). All three lines of funding seek to create and strengthen networks of research excellence.

In New Zealand, the CoRE scheme is an independently administrated programme, but it is complemented by measures to support excellent research: the New Zealand Performance Based Research Fund, the New Zealand Fellowships for Excellence and the New Zealand Marsden Fund. According to the ministry, these schemes were established separately, but are increasingly seen as a set of complementary initiatives with aligned policies.[28]

Slovenia's CoE scheme is related to an industry-oriented scheme called Competence Centres. According to the ministry, the latter is "complementary to that of the centres of excellence; together they constitute an autonomous whole in the area of research and development".[29]

Figure 2.7. Financial allocation for REI funding cycles and REI centres, share of government funding of R&D and selectivity

Size of bubbles represents max. funding per research unit in USD PPP 2011



Note: Matrix boundaries calculated based on average values for all countries. All monetary values in USD PPP. For each country the two-digit country code is supplemented with an abbreviation for the specific REI. Data unavailable for AU-ARC, DK-UNIK, DE-HE-LOEWE, DE-SA-Networks, DE-TH-Excel., IE-CSET, JP-GCOE, NL-BIS, NZ-CoRES, PL-KNOW, RU-NRU, SE-SRA, US-STC. See Annex 2.A1, Table 2A.1.2 for full funding data.

Source: OECD/RIHR questionnaire to government ministries: questions 4.1, 4.2, 8.2, authors' own calculations based on OECD data for HERD and GOVERD and number of researchers employed in public sector (higher education and government).

Relative financial importance and concentration of REIs

This section considers REIs as competitive and selective funding instruments designed to achieve excellence in research. Figure 2.7 cross-references their relative share of research funding with their selectivity (i.e. concentration) on the basis of the relative numbers of researchers. To calculate selectivity (horizontal axis), the number of selected centres is related to a size dimension for the national research system (as a denominator). The number of researchers in the funded centres in relation to the number in the national system as a whole is used as a proxy for size, since the latter could have been part of a centre. The number of researchers in a country is likely related to the number of possible centres. On this measure, the selectivity index of the South Korean Brain Korea 21 with 517 centres is 72% (i.e. 72% of all researchers receive funding via this REI) and that of Germany's Excellence Initiative with 85 centres it is 2.5%.

The index for the share of funding allocated via an REI (vertical axis) relates the annual expenditure on an REI to the total annual expenditure on R&D (i.e. HERD plus GOVERD). It shows that REIs account for more than 3.1% of government funding of R&D (i.e. HERD plus GOVERD) only in Estonia (CoE), Portugal (Multi-year funding programme), Slovenia (CoE) and Ireland (PRTLI-4).

The schemes that fund a relatively high number of centres are comparatively less selective funding instruments. Other REIs are much more selective (bottom left-hand quadrant), but account for relatively low shares of government R&D funding. The German Excellence Initiative is a highly selective funding instrument (horizontal axis) with a relatively high funding impact (vertical axis) and a large amount of annual funding per research unit (as shown by the size of the bubble – see also Annex 2.A1, Table 2A.1.2).

At the same time, it can be misleading to consider only direct REI funding when studying the financial situation of REI centres, given that many also attract considerable funds from other sources. For example, the Australian ARC Centres of Excellence draw on average only about a quarter of their resources from the scheme itself; the rest is secured from elsewhere. Similarly, the direct financial contribution of the Academy of Finland to their CoE centres was 12-16% in the funding period 2000-07, and for some centres, it was as low as 4% (Aksnes et al., 2012, p. 30ff.). These figures show that the scope of an REI cannot be measured solely in terms of funding from the scheme.

REIs and their role in political strategies

REIs pursue ambitious goals to which governments attach high strategic priority. For this reason the introduction of REIs is frequently tightly linked to broader national development goals in research and innovation. These more comprehensive goals are often defined in official innovation plans or similar communications. The following are specific examples taken from survey responses:

- The Australian government invested AUD 3 billion in R&D in 2001, later augmented by another AUD 5.1 billion. The underlying strategy, Backing Australia's Ability – Building our Future through Science and Innovation, included an increase in the budget for competitive excellence funding. The Australian Research Council's Centres of Excellence scheme came about as a result of this decision.

- The Danish UNIK initiative originated from the government strategy, Progress, Innovation and Cohesion – Strategy for Denmark in the Global Economy. This strategy was linked to a government statement (New Goals) that expressed the aim of becoming a leading knowledge society. UNIK, with its focus on creating top-level, internationally linked research environments at Danish universities, became a building block in this government scheme.
- The Japanese government's third Science and Technology Basic Plan of 2006 included plans to "promote the further enhancement of intensive investment under the principle of competition for organisations aiming to become the world's top-class research and education centres".[30] In support of those plans, the WPI scheme for creating globally visible research centres was launched in 2007.
- Poland's KNOW programme is part of a broader two-stage process of science and higher education reform started in 2008. After a set of funding and organisational transformations in the first stage, the Polish Ministry of Science and Higher Education launched KNOW to encourage the development of elite research centres.
- In 2005, the Slovenian government issued the National Research and Development Programme for 2006-10. The programme announced the development of centres of excellence in priority areas of research and technological development. The Centres of Excellence scheme was set up in 2009.
- In Germany-Thuringia, the REI ProExcellence is part of a government scheme called *Zukunftsinitiative Exzellentes Thüringen* (Future Initiative Excellent Thuringia), which includes a EUR 2.8 billion investment in R&D (2008-11). The ProExcellence scheme was designed by the Ministry of Education, Science and Culture in consultation with stakeholders from HEIs and PRIs.

Evaluations and experiences with REI

Assessment of performance

Most REI centres undergo evaluations at one or more points in their lifecycle. The most common arrangement is an interim evaluation. Mid-term evaluations mainly serve two purposes. First, they allow funding bodies to see whether the research projects described in the applications have progressed as planned or whether any deviations have occurred. Second, they are used to judge whether or not funding should continue. The relatively long lifecycles of REI centres explain the use of such evaluations even before the funding terminates. Some REIs also provide for the possibility of increased or decreased funding as a function of the centre's performance.

In some REIs, centres are required to provide annual progress reports. Among them are UNIK (Denmark), CoE (Finland), ProExcellence (Germany-Thuringia), Global COE and WPI (Japan), BK 21 and WCU (Korea), Centres of Excellence (Slovenia), SRA (Sweden) and STC (United States). UNIK and SRA also have mid-term evaluations. Mid-term evaluations are more elaborate than written reports and may include audits, reviews or site visits. In the Finnish CoE scheme, the annual reports are aggregated to form the mid-term and final reports.[31]

For the Swedish Linnaeus Grants and the Berzelii Centres, the timing of reviews is slightly different, with three evaluations during a ten-year funding period. The German Excellence Initiative does not have mid-term reviews. However, units funded in the first cycle of the REI were allowed to re-apply in the second cycle (under special conditions), and 70 out of 84 projects received a second five years of funding. In a sense, this second funding cycle resembled a mid-term review in an REI with ten-year funding periods.

REI evaluations can also have a specific focus. For instance, the Swedish Linnaeus environments undergo two evaluations. This first focuses on organisation, co-operation and leadership, and the second on scientific quality, added value, gender balance and communication aspects.

Modifications

An overview of changes that have taken place in existing REIs since their inception shows that there have been few fundamental modifications, and the reported changes are not easily categorised:

- Estonia, CoE: In the first cycle (2001-07), applications from individual research groups were allowed, while in the second cycle (2008-15) consortia of at least two groups were required, one of which assumes a co-ordinating function, while the other(s) is/are partner(s). Moreover, in the second funding cycle, the main funding source is EU Structural Funds, while in the first cycle they accounted for only 33.6% of the funds, while the rest were Estonian state funds.
- Finland, CoE: There were three main modifications in 2009: limits on the number of times a centre could re-apply for CoE funding were dropped; centres were allowed to apply for other funding grants from the Academy of Finland in the second half of their funding period; and basic funding for CoEs was increased, possibly resulting in a decrease in the overall number of CoEs.
- Germany, Excellence Initiative: For the second funding cycle (2012-17), a few minor changes in the regulations were adopted, most of them pertaining to financing rules. For example, set amounts of funding per centre were replaced by funding bands. Research-oriented teaching was introduced as a new selection criterion in the third line of funding (Institutional Strategies) following criticism that research might outshine teaching performance (Keller 2008, p. 9).
- Germany/Saxony Anhalt, Networks of Scientific Excellence: Centres are now required to raise EU funds as an additional funding source because the government will not be able to maintain long-term funding for REI centres.
- Germany/Thuringia, ProExcellence: The ministry is planning changes that will result in stronger concentration of research capacities.
- Korea, BK 21: The requirement of co-funding of centres by host institutions was dropped in 2009.
- Netherlands, BIS: A new call will be launched in 2013, and different fields of science will compete separately, whereas in the first round of the scheme, all fields took part in a single competition. The aim is greater diversity of applicants. Until now, the scheme has only had centres in natural and life sciences.

- Norway, CoE: In the first phase of the scheme, thematic priorities were set in the calls for applications. This approach was later replaced by open calls, and thematic focus was transferred to the CRI and CEER schemes.
- Portugal, Multi-Year Funding Programme: Future calls will put more emphasis on strategic planning of centres and a detailed budget for each research objective. Also, leverage effects with respect to possibilities of raising international competitive funds, e.g. EU grants, will receive more attention.

Termination of REIs

Some REIs are presently in their final phase or have recently been terminated.

- The Danish UNIK scheme ended in 2012. The Danish Agency for Science, Technology and Innovation sees further funding of research excellence as a continuing task of the Danish National Research Foundation, which has been running a scheme called Centres of Excellence since 1993.
- Science Foundation Ireland decided to merge CSET and a similar initiative, Strategic Research Clusters, into a single scheme, called SFI Centres Programme. The scheme will cover 14 national priority areas. The merging of the schemes and their more pronounced thematic outlook is reported to result from the need to consolidate and focus national funding.
- While the current cycle of the Irish PRTLI scheme is likely to run until 2017, to date there has been no decision to initiate a sixth cycle.
- The Korean BK 21 programme was terminated after the second six-year funding period ended in 2012. The ministry plans to introduce a block grant funding system for universities. The WCU programme will end in 2013, and a follow-up scheme is presently under discussion.

System evaluations

When discussing evaluations, a distinction should be made between the evaluation of research centres funded by the REI and the evaluation of the funding scheme itself. Although the two are related, the latter usually includes questions about the REI's impact on the national science system, and possibly the "added value" of the REI as compared to other modes of funding. For the REIs discussed here, such evaluations have been less frequent than evaluations of individual centres, which are often an obligatory aspect of the scheme. Moreover, many REIs have not been running long enough for comprehensive long-term evaluations. Nevertheless, several countries reported having conducted (interim) evaluations of their REIs. Table 2.5 provides an overview of the survey responses.

Table 2.5. REI system evaluations

Country	REI	Comment
Denmark	UNIK	An expert panel produces annual reports on the performance of the centres and the wider effects of the REI on the research system.
Finland	CoE	Evaluations of the CoE programme are carried out with a specific thematic focus. The most recent evaluation focused on the societal impacts of the CoE programmes in 2000-05 and 2002-07.
Germany	Excellence Initiative	Commissioned by the German Research Foundation (DFG), the Institute for Research Information and Quality Assurance (iFQ) implemented a monitoring system that estimates both the intended and unintended effects of the REI on the basis of quantitative and qualitative empirical data. An evaluation report based on these data was written in 2008. A report on the second funding cycle is scheduled for 2015. A systematic evaluation of the REI by international experts will take place in 2016.
Germany – Hesse	LOEWE	The REI was evaluated by the German Research Council in 2012.
Germany – Saxony-Anhalt	Networks of scientific excellence	An evaluation of the REI system was carried out by the Wissenschaftszentrum Sachsen-Anhalt (Science Centre Saxony-Anhalt, WZW).
Ireland	CSET	The REI was assessed in 2008, and another evaluation was carried out in 2012. The results of the evaluation were used to inform policy.
	PRTLI	An impact assessment of funding cycles 1-3 was conducted by PA Consulting for the Irish Higher Education Authority in 2011. The report focuses on the direct commercial and economic impacts of the scheme.
Japan	WPI	Policy evaluations are conducted every year.
Netherlands	BIS	In 2010, the Royal Netherlands Academy of Arts and Sciences (KNAW) reviewed the REI as a whole.
Norway	CoE	The REI was evaluated by the Nordic Institute for Studies in Innovation, Research and Education (NIFU) in 2010.
United States	STC	In 2010, the American Association for the Advancement of Science (AAAS) produced a review of the STC programme (2000-09).

Source: OECD/RIHR questionnaire to government ministries, Q5.4: Has the REI funding system as a whole been evaluated? (please describe).

The respondents were also asked to provide an assessment of whether the national REI(s) had achieved its (their) goals. Overall, 22 REIs were reported to have achieved their goals. For a further six it was too early to tell. No respondents answered that goals were not achieved. The following summarises answers from ministries that discussed goal achievement and wider effects of REIs:

- Denmark, UNIK: The REI has led to a new culture of collaboration within host universities, but also with national and international network partners. The UNIK universities have strengthened their international competitiveness, e.g. through infrastructure improvements supported by the REI. UNIK centres had an influence on policy deliberations leading up to the European Union's eighth Framework Programme on Research and Technological Development, Horizon 2020.
- Estonia, CoE: The REI has helped to improve the competitiveness of Estonian R&D, as shown by growing success in competitive applications to the EU's research funding programmes.

- Finland, CoE: The development of creative research and researcher training environments has progressed greatly. The accumulated knowledge and know-how of funded centres has disseminated into the national research system. The scheme has promoted the development of priority areas in HEIs.
- Germany, Excellence Initiative: The research output of REI-funded centres has increased significantly in quantitative and qualitative terms. Knowledge transfer to industrial and medical applications has been successful. The REI's Graduate Schools are setting standards for recruiting, supervision and study planning. New paths of academic qualification have opened up. Inter-institutional co-operation that was previously not practicable has been established. Universities have furthered their structural modernisation.
- Germany/Saxony-Anhalt, Networks of Scientific Excellence: Research quality has improved in various respects, and collaboration between researchers and between research projects has increased and resulted in more concentration of research and innovation capacity. Internationally visible research environments have been successfully established.
- Germany/Thuringia, ProExcellence: New and productive research structures have been created. Novel interdisciplinary approaches have been adopted and have a positive effect on science, teaching and economic development. Universities and research facilities are able to compete for competitive national and European funds. Young researchers supported through the REI have performed particularly well.
- Ireland, CSET: Along with similarly structured schemes run by Science Foundation Ireland, CSET has increased interaction between academics and industry and the attractiveness of Irish universities as research partners. The scheme has improved the reputation of the Irish research base and increased Ireland's attractiveness as a location for industrial R&D. In host institutions, CSET has instigated an increased emphasis on research strategy, management, collaboration and commercialisation in both strategic and administrative terms.
- Ireland, PRTLI: The scheme has led increased research outcomes (publications, citations, etc.). The increase in human capital for research is dispersing through industry and the public sector. HEIs now have a more strategic and planned approach to the long-term development of their research capabilities. The quality and relevance of graduate output and skills at all levels have been enhanced. High-quality infrastructure and capacity support for outstandingly talented researchers and teams within institutions are now in place. More co-operation by researchers within and between institutions, including inter-institutional co-operation, now exists. Significant private and international funding has been leveraged as a result of PRTLI.
- Japan, Global COE/WPI: Training of doctoral candidates has been improved. Centres have closed the gap on the world's best research environments, as shown by international third-party funding, applications for positions in centres from around the world, and publications of the highest quality.
- Korea, BK21/WCU: Early-stage research has been fostered, research quality has improved, and better linkages with industry have been established. International collaborative research has been strengthened, and the international visibility of Korean universities has increased.

- Netherlands, BIS: The scheme has led to a higher concentration of top researchers in BIS centres and better research output.
- New Zealand, CoRE: There have been improvements in research quality, as measured by outputs such as citation rates and postgraduate completion rates or external research income. Host institutions have raised research quality through clearer funding incentives.
- Norway, CoE/CRI/CEER: The CoE scheme has been particularly successful in terms of promoting researcher recruitment, strengthening the internationalisation of Norwegian research and, for CoE and CRI, creating networks through national and interdisciplinary collaboration. The competitive nature of all three REIs has helped to raise the standards of research in general. The schemes have led to a stronger focus on scientific leadership and strategies. Both CRI and CEER have increased academy-industry partnerships. CRI has encouraged application-oriented research that has benefited supporting industries and organisations in the public sector by providing innovative ideas for enhancement of processes and product development.
- Portugal, Multi-Year Funding Programme: Increased research quality and quantity throughout the Portuguese research system, as measured by the number of publications, are assumed to be linked to the REI and the programmes associated with it.
- Slovenia, Centres of Excellence: The scheme has improved capacity for support to young researchers. Concentration and specialisation have been successfully initiated.
- Sweden: An exhaustive study of effects of the Swedish REIs has yet to be carried out, but in view of earlier experiences with similar funding schemes, REIs are expected to contribute significantly to new approaches to interdisciplinary and innovative research, to closer academia-industry relationships, and to new and effective forms of leadership. An evaluation of the Berzelii Centres has revealed numerous strengths characteristic of the scheme, e.g. coherent basic and applied research strategies aligned with the vision and mission of the centres, successful development of young researchers, transfer of research outcomes, and collaboration between disciplines and between universities and the business sector.
- United States, STC: The centres have encouraged the development of new technologies, new instrumentation, and new approaches to pressing societal challenges; have resulted in broader collaboration; and have an excellent record in producing new master's and PhD students.

In sum from the point of view of most ministries and funding bodies, REIs have had an overwhelmingly positive effect. It is worth noting that these stakeholders assess the success of REIs not only in terms of immediate scientific outputs (e.g. publications), but also, and very prominently, in terms of the centres' contribution to linkages between disciplines, institutions and sectors. This suggests that besides their support to selected research units, REIs are as important drivers of collaboration and horizontal linking.

When asked about the unintended effects of REI(s), respondents reported positive experiences for the most part, e.g. improvements in strategic management in HEIs, or unexpected but fruitful forms of co-operation. Two respondents reported an unintended effect which they considered rather negative, i.e. the fact that some disciplines were

overrepresented in the final selection when compared to the range of eligible fields. In these cases the natural and life sciences appear to have met the application requirements better than other fields. In one case it was noted that requirements for the host institution to contribute funds to the REI centre(s) might come at the expense of other research projects or groups that would deserve funding from their institution but are not involved in an REI scheme.

Summary

This chapter has presented the results of a survey to government agencies responsible for administering research excellence initiative (REI) funding for higher education and public research institutions. The data show that in OECD countries REIs are now widely used as a funding instrument; two-thirds of OECD countries now operate such schemes.[32]

They are a special type of government programme. Their programmatic nature is defined by their objective: REIs aim to raise the international reputation of domestic research institutions. The general strategy to reach this goal is to fund large, stable and well-equipped structures that cross established institutional, disciplinary, sectoral and national borders. The structures are established through a competitive, science-driven selection process in which excellence is the main criterion. Host and partner institutions are challenged to define and adjust their profiles in line with their opportunities to benefit from REI funding. In addition to funding research activities strictly speaking, REIs support a host of research-related measures, such as the improvement or extension of physical infrastructure, the recruitment of outstanding researchers from abroad, and structured training of early-stage researchers. The precise focus of REIs often reflects the political priorities defined in national innovation strategies.

Ministries and responsible public funding bodies view REIs positively. The objectives of these programmes are largely reported to have been achieved. Among other things, new lines of research have opened up, new patterns of interdisciplinary research have been established, the development of human capital has been strengthened, and concentration processes have generally led to enhanced research capacities. In some countries, these results are supported by systematic evaluations of research centres funded by REIs.

Notes

1. At the Fourth meeting of the working party on Research Institutions and Public Research (RIHR) on 26-27 April 2012, delegates agreed that long-term funding should be defined as four years or more for the study.
2. In rare cases, calls for specific disciplines or subject areas are not made in the same year. If these discipline-specific calls are separated by at least two years, the respective measures are still included under this criterion.
3. At the Fourth RIHR meeting on 26-27 April 2012, delegates agreed that a precise funding figure should not be set until the final analysis was undertaken. This was to ensure that smaller countries with less funds for REIs would not be excluded from the study. Therefore, the definition used in the questionnaires stated that "substantially more funds are provided than individual project-based funding".
4. The project steering group was made up of nominated delegates and county experts.
5. www.aka.fi/Tiedostot/Hakuilmoitukset/Hakuilmoitus_syyskuu_2012_en.pdf, p. 53, accessed 20 February 2013.
6. Not all respondents answered all questionnaire items, so that the sum of all answers for any given item is usually lower than the sum of all REIs described here.
7. http,//bnc.krf.or.kr/home/eng/bk21/aboutbk21.jsp, accessed 20 February 2013.
8. http,//english.mest.go.kr/web/40724/en/board/endownload.do?boardSeq=40730, p. 16, accessed 20 February 2013.
9. Ministry of Education, Science and Technology Republic of Korea (undated).
10. http,//erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/si/supportmeasure/support__mig_0002, accessed 20 February 2013.
11. www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf& blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3DCEERFMEeng.pdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1274460395912&ssbinary=true, p. 8, accessed 22 February 2013.
12. www.tec.govt.nz/Documents/Forms%20Templates%20and%20Guides/cores-selection-process.pdf, p. 1, accessed 21 February 2013.
13. "A Boost to Research and Innovation - A summary of Government Bill 2008/09,50", available at www.regeringen.se/download/d9e23a41.pdf?major=1&minor=130765&cn=attachmentPublDuplicator_0_attachment, accessed 21 February 2013.
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18. Ministry of Education, Science and Technology, Korea (undated), p. 9f., accessed 20 February 2013; Australia, www.arc.gov.au/ncgp/ce/ selection_report11.htm#3, accessed 20 February 2013.

19. www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf& blobheadernam e1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3DSFI-Informasjontils%C3%B8kere-engelsk-21102009.pdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1274460443833&ssbinary=true, p. 7, accessed 20 February 2013.

20. http,//en.fi.dk/research/unik/expericence-gathering-2010/UNIK%20experience%20gathering%202010%20-DOK1288019.pdf, p. 3, accessed 20 February 2013.

21. www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf& blobheadernam e1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3DSFI-Informasjontils%C3%B8kere-engelsk-21102009.pdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1274460443833&ssbinary=true, p. 6, accessed 20 February 2013.

22. New Zealand's *CoRE* explicitly states this aspect,. www.tec.govt.nz/Documents/Forms%20Templates%20and%20Guides/cores-selection-process.pdf, p. 4, accessed 20 February 2013.

23. Available at www.jsps.go.jp/english/e-globalcoe/04_selection.html (viewed 20 March 2013).

24. The Polish respondent also mentioned this as an explanation for the relatively low number of applications to KNOW (25).

25. The Canadian REI Canada Excellence Research Chairs (CERC) has a similar feature, in the first stage of the selection process, institutions submit proposals. They are then shortlisted and may nominate "excellence chairholders", i.e. world-famous scholars that will build up research groups at the host institutions.

26. www.vr.se/mainmenu/pressandnews/newsarchive/news2009/recommendationsforthefundingofstrategicresearchareasnowcomplete.5.3b26f940121ecde8aa480006516.html, accessed 20 February 2013.

27. Ministry of Education, Science and Technology Republic of Korea (undated), pp. 6-8.

28. Another instance of an REI embedded in a comprehensive funding approach is the French *Initiatives d'Excellence*. It is nested in the scientific branch of a major state initiative called *Investissements d'Avenir*., which has a complex structure, with sub-programmes for curiosity-driven research, national priority areas, and infrastructure.

29. www.arhiv.mvzt.gov.si/en/areas_of_work/science_and_technology/centres_of_excellence_and_competence_centres/, accessed 7 March 2013.

30. http://www8.cao.go.jp/cstp/english/basic/3rd-BasicPlan_06-10.pdfm, p. 36, accessed 20 February 2013.

31. www.aka.fi/en-GB/A/Programmes-and-cooperation/Centres-of-Excellence-/Reporting-by-CoEs/, accessed 20 February 2013.

32. REIs are also a popular funding instrument in non-OECD economies; see Salmi (2009, pp. 85ff.), which lists REIs in China and Chinese Taipei.

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Annex 2.A1
Additional tables

Table 2A.1. Funding schemes reported by ministries but not included in this document

Country	Name of scheme	Reason for exclusion
Australia	NHMRC Centres of Research Excellence	Funding per centre lower than 1 million USD a year; calls for applications more frequently than every two years
	NHMRC John Cade Fellowship in Mental Health Research	Funding is for individuals
	NHMRC Programme Grants	Calls for applications more frequently than every two years
Austria	Christian Doppler Laboratories	No fixed time frames for application procedure
	Laura Bassi Centres of Expertise	Funding per centre lower than 1 million USD a year
	Institute of Science and Technology Austria (IST)	An institute, not a funding programme
	Special Research Programmes (SFB)	Calls for applications more frequent than every two years
	Wittgenstein Award	Funding is for individuals
	START Award	Funding is for individuals
Germany / Berlin	Einstein-Foundation Berlin	No application procedure in a fixed time frame / funding for individuals
Germany / Bavaria	Elite Network of Bavaria	Funding per centre lower than 1 million USD a year
Germany / Rhineland-Palatine	Centres of Excellence	Funds are provided as part of obligatory target agreements with HEIs
	Additional funds for top researchers	Funding is for individuals
Ireland	Principal Investigator Programme	Funding is for individuals
	Strategic Research Clusters	Too little information provided
	Health Research Centres	Too little information provided
	Technology Centres Programme	Primary addressees are firms, not HEIs
	Irish Clinical Oncology Research Group (ICORG)	Funding periods are shorter than four years
Italy	University Research Excellence Centres Initiative (2000-2006)	Funding periods are shorter than four years
Korea	Institute for Basic Science (IBS)	An institute, not a funding programme
New Zealand	New Zealand Performance Based Research Fund (PBRF)	Element of core funding based on ex-post performance metrics
	New Zealand Fellowships for Excellence	Funding is for individuals
	New Zealand Marsden Fund	Funding is for individuals and their teams
Portugal	CIENCIA 2007	Funding is for individuals
	WELCOME	Funding is for individuals
Sweden	VINN Excellence Centres	Funding per centre lower than 1 million USD a year
United States	Research Centres / National Institutes of Health / National Cancer Institute (NIH/NCI)	Too little information provided
	Energy Frontier Research Centres (EFRC), Department of Energy	Too little information provided

Table 2A.1.2. Financial allocation to REI funding cycles and REI-funded research units

Country	Name of REI	Time period of cycle	Funding of cycle		Maximum funding for individual research unit / centre per year		National currency	Maximum funding period for individual research unit / centre
			USD PPP millions	National currency millions	USD PPP millions	National currency millions		
Australia	ARC Centres of Excellence	2011 - 17	171.4	255.9	2.68	4.0	Australian Dollar (AUD)	7 years
Austria	COMET	2008 - 19	903.7	765.0	2.72	2.3	Euro (EUR)	K1, 7 years
Austria					8.86	7.5		K2, 10 years
Denmark	UNIK	2009 - 13	61.1	480.0	3.05	24.0	Danish Kroner (DKK)	5 years
Estonia	Development of Centres of Excellence	2008 - 15	84.6	45.8	2.03	1.1	Euro (EUR)	7 years
Finland	CoE	2008 - 13	60.0	56.3	Based on individual negotiations	Based on individual negotiations	Euro (EUR)	6 years
Germany	Excellence Initiative (national)	2005 - 17	5 726.4	4 600.0	17.93	14.4	Euro (EUR)	5 years
Germany	LOEWE (Hesse)	2009 - 13	510.4	410.0	9.96	8.0	Euro (EUR)	6 years
Germany	Networks of scientific excellence (Saxony-Anhalt)	2006 - 10	124.5	100.0	5.10	4.1	Euro (EUR)	5 years
Germany		2012	23.2	18.6				
Germany		2013	25.3	20.3				
Germany		2014-15	12.4	10.0				
Germany	ProExcellence (Thuringia)	2008 - 13	62.6	50.3	1.24	1.0	Euro (EUR)	5 years
Ireland	PRTLI	2007 - 13	311.7	260.7	6.52	5.5	Euro (EUR)	6 years
Ireland		2011 - 17	427.6	357.7	15.10	12.6		
Ireland	CSET	2003 - 12	294.1	246.0	1.20	1.0	Euro (EUR)	10 years
Japan	GCOE	2007 - 12	218.00	23700.00	1.56	169.29	Japanese Yen (JPY)	5 years
Japan	WPI	2007 - 12	386.0	42 000.0	12.87	1 400.0	Japanese Yen (JPY)	15 years
Korea	BK21	2006 - 12	2 156.0	1 796 000.0	7.80	6 496.9	Korean Won (KRW)	7 years
Korea	WCU	2008 - 13	990.4	825 000.0	7.20	6 000.0	Korean Won (KRW)	5 years
Netherlands	BIS	2009 - 13	148.3	125.0	No maximum set	No maximum set	Euro (EUR)	No maximum set
New Zealand	CoRES	2008-2014	140.4	208.0	5.29	7.8	New Zealand Dollar (NZD)	6 years
Norway	CoE (SFF)	2003 - 12	170.4	1 550.0	2.20	20.0	Norwegian Kroner (NOK)	10 years
		2007 - 16	88.0	800.0				
Norway	CRI (SFI)	2006 - 15	123.1	1 120.0	1.10	10.0	Norwegian Kroner (NOK)	8 years
		2011 - 19	52.8	480.0				
Norway	CEER (FME)	2009 - 18	132.8	1 208.0	2.20	20.0	Norwegian Kroner (NOK)	8 years

Country	Name of REI	Time period of cycle	Funding of cycle		Maximum funding for individual research unit / centre per year		National currency	Maximum funding period for individual research unit / centre
			USD PPP millions	National currency millions	USD PPP millions	National currency millions		
Poland	KNOW	2012 - 17	32.0	60.0	5.33	10.0	Polish Zloty (PLN)	5 years
Portugal	Multi-year Funding Programme	2008 - 12	260.9	165.2	1.58	1.0	Euro (EUR)	5 years
Russian Federation	NRU	2009 - 14	5 729.6	99 800.0	10.33	180.0	Russian Rouble (RUB)	10 years
Slovenia	Centres of Excellence	2009 - 13	120.3	77.5	3.88	2.5	Euro (EUR)	4 years
Sweden	SRA	2010 - 14	589.8	5 270.0	No upper limit	No upper limit	Swedish Krona (SEK)	5 years
Sweden	Linnaeus Grants	2006 - 16	156.7	1 400.0	1.12	10.0	Swedish Krona (SEK)	10 years
Sweden		2008 - 18	156.7	1 400.0				
Sweden	Berzelii Centres	2005 - 14	19.0	170.0	1.12	10.0	Swedish Krona (SEK)	10 years
United States	STC	2005 - 12	480.0	480.0	5.00	5.0	-	5 years

Source: OECD/RIHR questionnaire to government ministries, year of reference 2011, questions 4.1, 4.2, 8.2, authors' calculations based on OECD data for USD PPP 2011.

Chapter 3

Research excellence initiatives and centres of excellence

This chapter describes the basic characteristics of centres of excellence (CoEs) funded through research excellence initiatives (REIs) in 14 OECD countries. The analysis is based on quantitative and qualitative information collected by the OECD/RIHR survey to CoEs. It presents results on funding schemes and cycles, research fields, the age profile of CoEs, researchers and the mechanisms to create networks and foster interdisciplinary research. The information and results are also disaggregated by the size of CoEs in order to compare the characteristics of CoEs funded with different intensities. The chapter also examines the management structures between host institutions and CoEs, the reasons for a CoE to pursue interdisciplinary research, the impact of CoE research, and the value of REIs.

Introduction

This chapter discusses the results of an exploratory survey of centres of excellence (CoEs) conducted by the OECD Working Party on Research Institutes and Human Resources (RIHR). The survey covered various aspects of the CoEs' activities, such as management structure, funding schemes, measurement of impact and sustainability, co-operation with the public and private sectors, and the perceived long-term effects of the research carried out.

The survey, and the results discussed here, focused on activities funded through a research excellence initiative (REI). All centres funded through a national REI programme[1] have been defined as CoEs in this study. The questionnaires were sent either to the directors or to high-level staff of CoEs that were, at the time (2011), funded by national REIs (see Chapter 1). As response rates varied greatly among countries, it is difficult to make cross-country comparisons. The results are therefore provided as averages for the whole sample. When possible, the analysis is also presented by splitting the sample into different dimensions (size of the CoEs' research budget, age of the CoE, primary field of research, etc.) so as to provide more interesting and meaningful information for policy-making purposes.

The analysis presented here is based on the research centres' replies to the survey. It is important to stress that the information collected is not representative of the overall population of CoEs in each OECD member country.[2] Moreover, in some cases, respondents provided partial information, by replying only to some of the questions in the questionnaire. This can create difficulties for comparing the results of specific questions with different response rates. As the number of respondents differs from question to question, so does the size of the sample on which the average values are computed; comparisons across different items are therefore not always straightforward. In addition, the information on smaller subsamples (e.g. when comparing average funding of CoEs in different research fields covered by the survey) should be interpreted with some caution, as the analysis may be based on a limited number of data points for each category or research field.

Data source and methodology

The OECD/RIHR survey to CoEs was mainly based on multiple-choice questions. However, it also included fields for optional comments, and this chapter draws on both the quantitative and qualitative data provided. In some instances it refers to specific examples from the case studies presented in Part II, Chapters 5 to 10.

Coverage

A total of 304 centres in 14 OECD member countries responded to the survey. However, some of the centres were not associated and funded through an REI programme as defined in this study. As described in Chapter 1, the seven criteria used to identify REIs are as follows:

- government-level funding of selected research units and institutions
- exceptional quality in research and research-related activities
- long-term funding (a minimum of four years)

- funds are competitive and are distributed on the basis of peer-reviewed applications
- applicants are required to participate in selection processes with fixed time frames
- institutions or research units (instead of individuals) apply for the funds as a collective body
- funding is substantially larger than for individual project-based funding (a general lower limit of USD 1 million a year per centre).

Of the 304 centres responding to the survey, 258 were matched with a REI programme and categorised as a CoE in this study.[3] In some cases, responses that did not fit the definition used to classify a centre as a CoE are analysed in a separate box in this Chapter (Boxes 3.1 and 3.3), as the information provides comparative information for policy makers.

Sample size and groupings

The number of CoEs providing information in each of the 14 responding OECD members differs widely. Table 3.1 shows the number of CoEs responding in each country and their relative weight in the final sample(s) used for the analysis.

Around 42% of the CoEs analysed are based in Japan, followed by 15% in Germany and Portugal. The countries that are least represented in the overall sample are Estonia, Finland, Korea and Poland.

Table 3.1. Distribution of CoEs across participating OECD countries

Country	Number of CoEs	% CoEs	Number of CoEsLB (funding more than USD 1 million per year)	% CoEsLB	Number of CoEsSB (funding less than or equal to USD 1 million per year)	% CoEsSB
Austria	14	5.4	13	7.0		
Denmark	4	1.6	4	2.2		
Estonia	3	1.2	1	0.5		
Finland	3	1.2	1	0.5	2	4.1
Germany	39	15.1	34	18.4	1	2.0
Ireland	8	3.1	3	1.6	2	4.1
Japan	108	41.9	87	47.0	19	38.8
Korea	1	0.4	1	0.5		
Netherlands	2	0.8	2	1.1		
Norway	26	10.1	17	9.2	6	12.2
Poland	1	0.4	1	0.5		
Portugal	39	15.1	11	6.0	19	38.8
Slovenia	5	1.9	5	2.7		
United States	5	1.9	5	2.7		
Total	**258**	**100**	**185**	**100**	**49**	**100**

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Of the 258 centres associated with an REI programme, 234 provided self-reported information on their total funding per year: 185 CoEs reported funding above USD 1 million (PPP) per year and have been categorised as CoEs with larger budgets (CoEsLB), while 49 reported less than USD 1 million (PPP) per year and have been categorised as CoEs with smaller budgets (CoEsSB).[4] Around 47% of the CoEsLB are in Japan, followed by 18% in Germany and around 9% in Norway.[5] Around 39% of CoEsSB are in Japan and Portugal, followed by around 12% in Norway.

Given that the overall size of the research budget available to centres is a critical dimension for achieving excellence, the results for CoEsLB and CoEsSB are systematically compared to the whole sample to investigate whether differences in their behaviour can be observed. However, the data on funding per year were collected through the OECD/RIHR questionnaire to CoE, and these figures need to be interpreted with caution since some respondents provided only estimates of the total amount of funding received through national funding schemes or REIs.[6] When possible, these results are also presented by splitting the sample into categories of respondents classified along other dimensions such as age or length of the funding cycle.

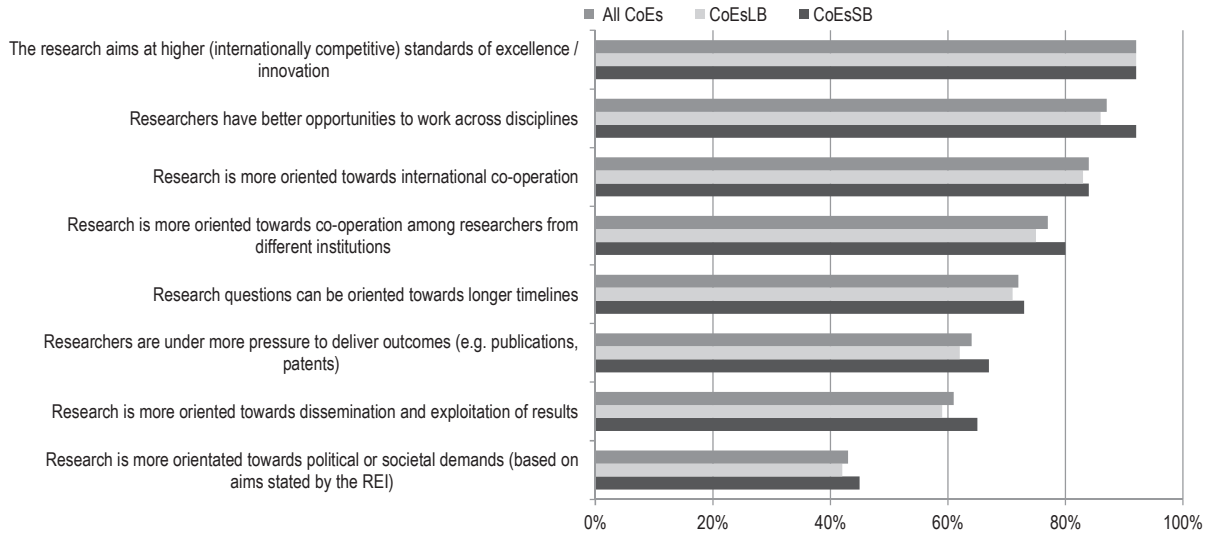
Basic characteristics of CoEs

Innovation is a crucial driver of productivity and economic prosperity, and scientific research is a key component of innovation. Therefore, understanding how scientific research is carried out, managed and funded is fundamental for science policy. REIs and CoEs represent a novel way of funding and managing research activities, as they explicitly aim to foster excellence in research and produce large effects on society and economies. The following section analyses the ways in which CoEs differ in their objectives with respect to other research centres, the way funding is allocated, researchers co-operate, fields of science are intertwined and resources as well as human capital are managed.

Research objectives

CoEs are entities with research objectives that differ in nature from those of other research institutions. They were asked how their research differs from that undertaken in other institutional settings. Replies stressed the higher quality of the research (as opposed to that of other research centres), which must meet international standards of excellence and innovation (92% of CoEs). Another important difference perceived as being intrinsic to CoEs' activities is the promotion of co-operative research across disciplines (87% of the CoE sample) in order to produce innovative outcomes by involving different scientific paradigms, methodologies and sets of knowledge in the research effort. Some 84% of respondents mentioned that CoEs are more oriented towards international co-operation, again a means of sharing knowledge and innovating by drawing on a variety of scientific paradigms and scientific personnel with different backgrounds. No significant differences between CoEsLB and CoEsSB are observed with regard to their main research objectives (Figure 3.1).

Figure 3.1. Specificity of CoEs research



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Some respondents described other distinguishing features of CoE research in the free text field. A number mentioned that the CoE enabled them to collaborate successfully on Seventh Framework Programme (FP7) research activities, while others noted that the orientation and intensity of their research had changed (e.g. more risky and/or inter-disciplinary research, better exploitation of results). As mentioned, REIs fund excellence in research through longer (than usual) funding schemes. In confirmation, one CoE mentioned that it focuses on basic research and that the industrial exploitation of its research results were not expected in the next five to ten years, a time lag that can be difficult to justify in other research settings. Another respondent mentioned that it was important not to overemphasise international standards of excellence when analysing CoEs because a lot of research in the humanities field is closely linked to national issues.

Funding in CoEs

The availability of research funds is a crucial aspect of the functioning of research centres. The CoEs considered in this study are, by definition, generously funded (Table 3.2). This is due to the fact, as mentioned in Chapter 2, that the research they carry out has ambitious goals (e.g. promoting scientific breakthroughs, fostering novel scientific approaches, as well as building solid research networks) which require more funding than many other research initiatives. The average annual funding of the CoEs examined in this study (for which self-reported information was around USD 2.6 million in PPP (with a minimum of around USD 81 000 and a maximum of around USD 26 million) while the median funding per year is around USD 1.8 million. The CoEs are very different with respect to the size of their research budget, which strengthens the case for disaggregation in order to capture possible differences across CoEs. The average annual funding of the 185 CoEsLB is by definition larger, around USD 3.2 million, while the 49 CoEsSB have funding, on average, of USD 470 000.

Table 3.2. CoEs' funding per year (2011 or nearest available year)

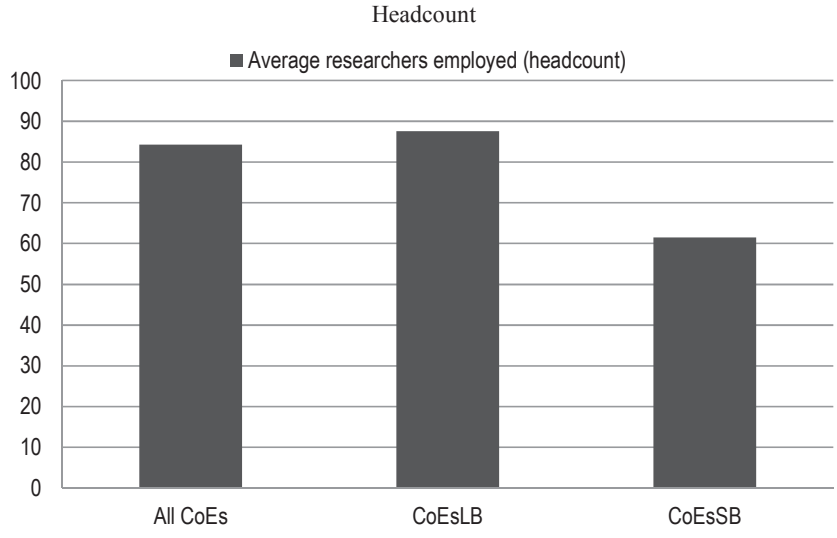
	Average USD (PPP)	Minimum USD (PPP)	Maximum USD (PPP)	Median USD (PPP)
All CoEs	2 636 691	81 139	26 000 000	1 840 463
CoEsLB	3 210 744	1 021 943	26 000 000	2 199 064
CoEsSB	469 348	81 139	957 260	398 483

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Researchers: Average size of teams

In addition to significant funding, CoEs also need an adequate number of researchers to create the critical mass necessary to achieve important scientific breakthroughs. The funding provided by REIs usually includes resources not only to attract and hire highly qualified researchers on both the national and international job markets but also to create large research groups to work on human-resource-intensive and innovative projects. The available data indicate that the average research team at CoEs has around 84 researchers (87 on average for CoEsLB) while the research teams at CoEsSB are on average smaller and have around 61 scientists (headcount) (Figure 3.2).[7]

Figure 3.2. Average size of research teams



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Age profile of centres

The available survey data also show that the ages of the centres differ. The average age of the CoEs in the current study is approximately seven years. The average age of CoEsLB is six years while CoEsSB are on average older than nine years. [8]

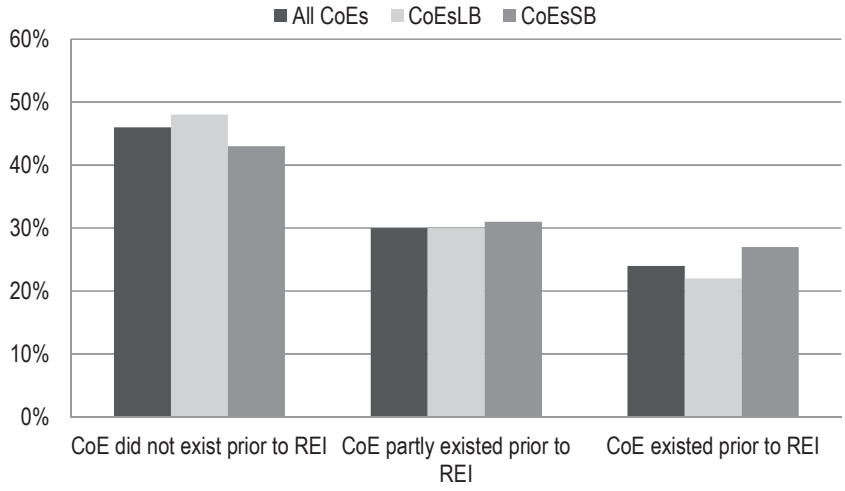
Table 3.3. CoEs' average age

	Average age (years)
All CoEs	7.2
CoEsLB	6.0
CoEsSB	9.8

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

A possible explanation for the difference in the age profiles across CoEsLB and CoEsSB may be found in the link between the establishment of a CoE and the existence of an REI to support it. Almost 46% of CoEs were tightly linked to the pre-existence of an REI programme and were formed as a direct result of an REI's call for proposals. Around 30% had only a limited existence prior to the application for funding to an REI (Figure 3.3). Some 24% of the CoEs represented here existed before applying for funding to the REI but they have benefited from additional funds provided by the REI more recently. Around 27% of older CoEsSB were established before the existence of the REI as opposed to 22% of the younger CoEsLB that seem to rely more intensively on the pre-existence of an REI for their establishment. These differences are however slight.

Figure 3.3. REIs and the establishment of CoEs



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Funding cycles

It is commonly argued that REIs that support CoEs should provide longer funding cycles than other forms of funding (e.g. project funding) in view of the goals pursued by CoEs and the complexity of their research projects. The available data support this argument. The average funding period for CoEs is around 6 years and stretches up to a maximum of 15 years. There are differences in the available funding per year in terms of the funding cycles. The average funding per year of CoEs with shorter funding cycles (less than or equal to 6 years) is around USD 2.3 million while that of CoEs with longer funding cycles (more than 6 years) is substantially larger and around USD 3.7 million (Table 3.4).

Table 3.4. Funding per year and funding cycle length (2011 or latest available year)

	Average USD (PPP)	Minimum USD (PPP)	Maximum USD (PPP)	Median USD (PPP)
CoEs with funding cycles of less than or equal to 6 years	2 364 623	81 139	26 000 000	1 685 347
CoEs with funding cycles of more than 6 years	3 748 623	274 882	14 000 000	2 358 852

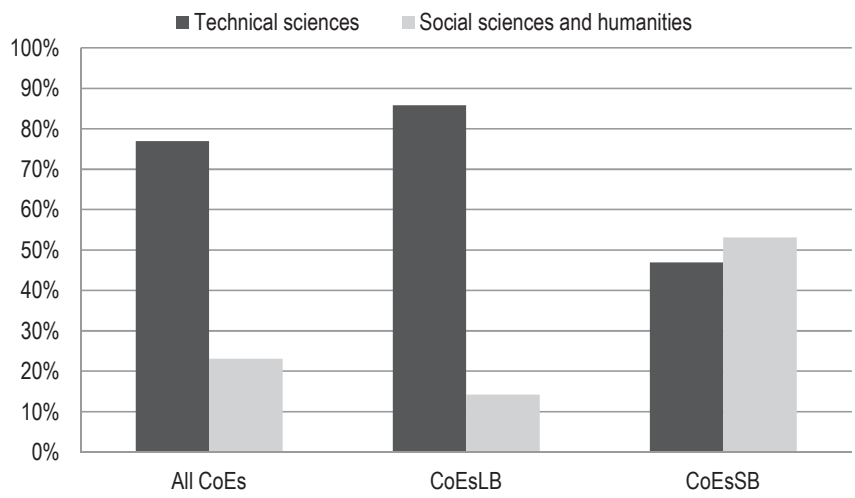
Note: Shorter and longer funding cycles are defined as those above/below the CoE sample average of 6 years.

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Research fields

In principle REIs are open to all fields of science and to all centres meeting the selection criteria of the REI and demonstrating a potential for research excellence. However, some concerns have been raised about a possible bias in the allocation of funds and grants to small and large host institutions (and hence possibly to the hosted CoEs). In the case of the Japanese GCOE programme, for instance, critics detected a tendency to overemphasise currently popular topics (see Chapter 7). Out of the 258 CoEs for which survey data were available it was possible to identify the primary research focus of all but two. Around 77% declared the technical sciences[9] as their primary research field but only 23% declared the social sciences and humanities (Figure 3.4). Significant differences emerge in the distribution of CoEsLB and CoEsSB across different research fields. The vast majority (86%) of the CoEsLB undertake research in the technical sciences, and less than 35% of them are concerned with the social sciences and humanities. The distribution of the CoEsSB is less skewed across research areas, with 47% in technical sciences and 53% in social sciences and humanities. These results highlight an important possible difference in the scope, objectives and type of research carried out by CoEs with different research budgets. With their relatively larger budgets and research teams, the CoEsLB concentrate on technical and applied fields of research for which laboratories and expensive physical infrastructures are often needed.

Figure 3.4. Primary research focus of CoEs



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Relation between funding and research fields

The differences in funding per year across disciplines are presented in Table 3.5. CoEs focused on technical sciences receive on average USD 3.1 million (for the whole sample of CoEs) and USD 3.4 million (for the sample of CoEsLB). This is double the amount received by CoEs undertaking research in the social sciences and humanities (around USD 1 million for the whole sample and USD 1.6 million for the sample of CoEsLB). The differences in funding across disciplines are small when CoEsSB are analysed. CoEsSB in technical sciences and in social sciences and humanities receive, similar funding per year (USD 457 000 and 480 000 respectively).

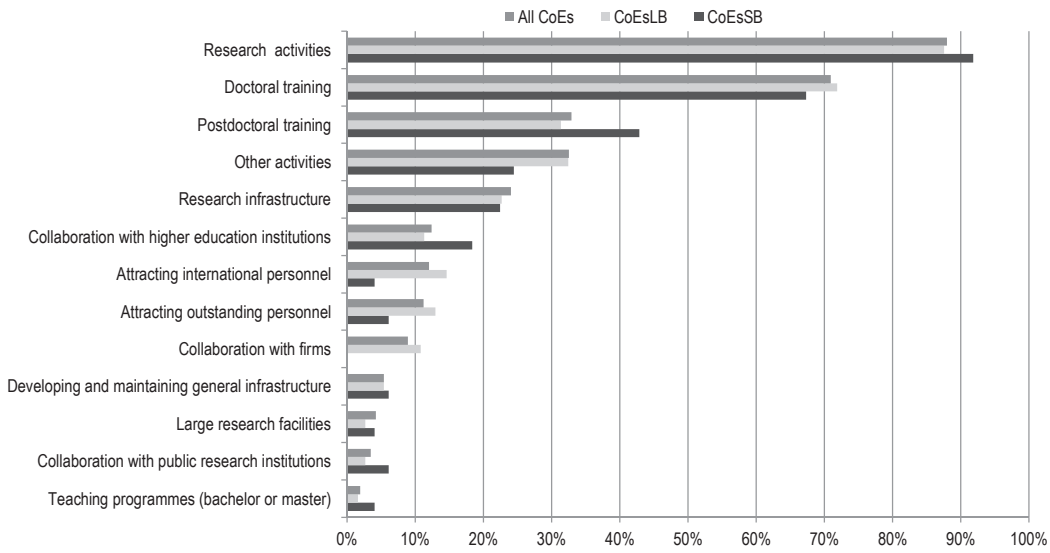
Table 3.5. Primary research fields and funding per year, USD PPP (2011 or latest available year)

	Technical sciences	Social sciences and humanities
All CoEs	3 106 860	1 049 449
CoEsLB	3 495 038	1 618 737
CoEsSB	457 127	480 161

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Centres participating in the survey were also asked to report the type of activities mostly supported by REI funds. Figure 3.5 shows the main activities for which the funding is said to be primarily used.[10]

Figure 3.5. Most frequent types of activities supported by REI funding



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The majority of respondents indicated that the funding was mainly used for research. Interestingly, doctoral and post-doctoral training are also among the main activities funded by REIs. Post-doctoral training is slightly more important for CoEsSB than for the average sample of CoEs (43% and 33%, respectively), while doctoral programmes are more important for CoEsLB than for CoEsSB (72% and 67%, respectively). This may be related to the financial effort needed to run a doctoral programme.

As noted earlier, the OECD/RIHR survey to CoEs included a field for comments for many of the questions, and respondents described a number of additional activities supported by the REIs. As shown in Figure 3.5, "other activities" ranks fourth on the chart. The open responses were grouped into five main categories:[11]

- **Training** including leadership training in general and specific leadership training for women and junior group leaders; lab management training; gender awareness/equality; professional skills/career development; mentoring programmes; research project administration; and human resource management.
- **Public awareness of science** including science communication; public outreach, engagement and communication; collaboration with civil society; hosting citizen lectures; collaboration with museums, science centres etc.; and increasing scientific literacy.
- **Staff mobility** including international exchange of scholars; mobility programmes; internships; international collaboration; and globalisation training (i.e. sending graduate students to academic institutions abroad and accepting graduate students from abroad).
- **Industry and innovation** including industry engagement; innovation management; industry outreach; and industrial clusters.
- **Other** including: capacity building in developing countries; collaboration with non-government organisations (NGOs); and workshops and conferences.

As Figure 3.5 shows, doctoral and post-doctoral training are two of the main activities funded through REIs, and other types of training activities frequently cited in the comments concern generic or transferable skills. While researchers acquire skills in the course of their studies and daily work, increasing attention is being paid to the formal development of transferable skills, particularly in higher education programmes (OECD, 2012). CoEs can provide an environment for the development of transferable skills training.

Another important element of science policy is boosting the participation of women in scientific careers. In higher education and research, female scientific participation levels drop steadily at higher seniority levels (European Commission, 2013). REI and CoE programmes can also be used to address gender issues in science (Box 3.1).

Box 3.1. Austria's Laura Bassi centres of expertise

In 2005, the Federal Ministry of Economy, Family and Youth commissioned a survey of the Austrian Society for Environment and Technology to identify the obstacles for women's careers in co-operative research. Obstacles included ambiguous awarding procedures, a male alliance structure that impeded women's advancement, and few opportunities to network with industry. Based on these results, the Laura Bassi centres of expertise REI was established. The two-stage selection process included new types of evaluation criteria to make the competences of excellent female researchers more visible.

The Laura Bassi centres of expertise are consortia in the field of applied basic research with at least one research institution (scientific partner) and at least one company partner. The eight centres are headed by highly qualified females at universities or public research institutions. Starting in 2009, they have a lifespan of seven years. In the fourth year, an interim evaluation was carried out to decide on the extension of funding for another three years. The Laura Bassi centres of expertise were established as a one-off initiative. They will not be institutionalised in the Austrian research landscape, but are used to create opportunities and to achieve gender equality in collaborative research within existing REIs.

The initiative has a budget of EUR 16.1 million (USD 19.02 million) from 2009 to 2017. The maximum funding for each centre is EUR 0.53 million (USD 0.63 million) a year. As discussed in Chapter 2 (Table 2A.1.1 Annex 2.A1) the Laura Bassi centres of expertise were excluded from this study as the funding per CoE was less than USD 1 million a year. However, they demonstrate that REIs can be designed to target specific national needs.

Source: OECD/RIHR questionnaire to government ministries and CoEs.

Networks and co-operation

Collaboration and creation of networks, either with private firms or higher education institutions, is usually an important focus of research centres' activities and, as Figure 3.5 shows, this is an activity to which REI funding is allocated. However, while 11% of CoEsLB report that collaboration with private firms is a major activity, none of the CoEsSB declared this as one of the main activities to which they allocate REI funding. Instead, CoEsSB use their funds to create networks with higher education institutions (18%) and public research institutions (6%). For CoEsLB, the figures were 3% and 11%, respectively.

This likely reflects differences in the research fields of CoEsLB and CoEsSB. Given that many CoEsLB focus on applied and technical research (Figure 3.4), they may see the private sector as the natural market for their research as well as a potential pool of research partners for projects with a technical and applied focus. CoEsSB, which place more emphasis on the social sciences and the humanities, are more likely to co-operate with higher education and public research institutions.

Given the available data, it is possible to see the outcome of the networking strategies pursued by CoEs by looking at the average number of co-operating departments in each host institution. The intensity of CoEs' co-operation with different departments of the host institution differs across research fields and research budget sizes (Table 3.6). CoEs whose primary research focus is in social sciences and humanities co-operate, on average, with five departments while CoEs focusing on technical sciences co-operate with around six departments in the same institution. The size of the research budget available to CoEs affects to some extent the likelihood to co-operate with other departments in the same institution. CoEsLB generally co-operate with more departments than CoEsSB. CoEsLB in technical research fields co-operate more than CoEsSB in the same research field (6.3 and 5.9 departments, respectively). Those CoEsLB focusing on social sciences and humanities also co-operate with 5.7 departments, while CoEsSB in social sciences and humanities co-operate with 4.6 departments.

Table 3.6. Average number of co-operation partners (with other departments) by research field

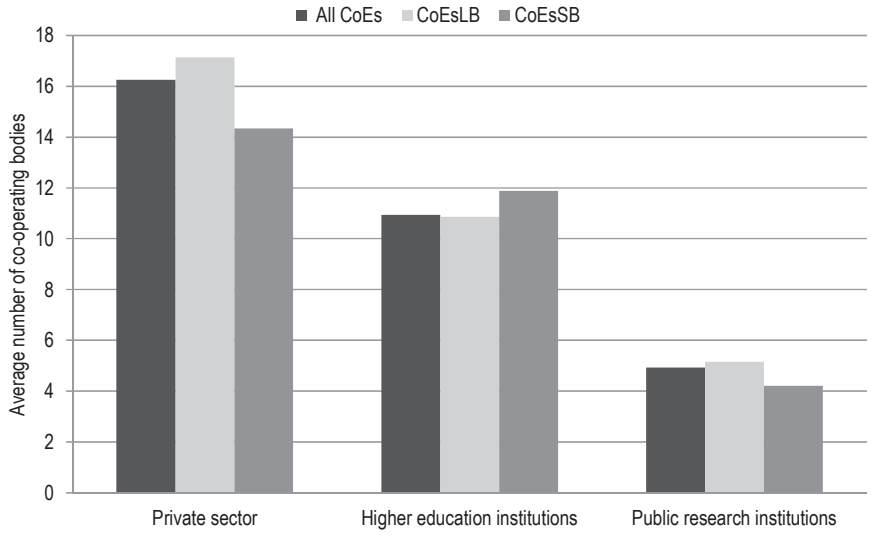
	Technical sciences	Social sciences and humanities
All CoEs	6.3	5.0
CoEsLB	6.3	5.7
CoEsSB	5.9	4.6

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Another important way to produce new knowledge and innovations is to establish networks and to co-operate with independent research institutes or with partners from the private sector. In some OECD countries, the call for applications for REI funding explicitly includes a formal requirement to co-operate with industry or public agencies. This is, for instance, the case of some Norwegian CoEs (see Chapter 8). Similarly, the German Excellence Initiative explicitly mentions co-operation with non-university research institutions as a general funding criterion (see Chapter 6). One goal of REI funding is thus to ease the administrative burden that may arise when establishing co-operation links and fostering collaboration by different types of actors. Likewise, some Slovenian CoEs are explicitly based on partnerships with the academic and industrial sectors and may focus on specific industry-oriented research programmes, such as the transition to an energy-efficient economy based on a low-carbon society (see Chapter 10). As noted in Chapter 2, the Irish CSET and the funding line K2 of the Austrian COMET require collaboration between academic and industrial partners.

The CoEs covered in this study co-operate intensively with higher education institutions (10.9 on average) and with private companies or research institutes (almost 16 on average). There is somewhat less co-operation with public research institutions (Figure 3.6). An analysis of CoEsLB and CoEsSB shows a similar pattern. CoEsLB establish more ties with the private sector (17.1) while CoEsSB co-operate with more partners from higher education institutions (11.9).

Figure 3.6. Average number of co-operating bodies by type of partner

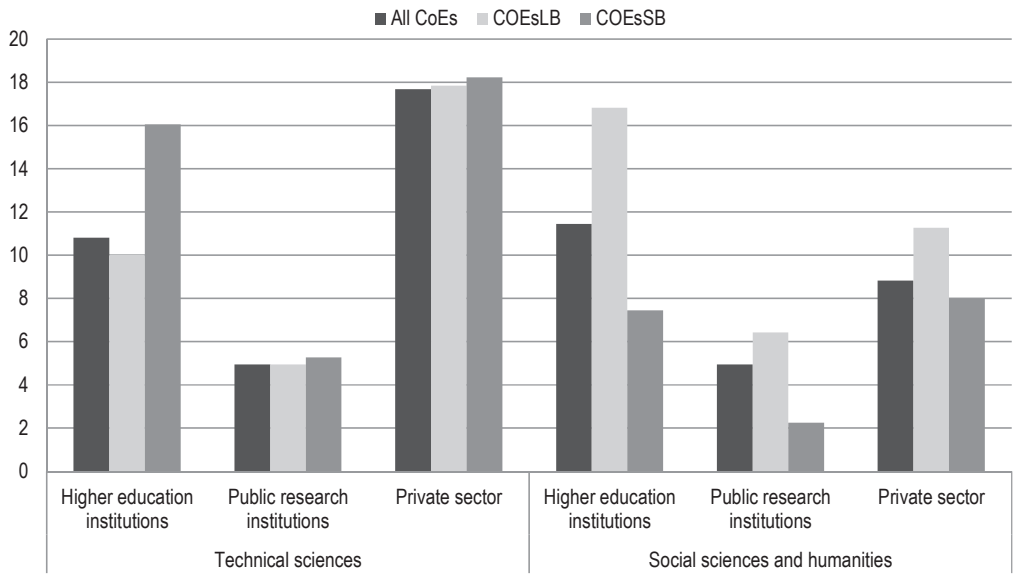


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

When disaggregating these figures by research fields, there are marked differences in the average number, as well as in the nature, of the institutions that co-operate with CoEs. CoEs that focus on technical sciences stand out in terms of co-operation with the private sector (co-operating, on average, with 17.7 private partners), whereas CoEs that focus on social science and humanities co-operate on average with 8.8 partners from the private sector. CoEs that focus on social sciences and humanities co-operate mostly with higher education institutions (11.4 on average).

An analysis of CoEs by budget size and research area reveals a similar pattern (Figure 3.7). Both CoEsLB and CoEsSB that focus on technical sciences co-operate mostly with private partners (17.7 and 18.2, respectively) and less with higher education institutions (10 and 16.1, respectively). CoEsLB that focus on social sciences and humanities co-operate more with higher education institutions (16.8 compared to 11.3 partners from the private sector) while CoEsSB in the social sciences and humanities co-operate to a similar degree with higher education institutions and private partners (7.4 and 8, respectively).

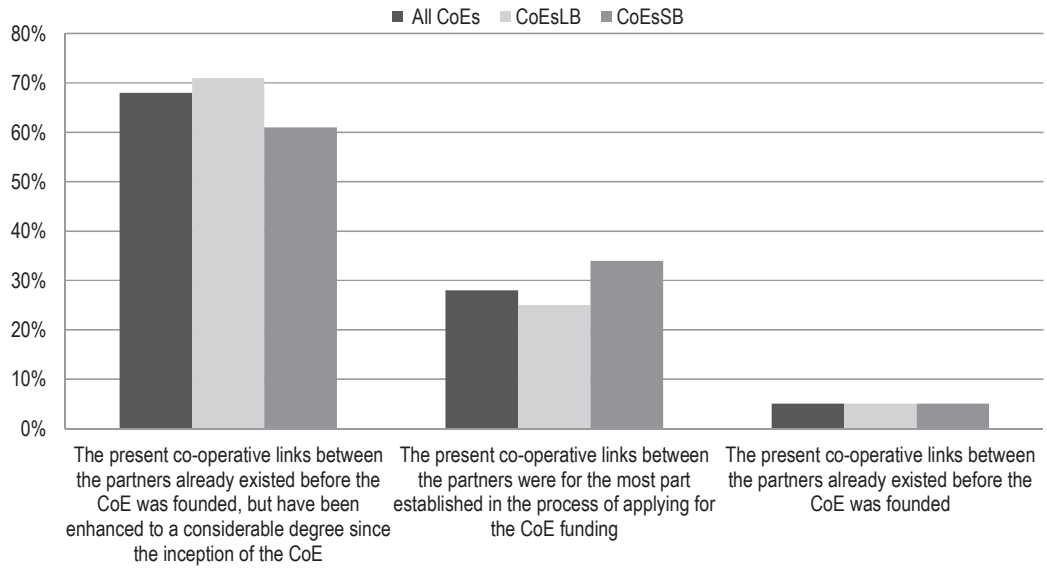
Figure 3.7. Average number of co-operating bodies by research field



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

In most cases, the data show that co-operation between CoEs and other institutions (higher education institutions, public and private research institutes) often predated the application to an REI (Figure 3.8) but was considerably enhanced following the creation of the CoEs in 68% of cases (71% for the CoEsLB). In around 28% of cases the co-operative links were established in the process of applying for REI/CoE funding; only in a very restricted number of cases was the relationship between the CoE and the co-operating institutions well established prior to the REI application.

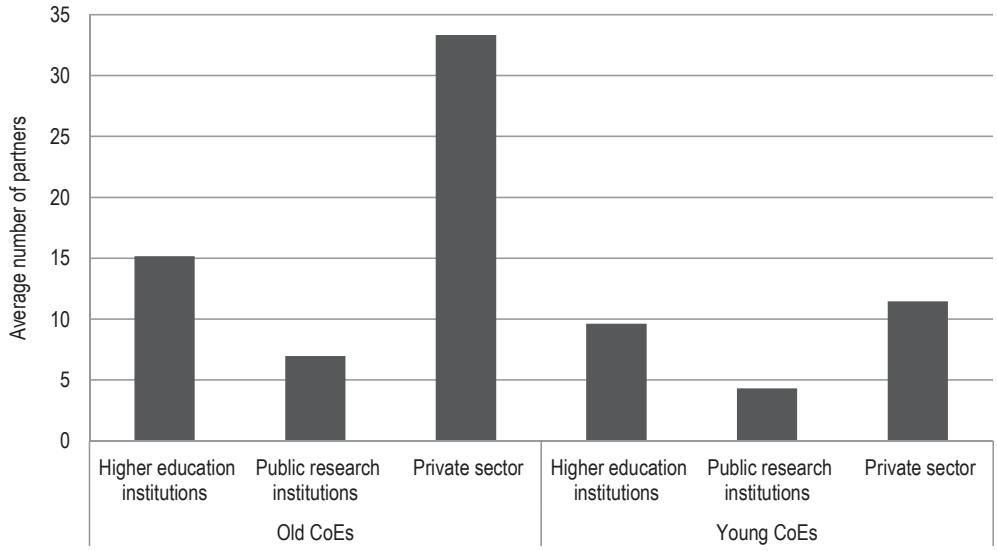
Figure 3.8. Co-operation activities and application for funding



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

When co-operation is crossed with the age of CoEs, it is clear that older CoEs (those over the average of 7 years) have been able to create more ties than more recent ones. This is especially evident for co-operation with the private sector: older CoEs co-operate on average with around 33 private-sector partners while more recently established CoEs co-operate with around 11 on average (Figure 3.9). This suggests that co-operation takes time to establish and is a lengthy process.

Figure 3.9. Average number of co-operating bodies by age of the CoE



Note. Old/young CoEs are defined are those above/below the sample average of 7 years.

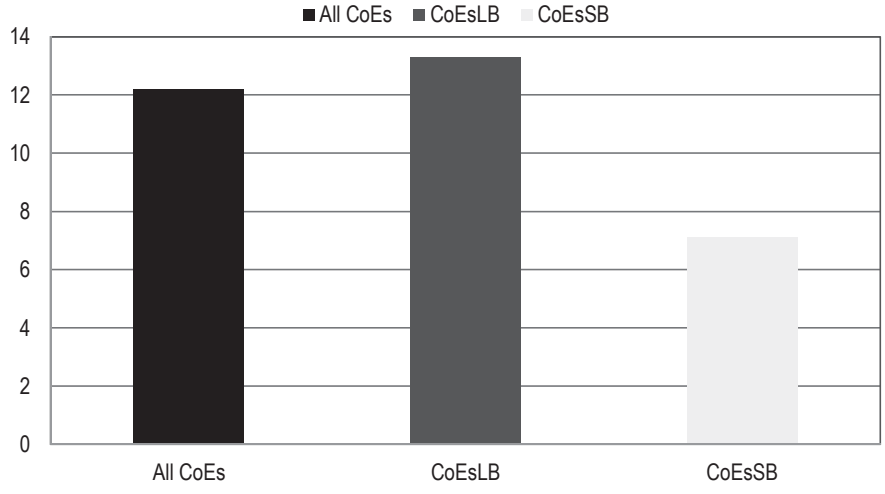
Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The importance of skilled research personnel, foreign talent and international links

Strategies aimed at attracting highly skilled scientific personnel, providing them with the best infrastructure and putting them in a position to co-operate productively and create research networks are extremely important to the success of a CoE. CoEsLB and CoEsSB (see Figure 3.5) pursue different strategies to attract outstanding or international personnel; this may depend on the relative size of their research budgets. CoEsLB, by definition endowed with larger budgets, are more likely to use these funds to attract international researchers (in 15% of cases) or outstanding personnel (in 13% of cases). In CoEsSB the figures were only 4% and 6%, respectively.

Another way of promoting co-operation and creating (or consolidating) research networks is to attract talent from abroad. Foreign researchers who move from one country to another (or from one research centre to another) take with them not only their intangible assets (e.g. human capital) but also their networks (their working relationships with colleagues from their previous institutions). When hiring a foreign researcher, a centre therefore potentially obtains a new research network that is likely to enhance the creation of knowledge and successful innovation. The survey examined this issue by looking at the number of researchers with foreign citizenship in each CoE (Figure 3.10). In line with the ambitious research objectives of the CoEs, the 226 CoEs providing information employ 12.2 foreign researchers (full-time equivalent, or FTE).[12] CoEsLB attract 13.3 foreign researchers on average while CoEsSB have 7.1.[13]

Figure 3.10. Average number of foreign researchers employed by CoEs (full time equivalent)

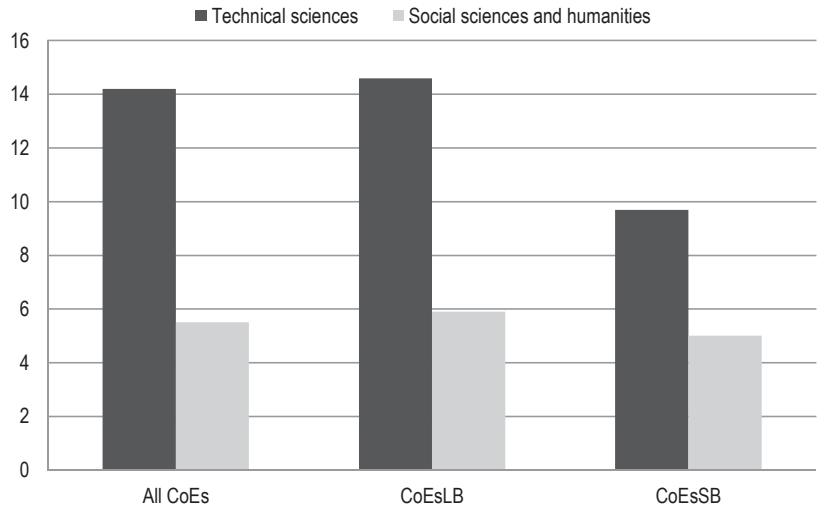


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

There are interesting differences in the capacity of CoEs in different research fields to attract foreign researchers (Figure 3.11). CoEs that focus on technical sciences employ the most foreign researchers (14.2 on average and up to 14.6 in CoEsLB). CoEs that focus on social sciences and humanities employ fewer foreign researchers (5.5 on average and around 6 in CoEsLB). CoEsSB employ the fewest foreign researchers; this may be because their smaller budget for research reduces their chances of attracting talent from abroad.

Figure 3.11. Average number of foreign researchers employed by primary research fields

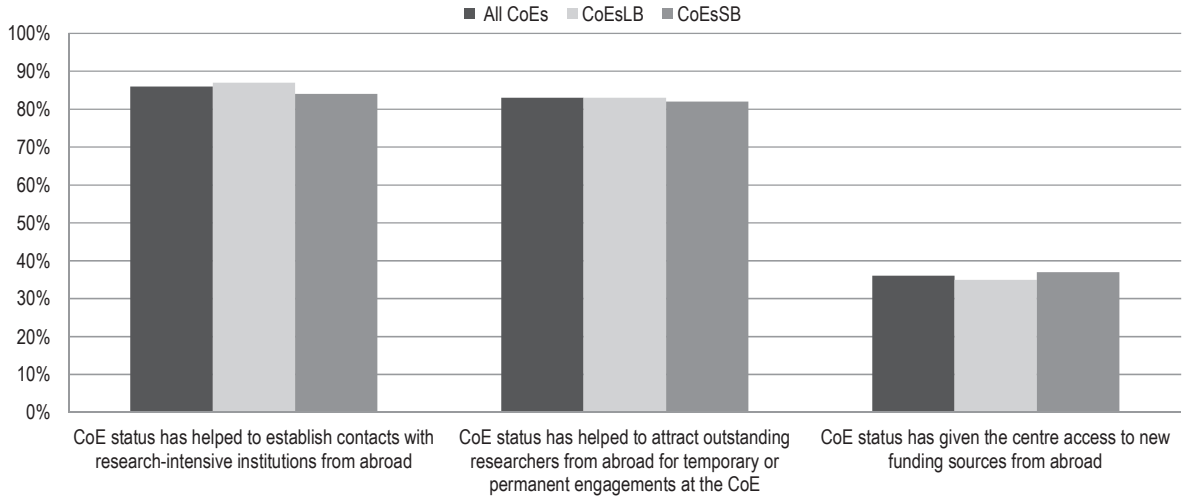
Full-time equivalent (averages)



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Hosting a CoE also has a strong effect on establishing international connections with other institutions and researchers. Around 83% of CoEs affirmed that their special status helped the host institution to attract outstanding researchers from abroad and to build temporary (or even permanent) relations with them. Similarly, 86% declared that the CoE's status helped in establishing contacts with other research-intensive institutions operating abroad. In some 36% of cases, the status of the CoE facilitated access to funding from outside national boundaries (Figure 3.12). This pattern holds when CoEs are grouped into CoEsLB and CoEsSB.

Figure 3.12. CoE status and international visibility

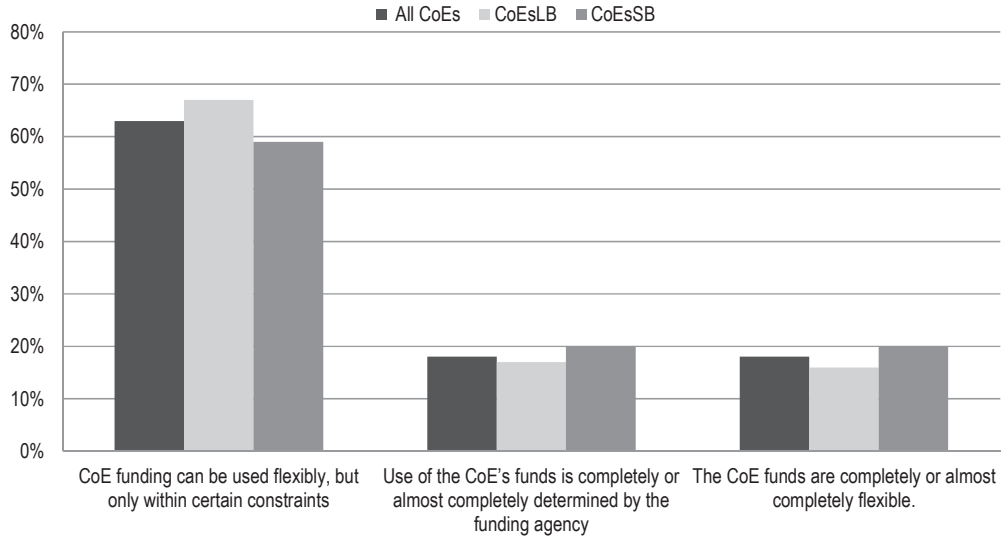


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Management structures and relations between hosts and CoEs

How flexibly CoEs can use their funds affects their overall functioning as well as the way staff are hired and research is carried out. Figure 3.13 shows that 63% of CoEs declared that they could use their funds with some flexibility, for instance by moving them between cost categories up to a maximum of 20% of total funds. Around 18% of CoEs declared that they could manage their funds freely and could allocate specific amounts to spending categories without having to justify movements across cost categories to the funding agency. No significant differences between CoEsLB and CoEsSB are observed in the degree of freedom for managing funds. For example, the funding of the German Excellence Initiative (see Chapter 6) can be used for a broad variety of purposes and cost categories. The universities were able to set their own spending priorities, provided the overall strategy and implementation concept was convincing. The funding could also be used to establish new professorships at both senior and junior levels. For its part, the Portuguese Multi-year funding programme (see Chapter 9) has proven more flexible than other forms of third-party funding, as it can be used for personnel, networking, diffusion activities, productivity bonus and management costs. However, there has been some criticism of the annuality rule, which does not allow for carrying unspent REI funds over to the next year. In some cases this can hinder fully flexible use of funds in long-term projects such as those carried out under REI programmes.

Figure 3.13. Freedom to allocate and manage funds[1]

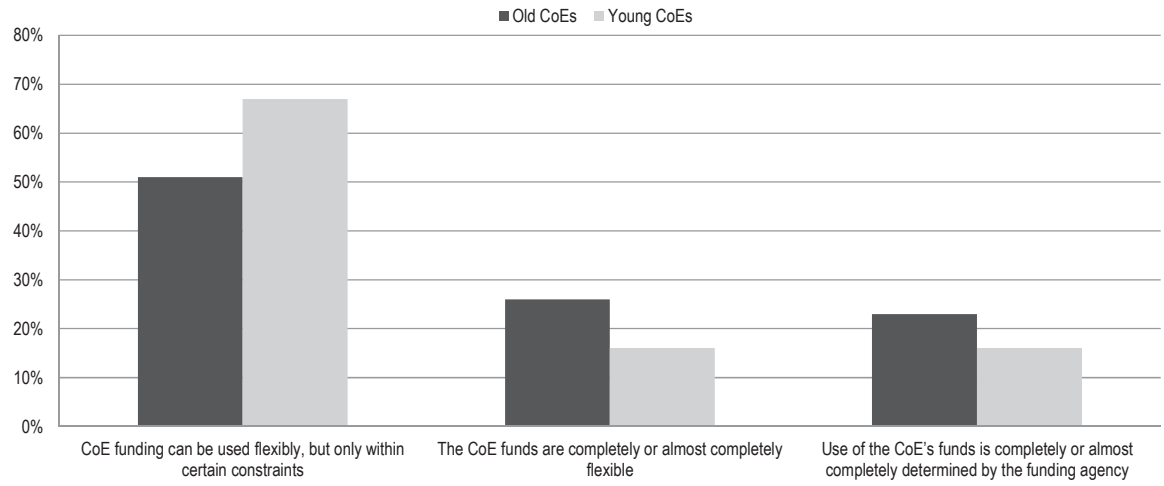


Note: 1. Japanese CoEs significantly drive these results. When they are removed from the All CoEs sample, the share of CoEs for which funding can be used flexibly drops from 63% to 50%. The other categories change slightly.

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The data show some differences in the freedom to manage funds when the age of the research units is taken into consideration. Older CoEs (established before 2005) are more constrained when managing REI funding than younger CoEs (Figure 3.14). Among older CoEs, 23% state that they are required to use their funding as determined by the funding agency while this is the case for only 16% of younger CoEs. The remaining CoEs, 77% and 84%[14] of old and young CoEs respectively, state that they can manage their funds flexibly, or almost flexibly.

Figure 3.14. Age of CoEs and freedom to manage funds

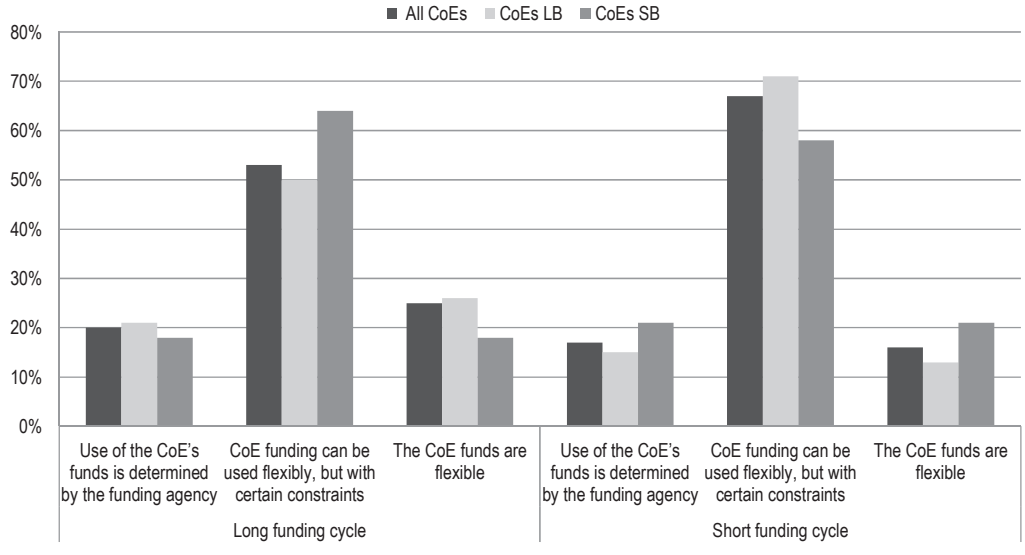


Note: Old/young CoEs are defined as those whose age is above/below the sample average of 7 years.

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The length of the funding cycle is associated with differences in CoEs' freedom to manage funds (Figure 3.15). Among CoEs with funding cycles of more than 6 years, 25% declare that they have freedom to allocate funding; the same is true for 16% of those with funding cycles of 6 years or less. However, differences arise when the size of the total research budget allocated to CoEs is taken into consideration. CoEsLB with longer funding cycles have more freedom to allocate their research budget than those with shorter funding cycles.

Figure 3.15. Length of the funding cycle and freedom to manage funds



Note: The average funding cycle is around 6 years for the All CoEs sample. Long (resp. short) funding cycles are defined as above (resp. below) this average length.

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

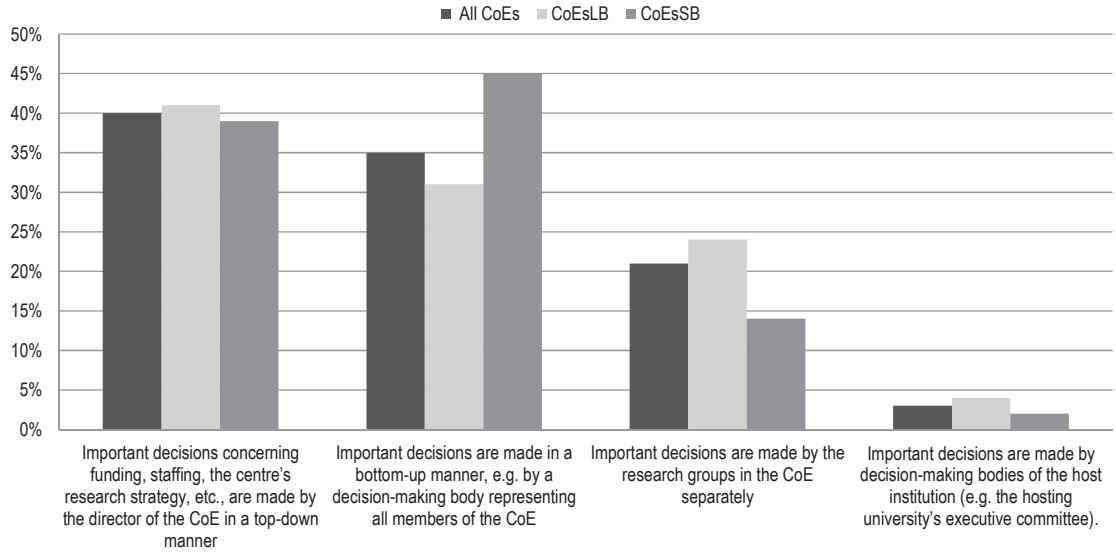
The CoEs analysed have diverse management structures (Figure 3.16). Around 40% of respondents indicated that important decisions about funding, staffing and research strategy are usually taken by the director of the CoE in a top-down manner. Around 35% declared that the management structure of their CoE works mostly in a bottom-up manner with the involvement of all bodies representing various members of the CoE. Finally, 21% of the sample stated that important management decisions are made by research groups within the CoE but independently from each other, in a transversal manner.

The results are quite different when CoEs' budget size is analysed. While the results for CoEsLB are in line with those of the overall sample, CoEsSB are more prone to make budgetary decisions in a bottom-up manner (in almost 45% of cases). The more frequent use of a bottom-up decision-making process in CoEsSB than in CoEsLB may be due to the smaller size of their research projects, as a bottom-up decision process is relatively easier than for very large CoEs with a considerable number of bodies to co-ordinate. Only a very small number of CoEs stated that decisions concerning the CoE are taken at the level of the host institution.

Specific decisional schemes are implemented in different countries (see Part II). For instance, in some Norwegian CoEs important decisions are made by the research groups (see Chapter 8). In some Danish CoEs decisions are taken after consultation with an internal management/advisory group or an external advisory body (see Chapter 5). Similarly, Japanese CoEs linked to the GCOE REI programme use part of the grant funding to create small administrative groups composed of professors and specially appointed project professors who are responsible for administration of the centre (see Chapter 7).

The comments revealed that in some cases the CoE management structure is based on a combination of approaches. For example, respondents mentioned the importance of dialogue and consultation and involving principal investigators, student representatives as well as colleagues in other faculties and disciplines when making decisions. In one case, the industry partners on the advisory board have a majority vote, and in another, the director of the CoE makes the important decisions, but they have to be validated by the decision-making bodies of the host institution. In other cases, the host institution is responsible for the administrative and financial procedures, whereas the CoE focuses on research decisions. Some CoEs have multiple host institutions, which can make the management structure more complicated. A number of respondents mentioned that important decisions required top-down and bottom-up processes. Many respondents stressed the importance of their scientific advisory board, governing board or scientific steering committee in terms of the management structure and decision-making process.

Figure 3.16. Management structure

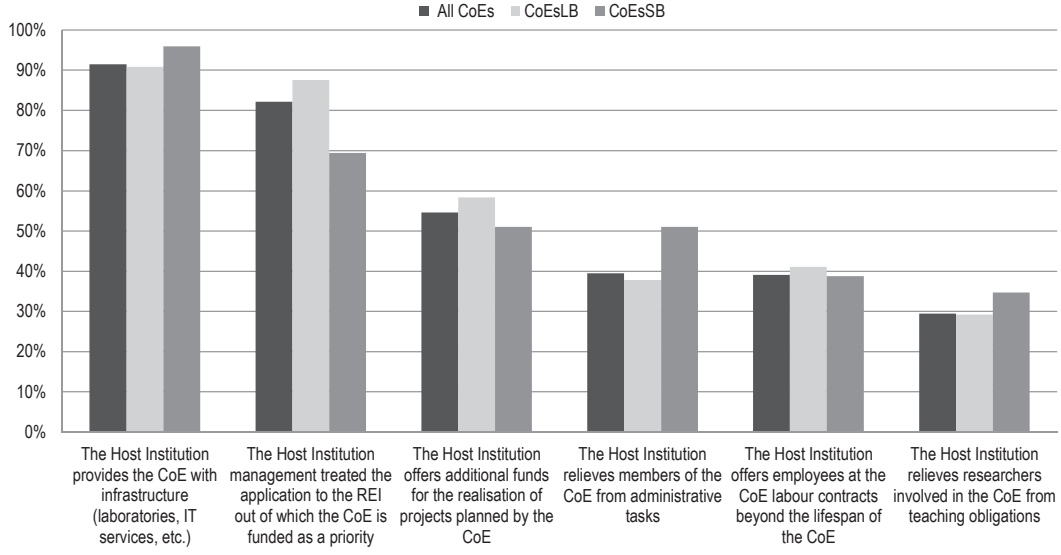


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Links with the host institution

Host institutions, even if rarely involved in CoEs' budgetary decisions, do support the management and research activities of CoEs in a variety of other ways (Figure 3.17). Host institutions play a fundamental role in managing CoEs' application to the REI for funding. They also furnish the CoEs with the physical infrastructure to conduct their research (laboratories, IT services, etc.). Around 82% of CoEs benefited from the host's management support during the period of application to the REI. CoEsSB receive more support from the host in terms of the use of the host's physical infrastructure than CoEsLB.

Figure 3.17. Support provided by host institutions



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

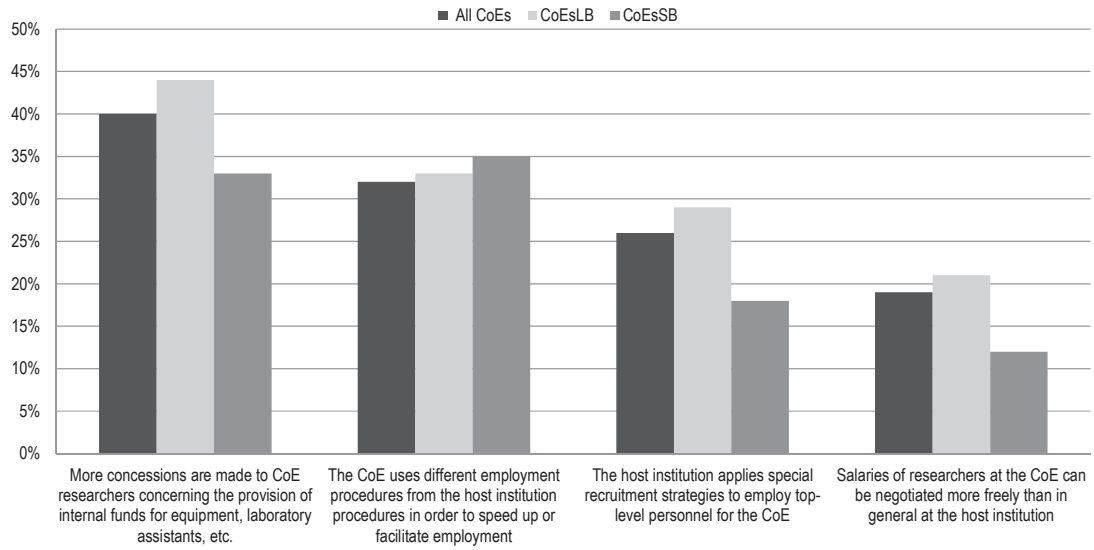
Even if the CoE is established at a host institution (and generally benefits from the host's physical infrastructure), the status of researchers at the CoE is usually different from that of researchers employed directly by the host institution (Figure 3.18). The most widespread difference between the status of CoE researchers and that of the host's personnel is that the former benefit from more concessions concerning, for instance, the provision of internal funds or laboratory assistants (around 40% of responding CoEs and up to 44% of CoEsLB). Similarly, CoEs can adopt different procedures (e.g. offer tenure track positions) to facilitate the employment of excellent researchers (32% of CoEs) or to attract an international and highly qualified workforce (26% of CoEs). Less frequent, even if enjoyed by almost 19% of responding CoEs, is the possibility of negotiating salaries more freely than in the host institution. This is the case for recruitment strategies at various German CoEs (see Chapter 6) where the funding flexibility allowed by the German REI programme made it possible to offer candidates professorships with very attractive packages in terms of research facilities and support staff.

The comments showed that while host institutions relieve members of the CoE from administrative tasks and/or teaching obligations, the practices vary across institutions. For example, in some cases only certain CoE personnel are eligible for a slight reduction in teaching obligations at the host institution, such as specially appointed researchers or the director of the CoE. Some CoE directors are also relieved from administrative tasks within the host institution. In other cases, researchers specifically hired by the CoE may be required to do a small amount of teaching (e.g. one semester course at Master's level) or provide an occasional lecture to students in the host institution. However, in other cases, the faculty members are not relieved from teaching and they constitute the majority of researchers in the CoE. A number of CoEs noted that they have no teaching obligations.

The possibility of negotiating salaries and special recruitment strategies for top-level personnel is on average more frequent in CoEsLB (in 21% and 29% of cases, respectively) than in smaller CoEsSB (in 12% and 18% of cases). Overall, these exceptional measures are meant to allow the CoEs to reach their ambitious research objectives more rapidly and effectively. The Danish CoEs (see Chapter 5) are an exception, as the salaries of researchers at the CoE cannot be negotiated more freely than at the host institution and none of the researchers is relieved from regular administrative tasks or from normal teaching obligations.

The links between the host institution and the hosted CoEs are usually long-term and in a variety of cases they continue regardless of the availability or continuation of the REI programme. Around 63% of CoE research staff (and up to 73% in CoEsSB) will maintain their contract with the CoE even after the REI ends. Similarly, 48% of the administrative staff will also maintain their contract with the CoE (and up to 59% in CoEsSB). This highlights the importance of the research lines opened by the REI funding and of the knowledge and intangible assets accumulated by the research and administrative staff during the development of the research excellence projects.

Figure 3.18. Special conditions of employees at the CoE compared to the host institution

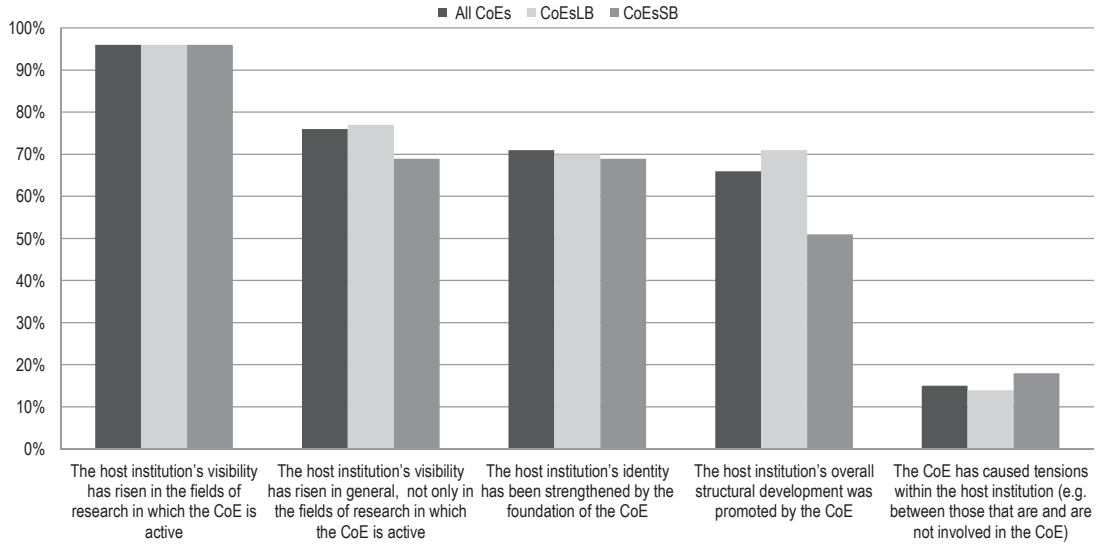


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

At the same time, strong links between host institutions and CoEs pose potential financial and administrative problems that are tackled in different ways across countries. Danish CoEs, for instance (see Chapter 5), put great emphasis on the control of potential financial risks associated with costly agreements or structures that cannot be cancelled or easily dissolved at the end of the grant period. This may lead to a decision to offer labour contracts beyond the lifespan of the CoE to only a limited number of employees. German, Norwegian or Japanese CoEs usually require (or expect) the CoEs to become self-sufficient at the end of the REI grant. In the German case, applicants have to prove the financial sustainability of their activities beyond the funding period (see Chapter 6). Similarly, Japanese and Norwegian CoEs are expected to generate enough additional funding to be self-sufficient after the termination of the CoE grant through enhanced access to additional third-party funding owing to the higher research status of both hosts and centres (see Chapters 7 and 8).

The benefits arising from REI funding accrue to both CoEs and hosts. Host institutions benefit substantially when sponsoring CoEs' research activities. Up to 96% of responding CoEs considered that the host institution's visibility in the CoE's field of research had risen as a consequence of the CoE's research (Figure 3.19). Around 76% also considered that the visibility and reputation of the host institution generally improved (regardless of the research field of the CoE) following the establishment of the CoE. The positive effects of the CoE in promoting the structural development of the host and in strengthening its foundations were similarly noted. Only a small fraction of CoEs considered that its establishment under the umbrella of the host institution caused tensions (resulting from the privileged status of the CoE's researchers) with research units not involved in the CoE. Only slight differences are observed with respect to the perception of these issues by CoEs with different budget sizes (CoEsLB and CoEsSB).

Figure 3.19. Effects of a CoE on the host institution

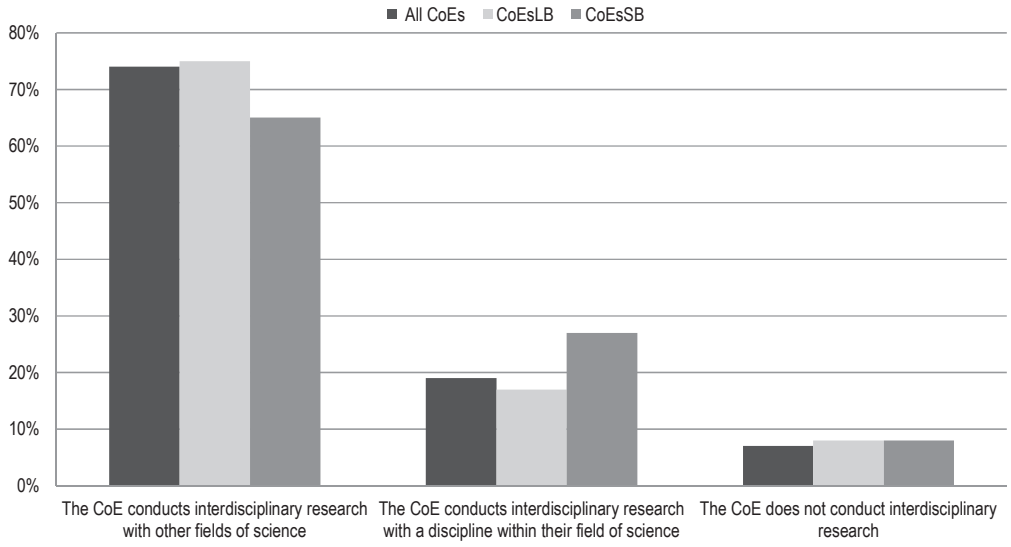


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Interdisciplinary research

Interdisciplinary research is one of the important activities promoted by CoEs and REI funding programmes. The aim is scientific innovations obtained by linking knowledge created in different fields. Some 74% of CoEs stated that they conduct interdisciplinary research and that only in 19% of cases is this research confined to the primary research field of the CoE (Figure 3.20). When crossing this information with the budget size of CoEs, CoEsSB are, on average, more prone to conduct interdisciplinary research with a discipline in their field of science (27%) than CoEsLB (17%). CoEsLB are more prone to create links with other fields of science (75%) than CoEsSB (65%) suggesting that the size of the research budget can help drive diversified interdisciplinary research.

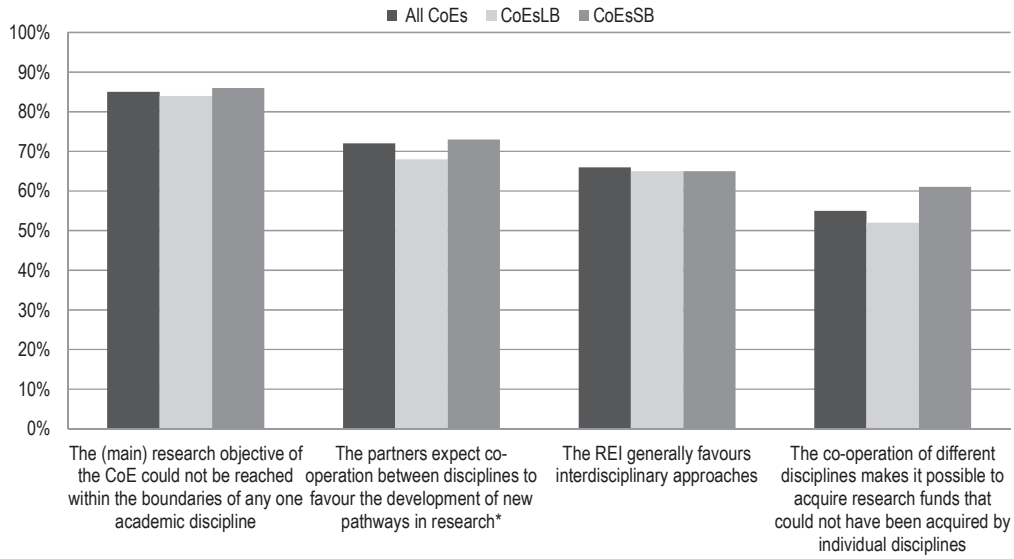
Figure 3.20. Interdisciplinary research



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The reasons for a CoE to pursue interdisciplinary research have also been examined. The main stimulus is to innovate by exploiting different methods and sets of knowledge from a variety of perspectives and disciplines (Figure 3.21). Around 85% of CoEs stated that their main research objectives could not be reached by relying solely on the knowledge and paradigms of a single discipline. Similarly, 72% considered that interdisciplinary co-operation was necessary to foster the discovery of unexpected research pathways.[15] Co-operation among different disciplines and its effect on the likelihood of acquiring additional research funds is more frequent in CoEsSB (61%) than in CoEsLB (52%).

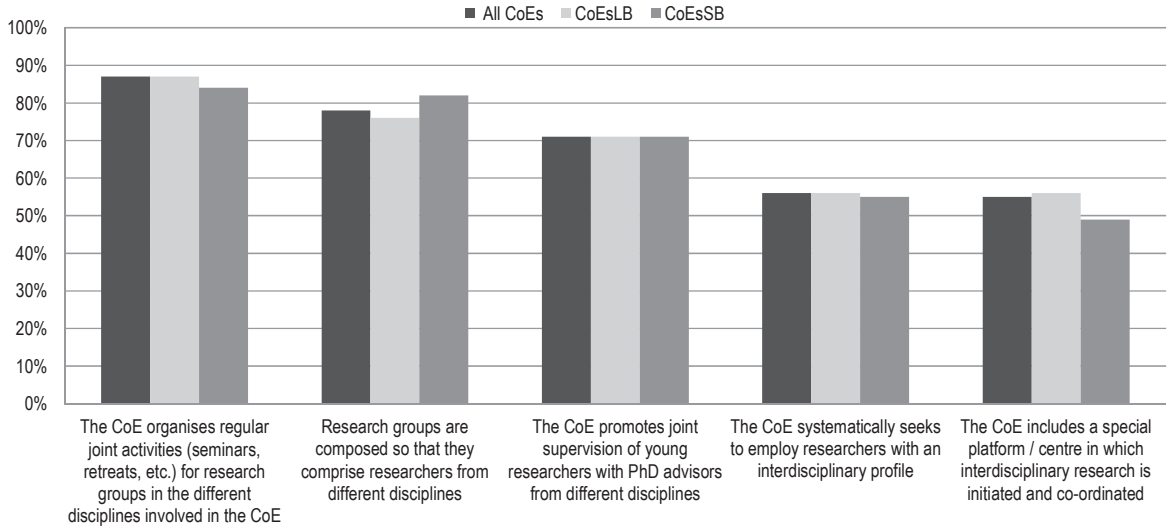
Figure 3.21. Reasons to pursue interdisciplinary research



Note: *This percentage reaches 90% when Japanese CoEs are removed from the main sample (i.e. All CoEs).
Source: OECD/RIHR Survey to Centres of Excellence, 2012.

There are many ways to conduct interdisciplinary research (Figure 3.22). An approach frequently adopted by CoEs is to promote and organise regular joint activities by groups of researchers in different disciplines (87% of CoEs). In addition, 78% of CoEs created research groups with researchers from different disciplines so as to maximise the knowledge mix in the research unit and to enhance co-operation among researchers with different scientific backgrounds. This percentage increases up to 82% when CoEsSB are analysed while 76% of CoEsLB use this strategy to pursue interdisciplinary research. Some CoEs pay particular attention to the recruitment of scientific personnel with specific interdisciplinary skills and backgrounds in order to create new interfaces with different disciplines. For example, the recruitment policy of some German CoEs (see Chapter 6) focused on hiring promising junior professors and researchers who were not attached to a specific thematic or departmental area of expertise but ranged across a variety of knowledge areas and could help to link different research areas in the CoE. Around 56% of CoEsLB (as opposed to 49% of CoEsSB) have a special platform/centre to initiate and co-ordinate interdisciplinary research.

Figure 3.22. Mechanisms to undertake interdisciplinary research

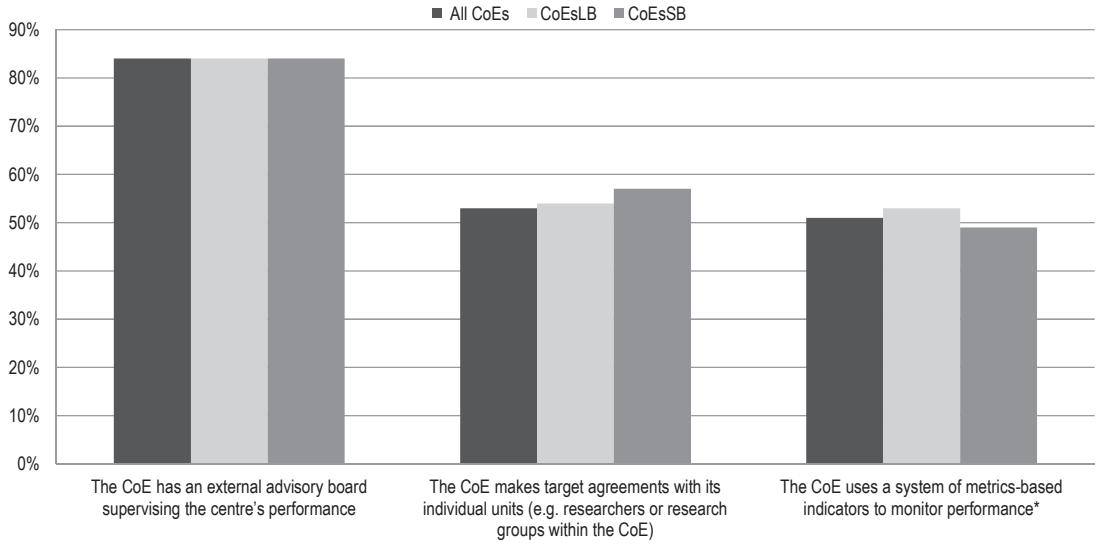


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Measuring the impact of research in CoEs

Given the large amounts of funding provided to CoEs, the impact of their research is of great importance to the REIs that fund them. Different strategies are used to account for the lasting effects of CoE research. Approximately 84% of responding CoEs stated that they were accountable to an external advisory board that supervises their research activities and performance (Figure 3.23). Less frequent is the use of metrics-based indicators to monitor research performance (51%) or agreements with individual units on research targets to be met within specific time frames (53% for the whole sample of CoEs,[16] rising up to 57% for the CoEsSB).

Figure 3.23. CoEs and performance monitoring to measure impact



Note: *This percentage reaches 66% when Japanese CoEs are removed from the main sample (i.e. All CoEs).

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

There are differences in the way CoEs in different research fields assess their performance and the impact of their research. Overall, the role played by an external advisory board is important for all CoEs, regardless of their research focus. The use of an external advisory board is more frequent for CoEsLB in technical sciences (85% of the sample) than for those that focus on social sciences and humanities (77% of the sample). CoEsLB in technical sciences are also more prone to use a system of metrics-based indicators to evaluate research performance (Table 3.7). This may be linked to the challenges associated with quantitative measurement of the scholarly output of the social sciences and humanities (OECD, 2010).

Table 3.7. Impact assessment methods and fields of research

	All CoEs		CoEsLB		CoEsSB	
	Technical sciences	Social sciences and humanities	Technical sciences	Social sciences and humanities	Technical sciences	Social sciences and humanities
The CoE uses a system of metrics-based indicators to monitor performance	56%	34%	55%	42%	74%	27%
The CoE makes target agreements with its individual units (e.g. researchers or research groups within the CoE)	53%	56%	52%	65%	85%	50%
The CoE has an external advisory board supervising the centre's performance	85%	83%	85%	77%	83%	85%

Source: OECD/RIHR Survey to Centres of Excellence, 2012.

Respondents were able to describe in the comments section additional performance monitoring tools that were not mentioned in the survey questions. A number of CoEs described mid-term evaluations and how the results were used to determine continued funding. Others mentioned regular evaluations by international experts and periodic peer reviews. For some CoEs, impact assessment is continuous and undertaken by the centre's steering group, research committee or advisory board. In some CoEs, individual researchers are required to meet key metrics (e.g. attract external research funding, publish in scientific journals), whereas in others, regular seminars are conducted to monitor performance.

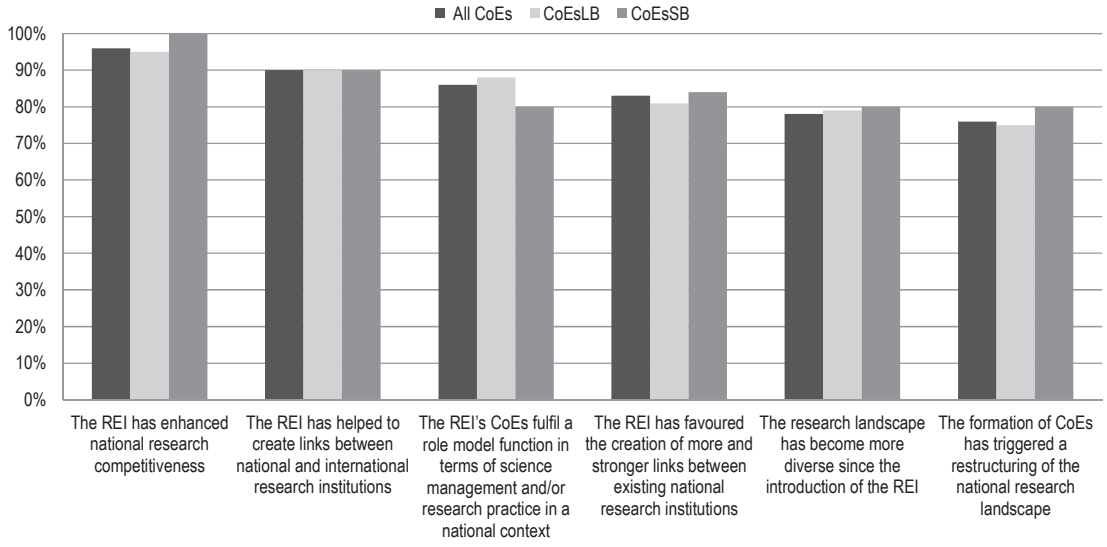
The contribution of REIs

The OECD/RIHR survey also measured the CoEs' perception of the positive effects, if any, of an REI. The CoEs generally find that the REI has raised national research competitiveness through its role in science management and research practice in each country's national context (Figure 3.24). They also agree that the REIs play an important role in helping to create stronger links between national and international research institutions.

The comments also support the positive perception of the effects of REIs. For some, the research landscape has become more concentrated and specialised and REIs have enabled more cross-disciplinary research,[17] including strategic links with industry. Other respondents mentioned that the scale of research programmes had become larger and that REIs provided crucial funding for equipment and infrastructure. According to some respondents, REIs boosted the number of high-quality researchers in their system and the funding had also improved technical support in laboratories (e.g. hiring technicians) and

the maintenance of research equipment.[18] A number of respondents mentioned that REIs would have lasting effects on future PhD training, while others highlighted the long-term benefits arising from both national and international collaboration.

Figure 3.24. Perceived effects of the REI on the national research system

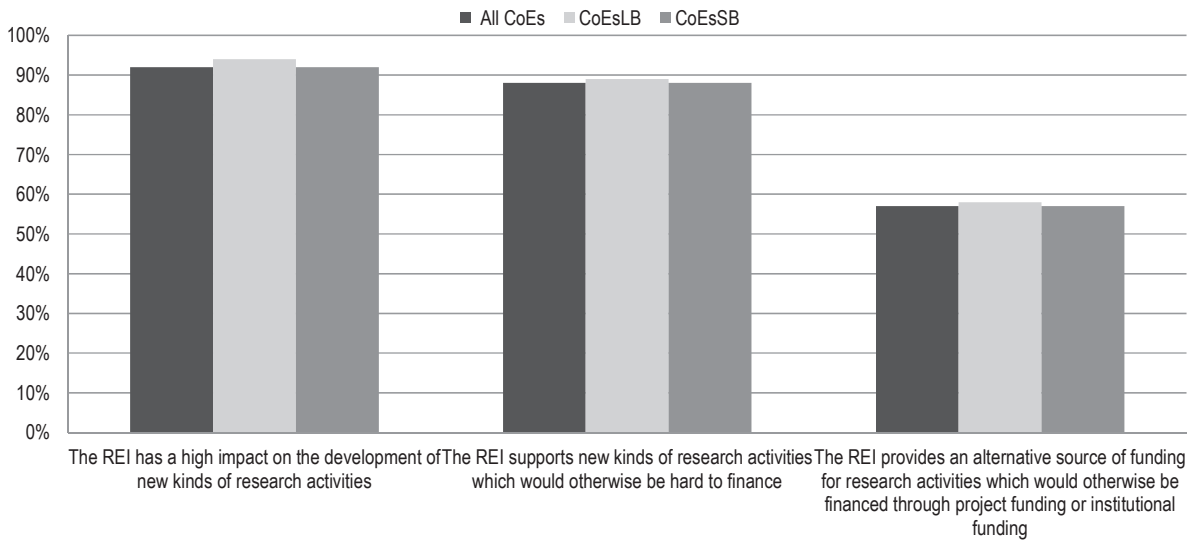


Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The REIs are judged very favourably in terms of supporting the development of new kinds of research activities (Figure 3.25). CoEs' responses in this area indicate that the REIs had a strong impact on the development of new lines of research that would otherwise not have been pursued. REIs are regarded as an important instrument for conducting innovative research. This is supported by the view that REIs are only partly seen as an alternative source of funding for pre-existing research lines (in 57% of cases).

The comments confirmed the usefulness and impact of the REI in supporting the development of new kinds of research activities. A number of respondents noted that the extended time horizon of the funding made it possible to undertake high-impact, high-risk research (e.g. basic research) under more realistic time frames and enabled them to pursue longer-term goals. This was particularly important in terms of interdisciplinary research as it takes time to establish and is difficult under short-term project funding programmes. Moreover, the CoE model enabled the formation of research groups with more varied expertise, and this generated new types of research. For some respondents, REI funding was critical, as their research would cease without it. In some cases this was due to general funding constraints (i.e. less institutional and project funding), whereas in others it was a result of the field of research (e.g. difficulty to secure funding in the humanities). A number of respondents mentioned that the REI funding had enabled them to establish new infrastructure and large-scale projects, while for others the grant enabled them to continue operating expensive research facilities.

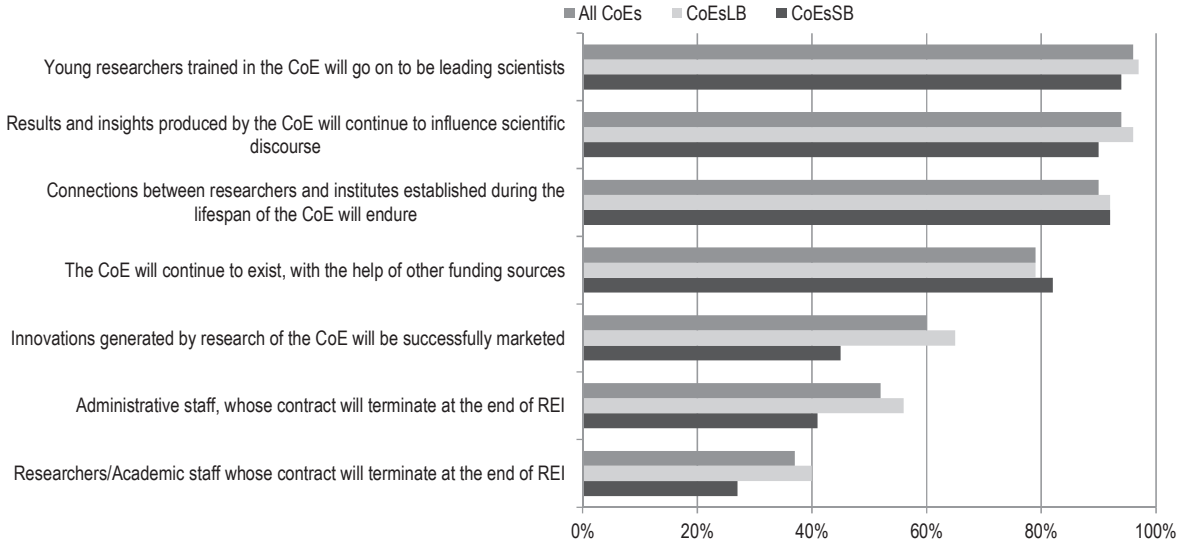
Figure 3.25. Usefulness and impact of the REI in supporting the development of new kinds of research activities



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The value of REIs and of the research activities carried out by CoEs has a long-run impact. Around 94% of CoEs feel that the results and insights produced by their research will continue to influence scientific discourse and to foster connections between researchers and institutes after the end of the REI (Figure 3.26). As regards the research output generated with the financial support of REIs, CoEs believe that this will be successfully marketed in 60% of cases, and that the research will continue with the help of other funding sources. Along these lines, the positive effects on the employment of researchers are also evident: 96% of CoEs declared that the young researchers trained by their facilities are, with all probability, going to become leading scientists in their fields.

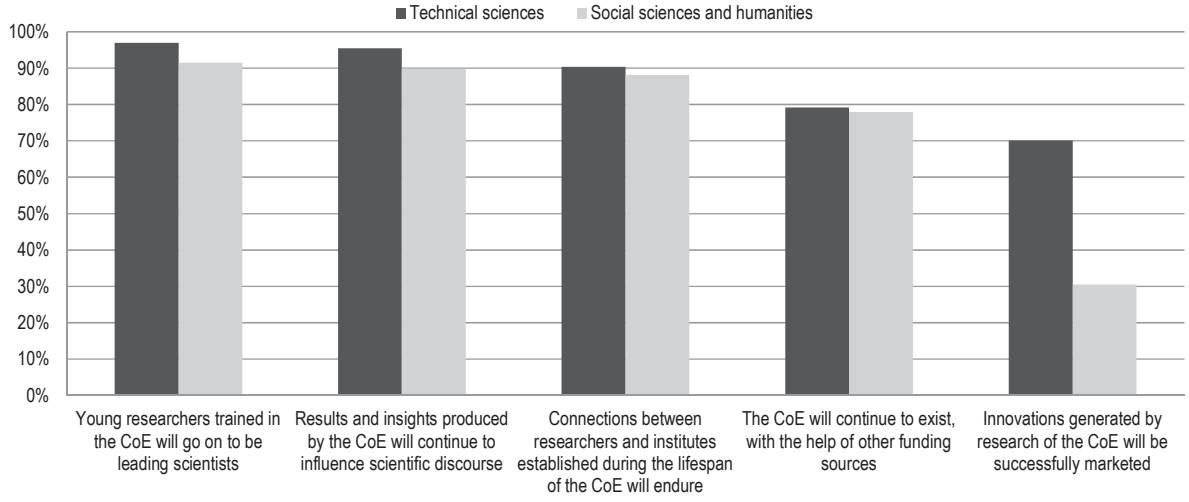
Figure 3.26. Perception of the lasting effects of CoE when REI ends



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

The results are similar when the perception of the REI's effects is analysed for CoEs that focus on different research fields. However, while around 70% of CoEs that conduct research in the technical sciences see the possibility of successfully marketing their innovations (Figure 3.27), only around 30% of CoEs in social sciences and humanities believe that their innovation will be successfully marketed. This result reflects the fact that CoEs in technical sciences are more prone to have links with the private sector (see Figure 3.6) and may also be linked to the nature of the research undertaken in the social sciences and humanities.

Figure 3.27. Perception of the lasting effects of CoE when REI ends by research field



Source: OECD/RIHR Survey to Centres of Excellence, 2012.

At the end of the OECD/RIHR survey, respondents were invited to add further comments on their REI and CoE and many focused on the positive impacts. Box 3.2 provides a selection of responses to further illustrate the value of REIs.

Box 3.2. Overall assessment of REIs and CoEs

The comments at the end of the OECD/RIHR survey highlight the positive view of REIs and CoEs from the perspective of the centres as well as some concerns about the sustainability of REI funding and future research activities.

- "Substantial investment has been used for establishing […the centre] and unique collaborative efforts have been set up to address the goals for this project. Collaborations have been established which would not have been undertaken by the normal research funding systems due to its interdisciplinary concepts and due to the longer time span. This considerable investment will however evaporate unless it is possible to obtain funding that allows these projects to continue. This is not a matter of permanent staff, but a matter of funding for the post-docs, PhD students and the running costs. If such funds are not available […our centre] will vanish after one or two years,"
- "The terms of the REI has made it possible to: work strategically with all stakeholders involved in the area (national and academic partners, large industry and SME, national and European funding bodies); to optimise the [research] output to meet societal needs and requirements; to attain academic leadership throughout the organisation; and to make strong and scientifically directed collaborations across disciplines, while maintaining the possibility of operating independently for all participants."

Box 3.2. Overall assessment of REIs and CoEs *(continued)*

- "A major problem of the REI (in particular CoEs) is that the funding period is rather short (5 years) and a possibility of continuity is not guaranteed. It is a problem of sustainability."
- "Performing basic research as part of a team in a CoE is a much more rewarding situation than trying to achieve the same in a university department. Having stable funding over an extended period of time is in my opinion the most important factor for obtaining research results that are inquisitive in nature rather than solving specific practical problems. If university departments are expected (forced) to finance large portions of their research by external funding, the challenges they will have to present to the PhD- and Postdoctoral candidates will be somewhere between applied research and systems- or product development. These tasks are much better covered by research institutes.''
- "Although the total funding of the CoE is more than five times the funding coming through the REI, the majority of the remaining funds are […] related to the specific projects. It is therefore vital for the CoE to keep core funding, allowing: […] interaction between the members and groups of the CoE around common themes (often multidisciplinary); support for the day-to-day [operation] of the CoE in terms of basic funding (administrative staff, technicians, equipment maintenance contracts, etc.) […]; to prepare proposals for projects (planned individually or within the groups of the CoE); and to purchase common equipment […]. The CoE acts as a scientific reference, within the host institution and within the national and international scientific community, for preparing and funding scientific initiatives in selected areas and themes that otherwise would not get the necessary funding."
- "CoEs offer a unique opportunity to conduct revolutionary interdisciplinary research […]. Scientific advances […to address] grand challenges in the 5-10 year span are inherently risky investments. But, these innovating projects have the potential to change the nature of how science is conducted because they challenge accepted practices. With industry and many individual grants focused on the optimisation or solving a specific problem in a 12-18 month cycle, CoEs are seen as the incubators for innovation. Industry and government agencies have sought out our CoE to find the answers to these more fundamental and longer reaching challenges."

Source: OECD/RIHR Survey of Centres of Excellence, December 2012.

Another example of excellence funding

As discussed in Chapter 1, REIs are not the only way in which research excellence is promoted by national science funders. However, this report is about a specific measure to promote research excellence, not about funding of excellence in general. Therefore, the REIs included in this report had to fit certain criteria (see Chapters 1 and 2). This meant that some schemes were not categorised as part of an REI (Chapter 2 provides a full list in Table 2A.1.1). For example, the Austrian Christian Doppler Laboratories were excluded as there are no fixed time frames for the application procedure. Nevertheless, they offer interesting comparative information for policy makers (Box 3.3).

Box 3.3. Austria's Christian Doppler Laboratories

Out of the 304 respondents to the OECD/RIHR survey to centres of excellence, 21 Austrian Christian Doppler Laboratories (CDLs) provided information. These centres were not included in the set of CoEs since the funding scheme under which these centres operate could not be categorised as an REI given that applicants are not required to participate in selection processes with fixed time frames and thus compete with other research centres for funding. The information collected from the survey, however, is interesting and highlights the differences between these centres and CoEs.

CDLs support knowledge transfer and co-operation between science and industry and are characterised by small groups of researchers (5 -15), co-operation with one to six industry partners, a duration of seven years and public private partnership funding of EUR 110 000 to 700 000 (USD PPP 136 935 to 871 407) per annum (50% public and 50% industry). Every CDL is embedded within a host research institution such as a university or public research institution. Applications for a CDL may come from any thematic field, based on the demand of high quality research from industry and rigorous scientific quality monitoring via the CDG scientific board and peer reviews.

- CDL are generally small in size when compared to the average CoE. A CDL's average annual funding is around USD 443 000 (PPP), which is also slightly less than the funding received by CoEsSB. CDL are also smaller in terms of the size of the research team, with an average of around 8.6 researchers (headcount) employed (up to a maximum of 15) whereas the average CoE employs around 84 researchers.
- The employment of foreign researchers in FTE is also considerably lower in CDLs (1.4) than in the sample of CoEs (12.1).
- CDLs state that they enjoy substantial freedom to manage their research budget. Only around 5% of CDLs (18% in the whole CoE sample) report that the management of research funds is determined by the funding agency.
- CDLs report less support from the host institution with regard to the possibility of acquiring additional funds for realising the projects planned by the CDL (9% in CDLs and 54% in CoEs) or relief from administrative tasks for members of CDLs (14% in CDLs and 39% in CoEs).
- The establishment of a CDL within a host institution resulted in fewer cases of tension (4%) than in CoEs (15%). However, the proportion of CDLs' scientific staff whose contract is expected to terminate at the end of the funding period is considerably higher than for the CoEs sample (73% and 37%, respectively).
- The number of co-operation ties established by CDLs with higher education and public research institutions (4.7) as well as with partners with the private sector (5.7) is lower than for the average CoE (10.9 and 16, respectively).
- The research carried out by CDLs also differs from that of CoEs in terms of its broad objectives. Around 9% of CDLs say that their research is less oriented towards political or societal demands (42% of the CoEs' sample) while 66% focus on dissemination and exploitation of the results, which is in line with the results from the whole CoE sample (61%).

Source: OECD/RIHR Survey of Centres of Excellence, December 2012.

Summary of the results

This chapter presents the results of the responses to the OECD/RIHR Survey on Centres of Excellence. The exploratory analysis carried out on the basis of this sample shows that CoEs' research differs from that undertaken in other institutional settings. Replies stressed the higher quality of the research, which must meet international standards of excellence. The ability to build interdisciplinary networks is also an important characteristic of CoEs. The results show that the means employed are mostly joint research activities and the creation of large research teams with scientific personnel from a variety of backgrounds and disciplines.

Research is the most important activity to which REIs funds are allocated. Post-doctoral and doctoral programmes are also important activities carried out by CoEs. Other activities supported include training, public awareness of science, mobility programmes, boosting links with industry and capacity building in developing countries.

CoEs report an average annual budget of USD 2.6 million a year in PPP and employ research teams with around 84 researchers on average. The data show that CoEs are usually young (7 years old on average) and that their existence is closely linked to the REI that supports their research objectives and provides the funding required to achieve excellence in research.

The chapter systematically compares CoEs endowed with large research budgets (above USD 1 million a year) with those of smaller size (whose annual funding is less than USD 1 million). CoEsLB receive larger amounts of funding for research (around USD 3.2 million a year), whereas CoEsSB seem to benefit more from the support of host institutions, especially through the use of the host's physical infrastructure or partial relief from administrative tasks or teaching obligations.

The CoEs for which information was received focus mainly on technical sciences; less than one-quarter of respondents had social sciences and humanities as their primary research field. The results highlight a marked difference in the average funding: CoEs in the technical sciences receive substantially larger research budgets than CoEs in the social sciences and humanities.

The results show marked differences in the objectives and strategies of CoEs with large and small budgets. CoEsLB engage significantly in co-operation with other research bodies, either departments of the same host institution or external centres, while CoEsSB, probably owing to the limitations imposed by smaller budgets, do so to a lesser extent. Overall, CoEs have substantial links with the private sector; these are particularly strong for CoEsLB that focus on technical sciences.

CoEs also put a considerable amount of effort into trying to attract and hire international researchers and thus create networks of excellence. Larger CoEs and those that focus on technical sciences employ the largest number of foreign researchers in their centres.

CoE researchers also have higher status than researchers affiliated only with the host institution. Researchers associated with a CoE have easier access to funds and career opportunities (e.g. tenure track positions) as well as privileged access to the host institution's physical infrastructures. In return, the host institution benefits from the establishment of a CoE, which raises the host's overall visibility and considerably strengthens its identity.

The management structure of the CoE relies on both top-down and bottom-up decision making strategies. The latter are more frequent in CoEsSB; being relatively smaller than CoEsLB, they are more able to involve all the bodies representing various members of the CoE.

REIs that support CoEs provide longer funding cycles than other forms of funding in order to achieve ambitious research goals. CoEs are generally able to manage research funds with some degree of freedom within the constraints imposed by the funding agency. Larger CoEs with longer funding cycles are, on average, granted more flexibility in the use of research funds.

CoEs are usually accountable to an external panel of reviewers who supervise their performance periodically. A smaller (while still consistent) fraction use metrics-based indicators to assess their overall performance. This latter method is more common in the technical sciences but less frequent in the social sciences and humanities owing to the measurement problems associated with building suitable output indicators in this area.

Overall, CoEs participating in the OECD/RIHR Survey on Centres of Excellence had a very positive view of the strategic importance of REIs, notably as regards their role in facilitating the opening of new lines of research and innovation that would not otherwise be pursued and thus in increasing the diversity of the research they undertake. Similarly, host institutions are likely to benefit from the research carried out by CoEs in terms of increased international visibility.

Notes

1. The full list of national REI programmes is given in Chapter 2.
2. The response rate is presented in Annex 2.A1.
3. The list of REIs is provided in Annex 2.A1.
4. Conversion from national currencies to USD PPP (year 2011) was carried out for cross-country comparability reasons. (Web link:. http://stats.oecd.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=SNA_TABLE4&ShowOnWeb=true&Lang=en).
5. Even though they represent a large share of the sample(s), Japanese centres do not drive the results significantly. To check robustness, the analysis was run without the Japanese CoEs and the results differed only slightly from the whole sample of CoEs. Whenever specific results obtained without Japanese CoEs were found to differ substantially (i.e. more than 15 percentage points) from the whole sample, the difference is noted in a footnote.
6. This problem is not unique to this project. In the context of the revision of the *Frascati Manual* (www.oecd.org/sti/inno/frascati-manual-revision.htm), efforts are under way at the OECD to improve the reliability and comparability of official R&D data on higher education expenditure on R&D (HERD). Measurement challenges are linked to the difficulty of separately identifying R&D from other activities in this sector.
7. The size of the research teams ranges from a minimum of 3 to a maximum of 460 researchers. Since data on employed staff were in some cases of uncertain quality, outliers (funding per researcher over USD 500 000) were eliminated from the computation of the average size of research teams. The optional field for comments revealed that providing exact data on staff was difficult in some cases. Some respondents noted that staff in the CoE are employed by the host institution(s) and/or partner(s), while in other cases the post-doctoral and/or PhD candidates were not solely attached to the CoE. Therefore, these data should be interpreted with care.
8. 2005 is used as a threshold for the age of the whole CoEs sample since it splits the sample into those whose age is above/below the average age in the data examined. CoEsSB are defined as young (old) if their age is below (above) the sample average of 9 years. The same applies for CoEsLB for which the average age is 6 years.
9. Within the category "technical sciences" the following areas are grouped: natural sciences, engineering and technology, medical sciences and health and agricultural sciences.
10. The questionnaire obtained information about the three most frequent activities for each CoE. Figure 3.5 shows the sum of all preferences for each option proposed in the survey as a percentage of the total.
11. These groups were not equally represented in terms of the number of responses and are based on qualitative responses.

12. This number reaches around 18 FTE researchers when Japanese CoEs are removed from the sample of CoEs.

13. Data are available for 161 CoEsLB and 44 CoEsSB samples.

14. These percentages are the sum of CoEs replying positively to both the first and second item in Figure 3.14.

15. This percentage reaches 90% when Japanese CoEs are removed from the main sample.

16. This percentage reaches 66% when Japanese CoEs are removed from the whole sample.

17. One respondent mentioned that interdisciplinary research is not yet adequately represented in the funding agency's evaluation/review boards and that it is easier for researchers to submit proposals for disciplinary rather than interdisciplinary research projects.

18. In some countries, the global financial crisis led to severe funding cuts, deteriorating working conditions for researchers (i.e. salary cuts) and few career prospects. One respondent mentioned that it seems almost certain that the current situation will lead to a significant fall in both research activity and quality in the short to medium term.

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Annex 3.A1
List of REIs, COEs and selected variables by country

Table 3.A1.1. Response rate by country

	Total questionnaires received	Respondents classified as CoEs according to project definition	Official number of national CoEs (as identified in Chapter 2)	Survey response rate at the national level
Austria	42	14	21	67%
Denmark	4	4	4	100%
Estonia	3	3	12	25%
Finland	3	3	18	17%
Germany	40	39	85	46%
Ireland	13	8	53	15%
Japan	108	108	146	74%
Korea	1	1	636	0%
Netherlands	2	2	6	33%
Norway	26	26	53	49%
Poland	1	1	6	17%
Portugal	51	39	84	46%
Slovenia	5	5	8	63%
United States	5	5	17	29%
Total	304	258	1 147	22%

Source: OECD/RIHR Survey to Government Ministries and Centres of Excellence and Survey, December 2012.

Table 3.A1.2. List of REIs, CoEs and selected variables

Country	Name of REI Programme	Official number of CoEs in each REI	Number of centres responding to survey	Response rate to the OECD/RIHR survey by each REI	Average funding per centre (USD million in PPP)	Median funding per year (USD million in PPP)	Minimum funding per year (USD million in PPP)	Maximum funding per year (USD million in PPP)	Number of centres providing self-reported funding data
Austria	COMET K1	16	10	63%	2.1	2.4	1.4	2.7	9
	COMET K2	5	4	80%	7.9	6.9	4	14	4
Denmark	UNIK	4	4	100%	3	3.1	3	3.1	4
Estonia	Development of Centre of Excellence in Research	12	3	25%	1.5	1.5	1.5	1.5	1
Finland	CoE (2008-13)	18	3	17%	1	0.6	0.5	2	3
Germany	Excellence Initiative	85	39	46%	4.1	1.9	0.7	13.9	35
Ireland	CSET	9	2	22%	4.4	4.4	4.4	4.4	1
	PRLTI	44	6	14%	2.1	2	0.1	4.1	4
Japan	Global COE	140	102	73%	2	1.6	0.1	26	100
	WPI	6	6	100%	10.8	11.3	8	11.6	6
Korea	WCU	636	1	0%	3.3	3.3	3.3	3.3	1
Netherlands	BIS	6	2	33%	5.4	5.4	4.7	6	2
Norway	CEER [FME]	11	7	64%	1.5	0.9	0.3	3.7	7
	CoE [SFF]	21	11	52%	1.6	1.3	0.7	3.1	9
	CRI [SFI]	21	8	38%	2.2	1.9	1.1	4.4	7
Poland	KNOW	6	1	17%	5.3	5.3	5.3	5.3	1
Portugal	Multi Year Funding Programme	84	39	46%	1.1	0.4	0.1	8.5	30
Slovenia	Centre of Excellence	8	5	63%	3.7	3.8	3.3	3.9	5
United States	STC	17	5	29%	3.9	3.7	3.4	5	5

Source: OECD/RIHR Survey to Government Ministries and Centres of Excellence and Survey, December 2012.

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Chapter 4

Research excellence initiatives and host institutions

This chapter describes the characteristics of institutions hosting centres of excellence (CoEs) funded through research excellence initiatives (REIs) in ten OECD countries. The survey data are used to provide information on the funding of host institutions (HIs) and CoEs and on their staff. The chapter looks at hosts' funding strategies, the direct and indirect means of support to CoEs, the way tasks are managed, and the perceived effects of REIs.

Introduction

This chapter presents the results of the survey to host institutions (HIs) of centres of excellence (CoEs) conducted by the OECD Working Party on Research Institutes and Human Resources (RIHR). The questionnaires were sent either to the director or to high-level staff of an institution that was, at the time, hosting a CoE funded through a national research excellent initiative (REI). Respondents provided information on funding schemes, administrative arrangements and the financial and research objectives of institutions that hosted one (or more) centre(s) of excellence (CoE) during 2011-12. An aim of the survey was to analyse the impact on these institutions of the research units funded by REIs. In addition, the information collected through the survey can help inform discussions on future government policy directions by providing new information on how REIs work and on the functioning and characteristics of institutions that host CoEs funded by REIs.

For the purposes of this study, REIs are characterised by government-level funding to selected research units and institutions (i.e. higher education institutions and public research institutes) for long-term initiatives in order to foster exceptional quality in research and research-related activities. Funding is usually awarded on the basis of peer-reviewed proposals (see Chapters 1 and 2).

Given the limited number of responses, the information obtained from the survey is best seen as offering relatively detailed examples of approaches taken by different organisations in different countries. As in the case of the analysis of CoEs in Chapter 3, it is important to stress that the information presented here should not be regarded as representative of the overall population of CoEs or HIs in OECD countries. In addition, some respondents were only able to reply to certain questions. Incomplete or partial information can create problems when trying to compare the results of specific questions with different response rates. As the number of respondents differs from question to question, so does the size of the sample on which average values are computed; comparison of different items is therefore not always straightforward. Nevertheless, with this in mind, interesting insights can be gained at the aggregate level (and in some cases by splitting the sample along some well-identified dimension).

Data source and methodology

The OECD/RIHR survey to HIs was mainly based on multiple-choice questions. However, it also included fields for optional comments, and this chapter draws on both the quantitative and qualitative data provided. In some instances it refers to specific examples from the case studies presented in Part II, Chapters 5 to 10.

Coverage

The survey collected information from 99 HIs in 10 OECD countries (Table 4.1). This chapter focuses on HIs that host CoEs associated with a REI programme. As described in Chapter 1, the seven criteria used to identify REIs are as follows:

- government-level funding of selected research units and institutions
- exceptional quality in research and research-related activities
- long-term funding (a minimum of four years)
- funds are competitive and are distributed on the basis of peer-reviewed applications
- applicants are required to participate in selection processes with fixed time frames

- institutions or research units (instead of individuals) apply for the funds as a collective body
- funding is substantially larger than for individual project-based funding (a general lower limit of USD 1 million a year per centre).

Of the 99 that responded to the survey, 75 hosted at least one CoE fitting the definition used in this study, and they constitute the final sample. Japanese HIs account for around 35% of the sample,[1] followed by German HIs (around 17%). The countries least represented in the overall sample are Estonia with two respondents (2.7%) and Denmark with three (4%). It should be noted, however, that the response rate across countries (Table 4.1) only provides information on the number of institutions responding to the OECD/RIHR survey and it is, therefore, not representative of higher education and public research institutions at the national level.

Table 4.1. Distribution of HIs across participating OECD countries

Country	Number of HIs	% of sample
Austria	5	6.7
Denmark	3	4.0
Estonia	2	2.7
Germany	14	18.7
Ireland	5	6.7
Japan	26	34.7
Norway	9	12.0
Portugal	4	5.3
Slovenia	4	5.3
United States	3	4.0
Total	**75**	**100**

Source: OECD/RIHR Survey to Host Institutions, 2012.

Characteristics of host institutions

Hosts were asked to provide information on the number of CoEs funded within their institution, the number of full-time equivalent (FTE) staff employed in each CoE, the total research budget of the host institution, and the annual amount of funds received by each CoE hosted. Table 4.2 presents the basic statistics.

Table 4.2. Characteristics of HIs and CoEs hosted (2011 or latest available year)

Variable	Number of observations (HIs)	Mean	Minimum	Maximum
HI research budget (USD million PPP)	64	221.7	1.2	1 333.3
Number of CoEs hosted by each HI	75	2.6	1	11
Total staff employed (FTE) by HI in all hosted CoEs	72	157	4	1363
Average staff (FTE) per CoE	72	42.5	3.9	181
Average funds per CoE (USD million PPP)	75	3.6	1.0	12.4

Source: OECD/RIHR Survey to Host Institutions, 2012.

The HIs' total average annual research funding is around USD 222 million in PPP[2] (based on the 64 HIs that provided self-reported quantitative information). Each HI hosts a different number of CoEs, from a minimum of one to a maximum of eleven. Each HI hosts an average of 2.6 CoEs. HIs hosting three or more CoEs are labelled HIsHCoE, while those hosting two or fewer are labelled HIsLCoE. These groups are analysed separately in this chapter when there are interesting differences with respect to the whole sample.

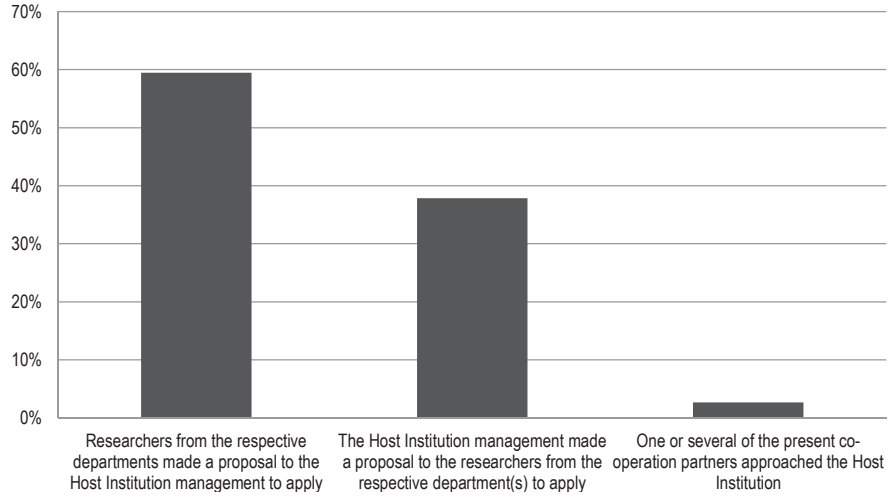
The total number of researchers affiliated with all hosted CoEs in each HI is around 157, with a minimum of 4 and a maximum of 1 363 FTE researchers. The average research team (in FTE) employed by each CoE has 42.5 researchers, with a maximum of approximately 181. The average funding per CoE is around 3.6 USD million in PPP.

Administrative arrangements and objectives

The decision to apply for REI funding and to establish a new research infrastructure (the CoE) under the umbrella of an HI relies on the interplay of different actors. The results show that the impulse to start the application process is generally driven internally, from either the HI's management structure or from the researchers in specific departments. Other bodies (i.e. external partners) play only a minor role in starting the application process for excellence funding. Around 60% of HIs (see Figure 4.1) declared that the initiative to apply for REI funding came from researchers in the respective departments and was eventually passed onto the HI's management. In around 38% of cases the HI's management structure suggested to researchers in specific departments to apply for funding. In only 3% of cases did one or several of the co-operation partners approach the HI to propose to apply for funding.

The decision to start the application process is sometimes linked to the size and variety of an HI's research areas. In German HIs and CoEs with few areas of excellence (see Chapter 6), the HI's management simply supported the activity of the initiators as much as possible. More formal procedures were required at HIs with strong research records in a broad variety of scientific fields to initiate the application procedure. For instance, the university management initially collected ideas from relevant departments, assessed them internally and then decided which proposals would be developed and submitted for funding.

Figure 4.1. Initiative to apply for REI funding

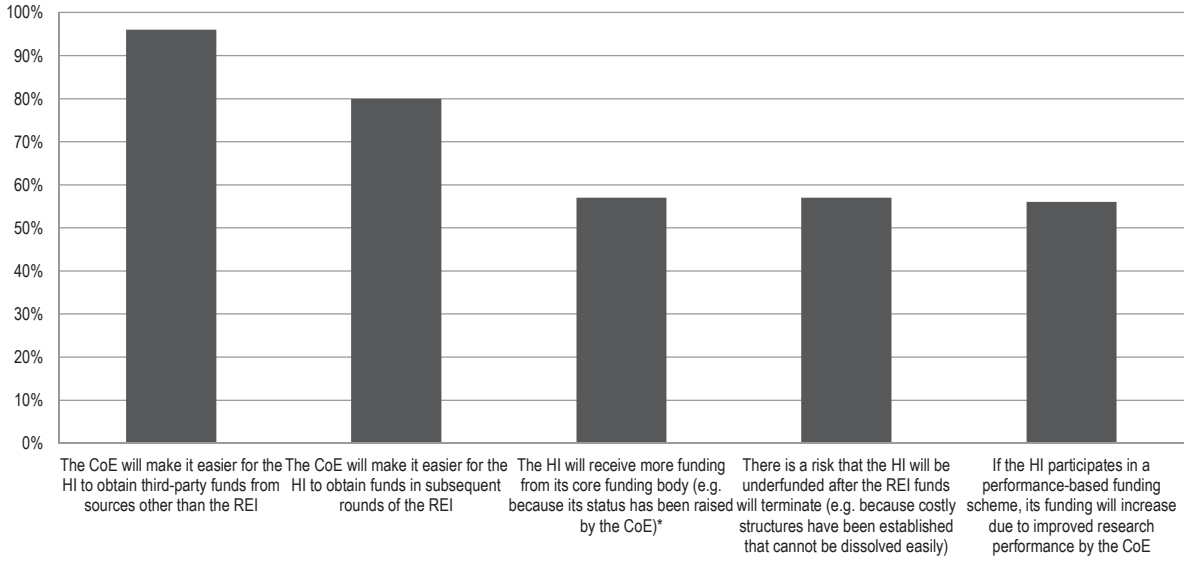


Source: OECD/RIHR Survey to Host Institutions, 2012.

From the point of view of the HI, supporting the creation and subsequent research activity of a CoE is usually linked to a strategic objective. Apart from the research outputs expected from the CoE, HIs are usually looking to enhance their visibility and improve their scientific, reputational and financial position in relation to other institutions. Figure 4.2 shows that 96% of HIs believe that their support for CoEs will eventually make it easier to obtain third-party funds. Similarly, 80% expect to be able to raise more funds in subsequent rounds of REIs. Supporting a CoE is also seen as a way to receive more funding from the HI's core funding body (57%) with the expectation that, once the CoE is in place, the HI's status will rise and it will attract further financial contributions.[3] In addition, 57% of HIs view their financial investment in the research activities of the CoE as a way to reduce the risk of insufficient funding once the REI expires.

Some Danish HIs (see Chapter 5) noted the importance of controlling potential financial risks, such as a CoE's costly agreements or structures that cannot be cancelled or easily dissolved at the end of the grant period; for example, they would only offer labour contracts beyond the lifespan of the CoE to a limited number of employees. Similarly, the university of Oslo in Norway, which was able to integrate the hosted CoE into the organisational structure of the host university, could only renew the contract of about half of the academic staff once the REI funding ended (see Chapter 8).

Figure 4.2. Expected results from supporting a CoE



Note: * Japanese HIs significantly drive some of the results. When they are removed from the sample, the share of HIs that expect to receive more funding from its core funding body drops to 47%.

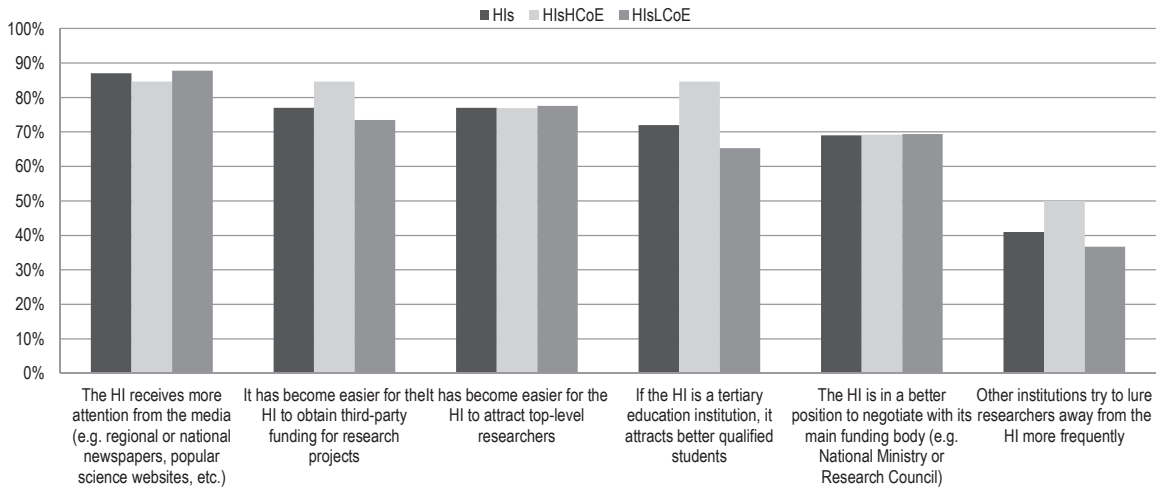
Source: OECD/RIHR Survey to Host Institutions, 2012.

The possibility of higher status and greater visibility in relation to other institutions is likely to affect the decision to sponsor, both directly and indirectly, the research activities of a CoE (Figure 4.3) and to influence the number of hosted CoEs. Around 87% of respondents stated that they receive more attention from the media owing to the establishment of a CoE. Higher status is also seen as a means to obtain funding from third parties (77%) as well as a way to increase the possibility of attracting top-level

researchers (77%) and better qualified students from other institutions (72%). German HIs were able for instance to establish new professorships at both senior and junior levels and to pay higher salaries to attract excellent researchers in order to raise the research status of both the CoE and the HI (see Chapter 6). However, 41% of survey respondents reported some potential negative effects of higher scientific status, mainly related to a tendency for competing institutions to try to lure researchers away.

The results in Figure 4.3 show that institutions hosting a larger number of CoEs (HIsHCoE) are on average in a better position to acquire third-party funding for research projects (85% of HIsHCoE as opposed to 73% of HIsLCoE). Similarly, HIsHCoE are also generally able to attract better-qualified students than HIsLCoE (85% of HIsHCoE as opposed to 65% of HIsLCoE). This situation again raises the danger that other institutions might try to lure researchers away from them (50% of HIsHCoE as opposed to 37% of HIsLCoE).

Figure 4.3. Effects of the CoE on the perceptions of external stakeholders



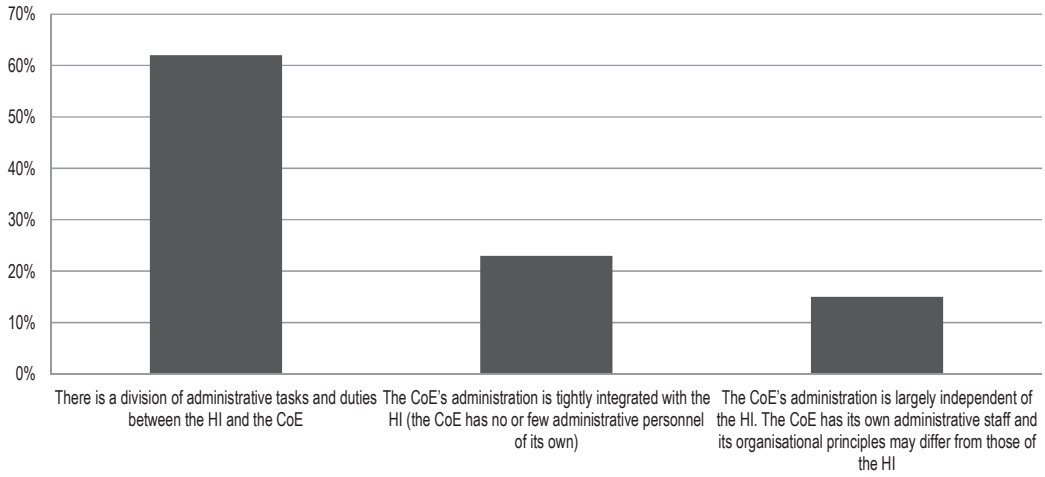
Note: HIs hosting three or more CoEs are labelled HIsHCoE. HIs hosting two or less CoEs are labelled HIsLCoE. The average number of hosted CoEs is 2.6.

Source: OECD/RIHR Survey to Host Institutions, 2012.

The way HIs interact with the hosted CoEs in the administration of their tasks is likely to affect the overall performance of both. Interesting information can be obtained by examining how tasks are administered between HIs and CoEs in HIs in which the REI positively affected their overall activities (i.e. 94% of the total HI sample). Approximately 62% of these also indicated that they had implemented a clear division of tasks and administrative duties between the HI and the CoE; a more restricted number of HIs declared that the administration of tasks was concentrated in either the host or the CoE (Figure 4.4).

In certain cases the clear division of tasks between the CoE and HI led to the creation of specific management groups. In Japan, since the universities do not administer the CoEs, a small administrative staff is hired using grant funds for this purpose (see Chapter 7). Similarly, in some Danish HIs many decisions are taken after consultation with an internal management/advisory group or an external advisory body. These auxiliary bodies consist of people with scientific expertise in the research field who supervise the centre's performance (see Chapter 5).

Figure 4.4. Administrative linkages and division between HIs and CoEs



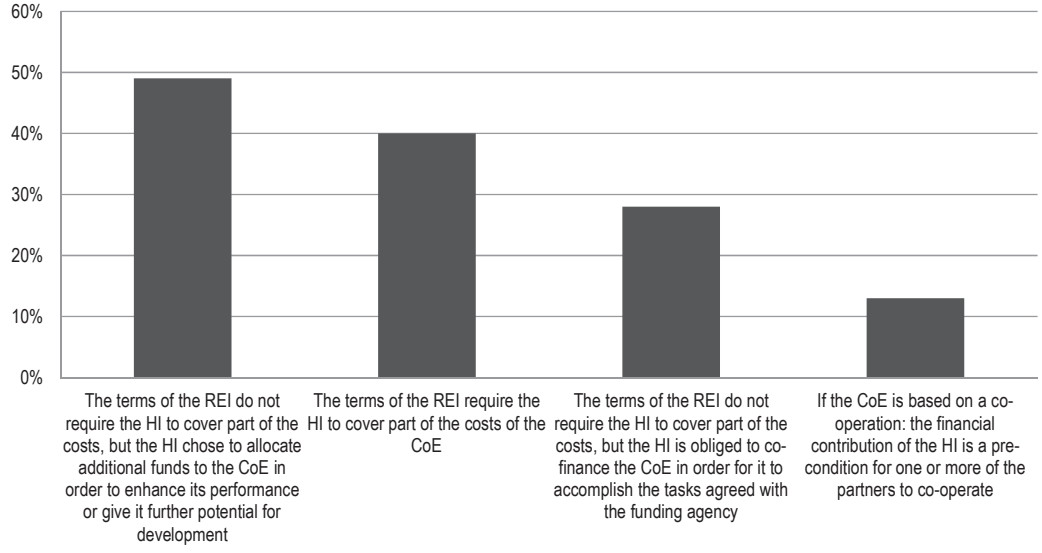
Note: This figure analyses HIs that positively value the experience of hosting a CoE (i.e. 92% of the total sample).

Source: OECD/RIHR Survey to Host Institutions, 2012.

Funding schemes

REIs generally provide guidance, directives and detailed obligations regarding the financial relationship between the hosts and the financed CoE. Figure 4.5 shows that 40% of HIs indicated that the terms of the REI required them to cover at least some part of the costs related to the activities of the CoE, 28% stated that they were obliged to co-finance the CoE, and 13% that the co-financing requirement was a pre-condition for co-operation. However, some 49% of hosts reported that their institution chose to allocate additional funds to the hosted CoE on a voluntary basis so as to enhance its research performance and/or give it further potential for development. This can be seen as a direct financial investment in the research activities of the CoEs.

Figure 4.5. REIs' funding requirements, HIs and CoEs



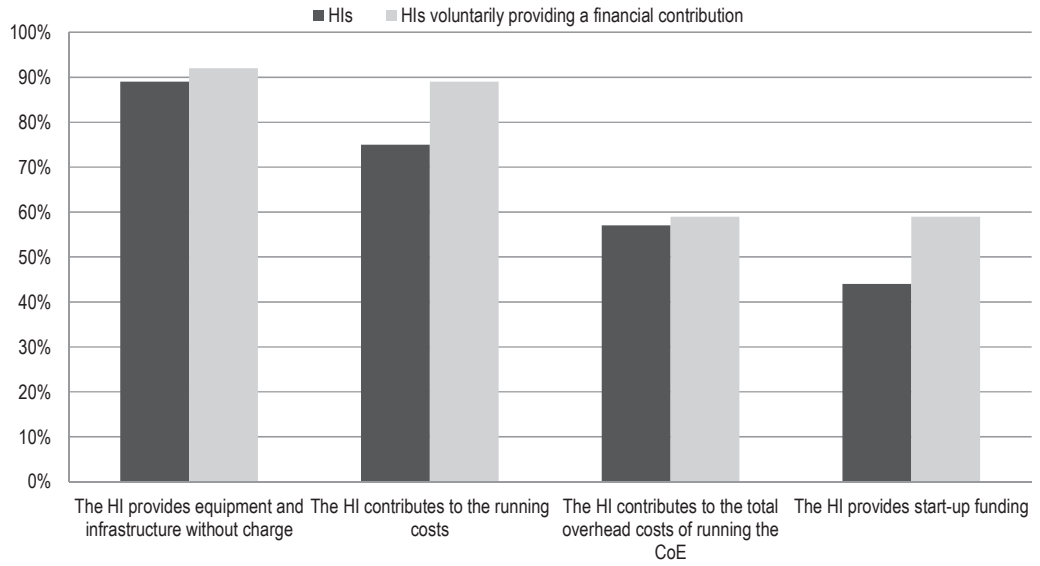
Source: OECD/RIHR Survey to Host Institutions, 2012.

Host institutions reported a variety of different schemes to finance CoEs. Figure 4.6 shows that 89% of the total sample of HIs provide equipment and infrastructure to the CoEs free of charge, while 77% contribute to the running of the research activities and 57% to the overhead costs. Only 44% of HIs provide start-up funds to the hosted CoEs.

In Norway, HIs are required to cover infrastructure and overhead costs for the CoEs (see Chapter 8). However, their practices vary: some interpret co-funding literally and provide funding from their own budgets, others use infrastructure as their co-funding. The former practice created tensions in some cases since the support given to the CoEs came at the expense of other research groups in the department. Survey responses show that overhead and running costs paid for by HIs range from administration and basic infrastructure to larger expenditures on staff positions, facilities and technical instruments used by the CoE.

There are marked differences in the financing methods preferred by HIs that voluntarily provide financial contributions to the activities of the CoEs (i.e. 49% of respondents, Figure 4.5). The results in Figure 4.6 show that 59% do so through start-up funding (44% in the overall HI sample) as well as by contributing to the running costs of the CoEs (89% of HIs voluntarily providing financial contribution). The vast majority of HIs that voluntarily support CoEs also provide equipment and infrastructure free of charge (92%). Co-financing of externally funded research projects was also mentioned as one way to embed the work of the CoE within the host institution. In Portugal, associated laboratories (CoEs) sometimes make use of start-up funding and then convert the intellectual property rights of the research carried out by the CoE into start-up equity (see Chapter 9).

Figure 4.6. Funding schemes



Note: HIs voluntarily providing financial contributions represent 49% of the total HI sample; see Figure 4.5.

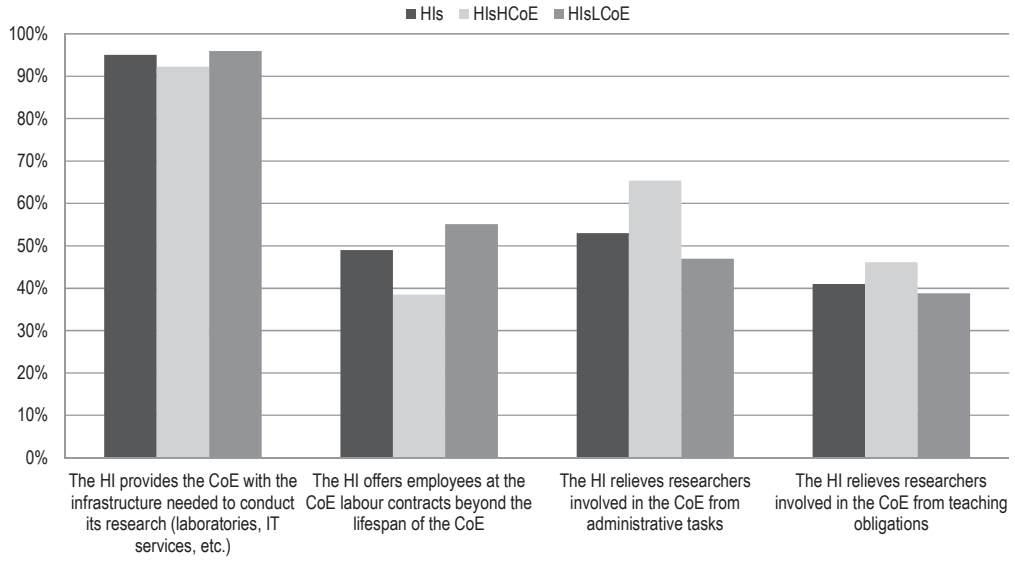
Source: OECD/RIHR Survey to Host Institutions, 2012.

Direct financial transfers are not the only method used by HIs to support the activities of CoEs. Support for CoEs' research activities is also provided in ways that do not involve any explicit financial contribution. Figure 4.7 shows that up to 95% of HIs support CoEs by providing the necessary physical infrastructure to carry out their research. Approximately 53% also support CoEs' research activities by providing the possibility, in specific cases, of relieving researchers from administrative tasks, and 41% of relieving them from teaching obligations to allow them to conduct research on a full-time basis.[4] Up to 49% of HIs also reported supporting researchers by providing a more stable work relationship with the host through research contracts that go beyond the lifespan of the envisaged life of the CoE.[5]

Differences in the results can be observed when the sample is split into HIs hosting a larger/smaller number of CoEs. HIsHCoE are less prone to offer employees a labour contract that goes beyond the lifespan of the CoEs, probably owing to the difficulty of making such a commitment for the large number of researchers employed by many hosted CoEs. However, they relieve researchers from administrative tasks and teaching obligations more frequently than in the total sample.

Survey responses also indicate that support arrangements often depend on the needs of the project. Some support arrangements include providing access to university functions such as technology transfer offices, and one institution has a dedicated support function for research institutes and CoEs. Some respondent institutions also indicated that they make academic appointments in strategic areas in order to support the CoE and the host department.

Figure 4.7. Other means of support for CoEs' activities



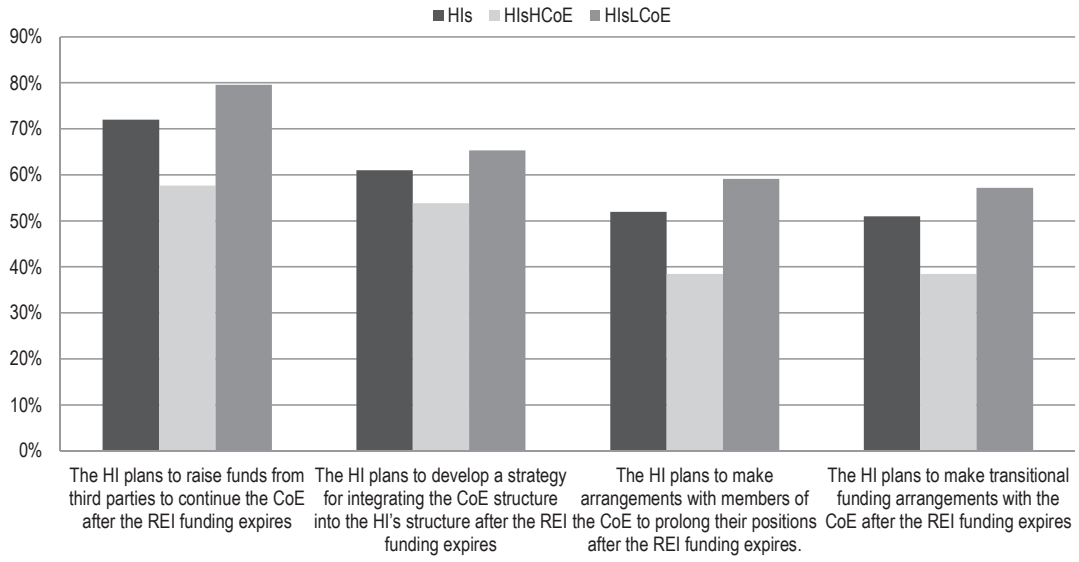
Note: * The results change significantly when Japanese host institutions (HIs) are dropped from the sample. The share of HIs that relieve researchers from administrative tasks drops from 53% to 39%, while the share of HIs that offer employees contracts beyond the lifespan of the CoE rises from 49% to 67%. Other items change only slightly. HIs hosting three or more CoEs are labelled HIsHCoE. HIs hosting two or fewer CoEs are labelled HIsLCoE. The average number of hosted CoEs is 2.6

Source: OECD/RIHR Survey to Host Institutions, 2012.

The survey also asked how HIs handle and manage the CoE after the REI ends. The responses reveal that the establishment of a CoE is not viewed as a one-off experience but as an important component of the HI's overall activity. Figure 4.8 shows that 72% of HIs are keen to raise funds from third parties after REI funding expires in order to continue the research carried out by the CoE. Similarly, most HIs plan either to prolong the positions of the CoE members (52%) and/or to devise suitable arrangements concerning transitional funding (51%) when the REI ends, while 61% plan to develop a strategy to integrate the CoE in the host structure.

The results show interesting differences when responses are disaggregated by groups of HIs. The HIsHCoE are on average less prone than HIsLCoE to prolong or integrate the existing CoEs into the HI's structure by either looking for third-party funds (58% of HIsHCoE and 80% of HIsLCoE) or transitional funding arrangements (38% of HIsHCoE and 57% of HIsLCoE). This is probably due to the higher burden that hosting a larger number of CoEs might impose on the administration and budget of HIs.

Figure 4.8. Arrangements for the end of the REI



Note: HIs hosting three or more CoEs are labelled HIsHCoE. HIs hosting two or less CoEs are labelled HIsLCoE. The average number of hosted CoEs is 2.6.

Source: OECD/RIHR Survey to Host Institutions, 2012.

The link between HIs and CoEs funding

Each HI allocates a fraction of its total research budget to fund and support the activities of hosted CoEs. According to the data provided by respondents, the share of HIs' total research budget allocated to the CoEs' activities represent on average 9% of each HI's total research budget.[6] This share, which is a proxy for the intensity with which HIs fund the research of CoEs, differs significantly across the sample of HIs from a minimum of 0.01% to a maximum of around 68%.

HIs for which the share of the total research budget allocated to CoEs is above 9% are categorised here as CoE-intensive HIs. Those for which the share is below 9% are categorised as CoE-non-intensive HIs (see Box 4.1).

Box 4.1. HIs' total research budget and intensity of CoEs

Because the survey collected data on both the funding allocated annually to centres of excellence (CoEs) at each host institution (HI) and the total research budget of each HI, it was possible to determine the approximate weight (i.e. intensity) of the CoEs' research activities in each HI's total activities. In the sample, the CoE budget represents on average 9% of each HI's total research budget. This average value is used as a threshold to group HIs by CoE intensity as follows:

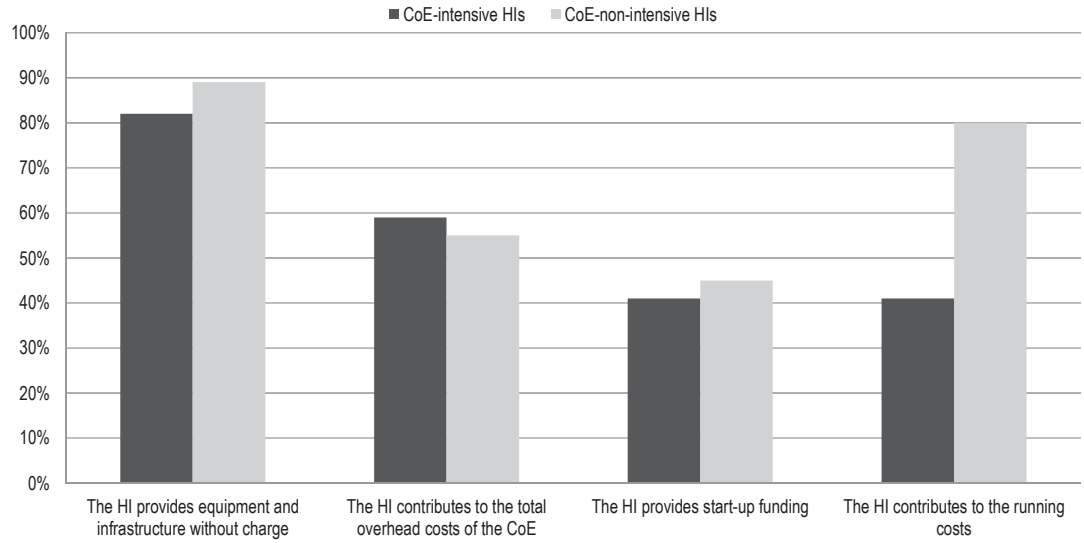
- The CoE-non-intensive HIs are those for which the share of HIs' total research budget allocated to CoEs' activities is equal to or below 9%. The CoE-non-intensive HIs are, hence, those in which the research activities of the CoEs represent a relatively minor share of their total research activity: 44 HIs are in this category.
- The CoE -intensive HIs are, instead, those that allocate a relatively larger fraction (above 9%) of their total research budget to finance and support the research activities of the hosted CoEs: 17 HIs fall into this category and are considered CoE-intensive.

Interestingly, the CoE-non-intensive HIs are endowed with larger total research budgets (USD 294 million (PPP) on average) while the CoE-intensive HIs are generally smaller (USD 73 million (PPP) on average).

It is important to bear in mind, however, that the financial data collected may, in some cases, not be fully reliable owing to the difficulties encountered by some respondents in identifying overall research expenditures and available budgets. In a limited number of cases, the self-reported data for the overall HI's research budget was smaller than the amount allocated to the hosted CoEs. In others, the data on the total research budget was very different from publicly available official data. Where there was a lot of uncertainty about the reliability of the data, the data on the total research budget were not used in order to avoid biased results. This problem is not unique to this study. In the context of the revision of the *Frascati Manual* efforts are under way at the OECD to improve the reliability and comparability of official R&D data on higher education expenditure on R&D (HERD) (see www.oecd.org/sti/inno/frascati-manual-revision.htm). Measurement challenges are linked to the difficulty of separately identifying R&D from other activities in this sector.

The relative weight of CoEs' research activities in each HI's total research activity (i.e. the CoE intensity) is likely to be related to the type of funding scheme used to provide financing to the CoE (Figure 4.9). Around 80% of CoE-non-intensive HIs contribute to the running costs of their CoEs but this drops to 41% of the CoE-intensive HIs. This may be because CoE-intensive HIs, even if allocating a larger share of their budget to the research activities of their hosted CoEs, are also, on average, endowed with smaller overall research budgets (around USD 73 million PPP, see Box 4.1) and, hence, have less possibility to support the activities of the hosted CoEs directly.

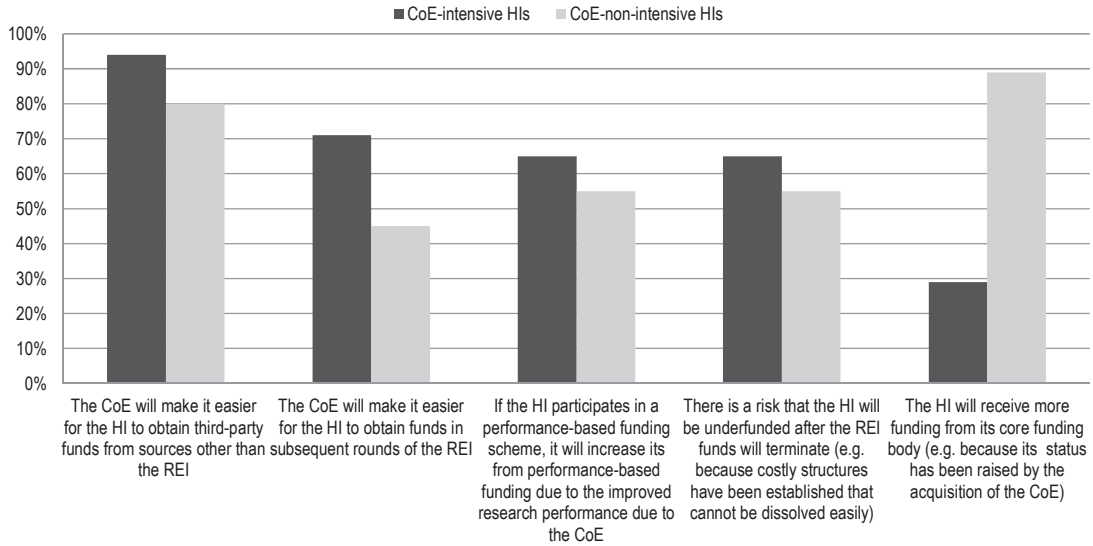
Figure 4.9. Funding schemes by CoEs' share of the HI's total research budget



Source: OECD/RIHR Survey to Host Institutions, 2012.

As regards the expected financial effects of hosting a CoE, significant differences appear when the total sample of HIs is split into CoE-intensive and CoE non-intensive HIs. Figure 4.10 shows that 71% of CoE-intensive HIs expect that the support they provide to research activities of hosted CoEs will make it easier to obtain subsequent REI funding but the figure drops to 45% for CoE-non-intensive HIs. CoE-intensive HIs also emphasise the role played by the activities of the hosted CoEs in attracting additional third-party funds or REI funds in the future. Yet, while only 29% of CoE-intensive HIs see CoEs' activity as an important driver of additional funding from their core funding body, almost 90% of CoE-non-intensive HIs do so.

Figure 4.10. Financial effects by CoE funding intensity



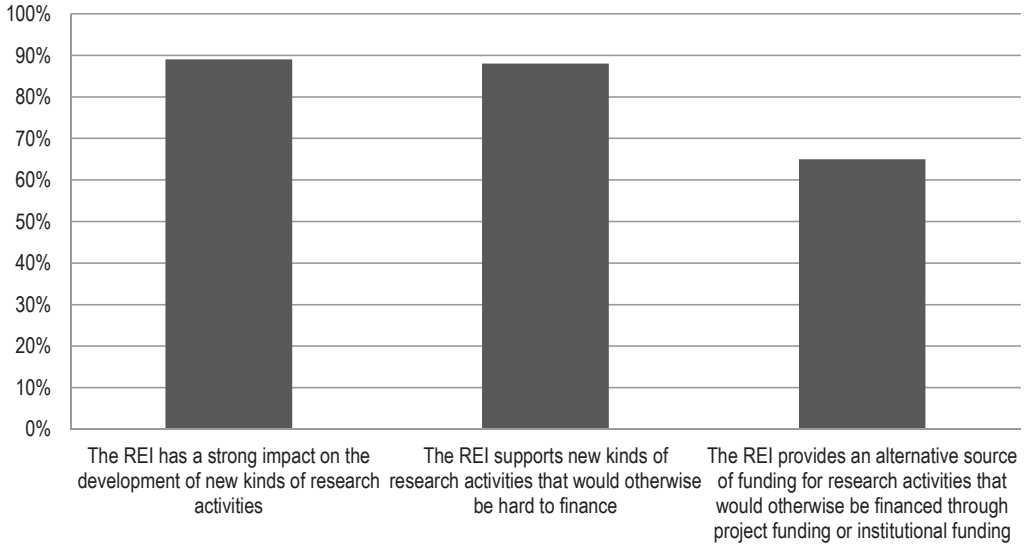
Source: OECD/RIHR Survey to Host Institutions, 2012.

These results indirectly reveal the different expectations of the two groups. CoE-intensive HIs, with smaller total budgets for research, seem to be more dependent on third-party or external funds (such as those of REIs) and hope to use the higher status and visibility granted by hosting a CoE to raise additional funds in the future. HIs endowed with larger total research budgets, and for which the importance of CoE activities may be relatively minor, rely more on the possibility of raising additional funds from their traditional funding schemes.

Perceived effects of REIs and CoEs

The survey also examined HIs' perception of the effects (if any) of REIs on their research activities. The results show an overall positive opinion of the effects of the REI funding (Figure 4.11). Around 89% of HIs reported that the REI had a strong impact on the development of new kinds of research activities and that it would have been difficult to finance some of these through other research funding schemes (88% of respondents). However, in 65% of cases, HIs also declared that the REI provided an alternative source of funding for research that would have been funded anyway through institutional or project funding because of the fundamental importance of the research.

Figure 4.11. Perception of the effects of REIs



Source: OECD/RIHR Survey to Host Institutions, 2012.

Both the tangible and intangible output of scientific research can spill over to different sectors, research fields and areas of knowledge (Benhabib and Spiegel, 2005; Coe and Helpman, 1995; Coe et al., 2009; and Keller, 2004). Similarly, hosting a CoE can lead to spillovers to the various departments of the host institution, some of which may be able to gain from the expertise of skilled scientists employed elsewhere in the HI. The positive effects of REIs and CoEs are therefore not confined to the departments directly affected by the funding. The survey addressed this issue by measuring HIs' perception of the effects of the hosted CoEs' research activities on departments not directly involved. Approximately 69% reported that other departments in the institution benefited from the work carried out by the CoEs in terms of new co-operation but also,

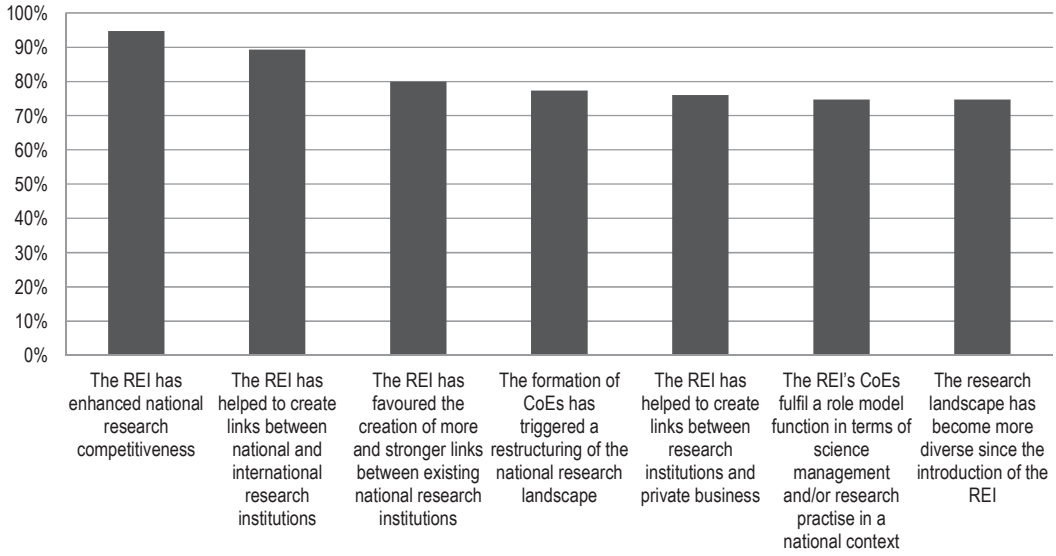
more intangibly, through a new sense of competition for excellence in research across the HI's various departments created by the increase in the HI's reputation. None of the respondents in the sample reported negative effects as a result of the establishment of CoEs and of the application to a REI programme. They considered that the relatively long timelines of CoEs were beneficial in launching projects that lead to long-term interdisciplinary collaborations (see Box 4.2).

German CoEs and HIs found that communication between departments increased and that they were able to build new bridges between disciplines (see Chapter 6). The notion that researchers need to communicate effectively across the borders of their own scientific discipline has also gained acceptance as a consequence of the co-operation activities triggered by the REI funding. Interviewees widely believe that departments and scientific disciplines have all gained by learning to talk and listen to each other.

Overall, HIs' perception of the lasting effects of REIs is very positive (Figure 4.12). In the vast majority of cases respondents declared that the REI had enhanced national research competitiveness (95%) and helped to create links between national and international research (89%) as well as stronger links between existing national research institutions (80%). The links with industry were also positively affected by REI programmes.

In Japan, REI programmes helped to bring together first-class domestic and foreign teachers and students in order to blur disciplinary boundaries and gain industry participation in the research carried out by the CoEs (see Chapter 7). The ambitious objectives of the REI funding scheme is also reflected in the way this affected the German national research system. One of the aims of the German Excellence Initiative was, in fact, to rethink the notion of a university. In this respect, the openness to change with regard to university culture mattered as a factor of success in the Excellence Initiative that eventually helped, among other things, to break down the barriers between departments and the university management (see Chapter 6).

Figure 4.12. REI's lasting effects on the national research system



Source: OECD/RIHR Survey to Host Institutions, 2012.

Box 4.2. Overall assessments of the intended and non-intended effects of REIs by host institutions

The survey of host institutions allowed respondents to describe their overall view of REIs. This included wider benefits and costs that had not originally been envisaged by the host. The majority of respondents gave positive assessments, though some downsides were expressed.

The first positive assessment of note was the effect of REIs on developing high-quality research. REIs were seen as a key instrument for opening new fields of innovative research that often would not have been funded by existing mechanisms. REIs were deemed highly important in bringing in research funding and this had knock-on effects – many institutions noted that hosting a CoE had stimulated additional third-party research funding from governments, business and other organisations. REI investment also helped, in many cases, to develop a critical mass within the host institution which allowed related research projects to continue, and in some cases led to investment in core facilities that left a longer legacy.

Most respondents mentioned research collaboration and improved reputational standing as major benefits. Host institutions noted increased co-operation with other research institutions, as well as lasting interdisciplinary co-operation and increased links with industrial research partners. They saw International collaboration and internationalisation of research as among the main benefits of REI participation – for many institutions, hosting a CoE led to many new formal and informal international partnerships. These collaboration benefits may stem in part from the reputational benefits of hosting an REI. Respondents identified a marked improvement in the profile of the institution as a key benefit. They also saw enhanced reputation resulting from the REI as a driver in attracting new researchers and students to the institution.

Another set of advantages noted by host institutions related to internal structures. Several responses noted that participation in REIs had affected the culture of the host institution. For instance, in some cases a new awareness of professional structures entered the institution more widely, and REIs were deemed to have resulted in increased competitiveness. Some respondents noted that the conduct of new, high-quality research within the institution also led to improved teaching and training of students and a beneficial effect on the careers of researchers.

On the negative side, the most common reference was to overhead and co-financing costs. The fact that overhead costs were not included in REI funding was cited as a drain on resources by some institutions. Administrative costs, such as those involved in the application, implementation and management of the CoE, were cited as burdensome in some cases. Otherwise, there were some concerns expressed as to the effects on a host institution of the termination of a CoE and the potential of a new CoE to create divisions within university departments or research institutions.

Summary of the results

This chapter describes the basic characteristics of 75 host institutions in ten OECD countries that hosted at least one centre of excellence funded through REIs. The exploratory analysis carried out on the basis of this sample shows that HIs have research budgets of approximately USD 222 million in PPP on average, and host almost three different CoEs at the same time. The total number of CoE-affiliated researchers at the HI is around 157 (FTE) and individual CoEs employ on average 42.5 researchers.

The HIs' main means of supporting and financing CoEs' research is to provide equipment and infrastructure free of charge and to cover CoE running costs. In some cases HIs also provide start-up funding and contribute directly to the CoEs' total overhead costs.

In some cases, the REI obliges the HIs to finance the hosted CoEs. Interestingly, almost 50% of HIs provide additional funds to the CoEs on a voluntary basis in order to enhance the performance of the hosted CoEs. The data show that HIs do not view the activity of the CoEs funded through an REI as a one-off experience but as a fundamental part of the HI's overall research strategy.

Some 61% of the HIs stated that they planned to develop strategies to integrate the CoE structure more formally into the HI once the REI funding expires. This is one of the most important exit strategies used by HIs to ensure that CoEs continue their research activity. Similarly, almost 50% plan to develop arrangements to renew CoE researchers whose contract depends on the REI funds once these expire. HIs with a larger number of CoEs, however, are less likely to integrate all CoEs into their existing structures given the administrative and financial burdens that this would imply.

The importance of the research carried out by the CoEs at the HIs is also revealed in the indirect ways HIs support CoEs' researchers and their activities. In 53% of HIs, CoE researchers can be relieved from administrative duties and in almost 41% from teaching obligations, so that they are able to allocate more time to CoE research. This is more frequent in the case of CoE researchers employed within the structures of HIs hosting three or more CoEs.

The substantial support provided by HIs to CoEs also has some clear strategic financial objectives. Hosting a CoE is perceived as a way to raise additional funds in the future. Some 71% of HIs believe that hosting a CoE will make obtaining additional REI funds easier in the future. Almost 94% perceive the support provided to CoEs as conducive to easier procurement of third-party funds owing to the higher research status conferred by the CoEs' research activity.

HIs differ substantially in terms of the share of total research budget allocated to the research of their hosted CoEs. On average, they allocate up to 9% of their total research budget to activities carried out by CoEs. However, some HIs allocate more than this (up to 68%). HIs that allocate larger shares of their budget to CoEs' research activities see their support as a means of obtaining additional REI and third-party funding, while others, for which the CoEs' activities represent a smaller fraction of their total research activities, rely more on traditional funding.

Overall, HIs show very strong appreciation of the REI funding schemes and of the research activity of the hosted CoEs. For almost 89%, the REI is perceived as having a strong impact on the development of new kinds of research activities that, in most cases, would otherwise have been difficult to finance. Moreover, 69% of the HIs declared that the positive effects of the research carried out by CoEs were not confined to the departments that received the funds but spilled over to departments not directly involved in the research. Other positive effects include more attention from the media and more possibilities to attract top-level researchers and better qualified students for their research programmes.

Notes

1. Even though they represent a large share of the sample, Japanese hosts do not drive the results significantly. To check robustness, the analysis was run without the Japanese hosts and the results differed only slightly from the whole sample. Whenever specific results obtained without Japanese hosts were found to differ substantially from the whole sample, the difference is noted in a footnote.
2. Funding data are converted using the OECD's official statistics on purchasing power parities (PPP) for each country for the year 2001. See,. http://stats.oecd.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=SNA_TABLE4&ShowOnWeb=true&Lang=en.
3. Japanese HIs significantly drive some of the results. When they are removed from the sample, the share of HIs that expect to receive more funding from its core funding body drops to 47%.
4. The results change significantly when Japanese HIs are dropped from the sample. The share of HIs that relieve researchers from administrative tasks drops from 53% to 39%.
5. The results change significantly when Japanese HIs are dropped from the sample. The share of HIs that relieve researchers from administrative tasks rises from 49% to 67%.
6. When Japanese HIs are removed from the sample, the average share of HIs' total research budget allocated to CoEs' activities increases to around 14%.

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PART II

COUNTRY CASE STUDIES

Part II presents a collection of six country case studies describing the different administrative arrangements, approaches, aims and effects of research excellence initiatives (REIs) in six OECD countries. It builds on the analysis presented in earlier chapters of the report by providing more detailed analysis of the strategies followed by each country in establishing funding and supporting the activities of REIs, centres of excellence (CoEs) and host institutions (HIs). It also discusses the perceived effects on the national research systems.

Chapter 5

Denmark: Centres of excellence

Sune Kaur-Pedersen
Danish Agency for Science, Innovation and Higher Education

This chapter presents a Danish research excellence initiative (REI), the Investment Capital for University Research (UNIK) and its four centres of excellence (CoEs). It discusses the REI's aims and funding, its implementation, the fields of science covered, the management and funding of the CoEs, as well as its impact and effects. Overall, the perception is that the initiative has enhanced national research competitiveness and has helped to internationalise Danish research by fostering collaboration between national and international research institutions.

Public research excellence initiatives: An overview

Denmark has a portfolio of public research funding that concerns centres of excellence. In 1993, the first of these initiatives was established under the Danish National Research Foundation (DNRF).[1] It was inspired by the German Max Planck institutes and major national strategic research programmes of the late 1980s. Then, in 2006 the Danish Council for Strategic Research started funding so-called strategic research centres. In the last couple of years, two initiatives with centre-of-excellence traits have been established and give grants to research institutions instead of individual researchers. One is the 2009 Investment Capital for University Research (*Universitets-forskningens Investeringskapital,* UNIK) under the then Danish Ministry of Science, Technology and Innovation. The other is the 2010 Strategic Platforms for Innovation and Research (SPIR),[2] which is funded jointly by the Danish Council for Strategic Research and the Danish Council for Technology and Innovation.

Table 5.1 summarises a number of parameters of the public research excellence initiatives (REIs). In addition, at least two private foundations have begun funding centres of excellence (CoEs) at universities; the universities themselves have also begun to distribute part of their block funding on the basis of criteria linked to research excellence.

Table 5.1. Denmark: Public research initiatives funding centres of excellence

First grant	Type of research	Scientific, thematic areas	Total funding, inception to 2012, million DKK	Scheme funding per centre, million DKK per year[1]	Number of grants/funded centres	Period of funding (years)	Applicants
Funding agency: Danish National Research Foundation							
Scheme: Centres of excellence							
1993	Basic research	All	5 469	8.9	88 of which 48 are active	5-10 (typically 10)	Individual researchers
Funding agency: Danish Council for Strategic Research							
Scheme: Strategic research centres							
2006	Applied research	Mainly "sustainable energy and environment", "strategic growth technologies" and "health, food and welfare"	1 137	6	36 of which 32 are active	5-7	Individual researchers
Funding agency: Ministry of Science, Innovation and Higher Education							
Scheme: Investment Capital for University Research (UNIK)							
2009	Basic and applied research	All	480	24	4 of which 4 are active	5	Universities
Funding agency: Danish Council for Strategic Research and the Danish Council for Technology and Innovation							
Scheme: Strategic Platforms for Innovation and Research (SPIR)							
2010	Applied research	Food, energy and welfare technology	270	13.3	4 of which 4 are active	5-7	Universities, research institutions and private companies

Note: 1. The amounts are calculated as average per year of the grants given in the latest round of applications and include an overhead of 44%.

This section describes Denmark's Investment Capital for University Research (UNIK) initiative. It is based on the OECD host and centre survey carried out in late 2012 by the Working Party on Research Institutions and Human Resources (RIHR). The questionnaire was sent to the four centres and the three host universities funded by the UNIK. The information from the OECD/RIHR survey was supplemented by the main documents relating to the REI in the Ministry of Science, Innovation and Higher Education in Denmark and telephone interviews with the CoEs and host institutions.

Investment capital for university research

Aims and funding

The overall aim of the UNIK initiative was to promote world-class research in Danish universities and to advance the government's goal of at least one Danish university among the ten best in Europe. The proposal behind the initiative was part of the government's strategy to meet the opportunities and challenges of globalisation; the funding came from a pool of DKK 21 billion established as part of a political agreement in November 2006.[3] Specific funding for the initiative was provided in the Danish Finance Acts of 2008 and 2009.

As mentioned, the UNIK initiative represented a new way of granting research funds. Until then, funds distributed on a competitive basis to CoEs were only granted to individual researchers. The initiative offered a substantial DKK 480 million (approximately USD 61.1 million[4]) in competitive funding to encourage Danish universities, as institutions, to strengthen their strategic efforts to prioritise research and create a distinctive research profile.

The rationale behind the initiative was to provide risk capital for excellent research that universities could use to develop specific skills and enhance their international competitiveness. Moreover, in a period during which several Danish universities were merged, the UNIK initiative was seen as a way to support and bridge the different research environments of the restructured universities.

At present, however, there are no political plans to continue the UNIK initiative with fresh funding. The present government considers that the funding of CoEs should be covered by the universities themselves or by the DNRF, which supports excellent research funds by funding individual researchers (and not universities) with large grants.

Implementation and evaluation of the call

A call for proposals was announced on 15 October 2007 with a deadline for applications by Danish universities of 1 April 2008. A special expert panel appointed four reviewers for each proposal after consultation with universities in April and May 2008.

Denmark's eight universities sent 28 proposals out of a maximum of 31. The universities chose the topics as the call stated that funding could be awarded to all thematic areas and to basic as well as applied research. However, it also stated that each proposal should extend beyond an individual research project to focus on an overall research theme. Each grant was considered as risk capital invested in a prospective field of research, with a somewhat uncertain outcome. Furthermore, the grant was meant to enable the university to invest in research fields that would not otherwise be a priority.[5]

The proposals were reviewed and prioritised in June and July and then again in November 2008 by an expert panel and through consultation with the universities. A conditional grant agreement was signed in January 2009 and the actual grant agreement was signed in April 2009.

DNRF supervised the peer review process on behalf of the Danish Agency for Science, Technology and Innovation (DASTI). In that capacity it contacted the international experts who were to review the proposals for the UNIK grants.

After the external international peer review and the consultation process, four proposals at three of Denmark's eight universities were funded. Two of the centres are at Copenhagen University, one at Aarhus University and one at the Technical University of Denmark.

The final decision was formally taken by the then Minister of Science, Technology and Innovation and was based upon the evaluation and ranking of the proposals carried out by the international expert panel, which consisted of 11 professors who were employed outside of Denmark.

The universities received approximately DKK 120 million for each of the four centres to cover funding from 2009 to 2013. Every year the centres are obliged to provide a cost statement and a brief progress report in writing. In addition, an expert panel carries out annual site visits at the centres. DASTI has legal responsibility for overseeing the appropriate use of the funding.

The four grant units

The four grant units that received funding from the 2009 call are presented in Table 5.2.

Table 5.2. Overview of UNIK grant units

Catalysis for Sustainable Energy – CASE
Purpose: to develop a science-based rational design strategy for new catalysts and processes for energy conversion for a spectrum of energy sources.
Host: The Technical University of Denmark. Total research budget DKK 2.9 billion (2011).
MINDLab
Purpose: to study mind-brain relationships from their religious, societal and psychological underpinnings to the biochemical and cellular mechanisms underlying normal brain function and their imbalance in disease.
Host: Aarhus University. Total research budget DKK 3.5 billion (2011).
Synthetic Biology
Purpose: to develop insights, tools and technologies for preparing and characterising bio-inspired systems with tailor-made functions.
Host: University of Copenhagen. Total research budget DKK 4.7 billion (2011).
Food, Fitness and Pharma for Health and Disease
Purpose: to identify and characterise the environmental and genetic causes of lifestyle diseases and develop new means to prevent and cure them.
Host: University of Copenhagen. Total research budget DKK 4.7 billion (2011)

UNIK was considered a dynamic and closely-co-ordinated research framework for related research activities. The organisational unit was to be well conceived and well organised in terms of the research field or the number of research groups involved. It could include some or several research groups, research centres and/or individuals.

All four units were established in 2009 as a result of the call for proposals. University management financed the drawing up of the four proposals that received funding. Three out of the four proposals were initiated by university management and one by the researchers themselves.

The management of each university was deeply involved in the process leading up to reception of the grant, as it chose the proposals to be forwarded to the ministry owing to the limit on the number of applications. At the Danish Technical University the research programme of the CoE was developed from the university's more general research strategy. At Copenhagen University and Aarhus University the UNIK initiative influenced the development of the university's overall research profile because it helped the university management to identify research areas to be given special priority in the future.[6]

After receiving the grant the universities made a special, central-level administrative unit responsible for overall supervision of the UNIK, as the vice-chancellor of the university is legally responsible for the grant. At Copenhagen University and Aarhus University administrative duties and tasks are divided between the university and the CoE. At the Danish Technical University the CoE administration is largely independent of the university's central administration.[7]

In its day-to-day management the CoE generally seems to operate without the direct involvement of the university management. One or two centres, however, have experienced some constraints. This may be due to the internal rules or the management of the grant at the different universities. For instance, is it important for the university management to control the CoE's potential financial risks, such as costly agreements or structures that cannot be cancelled or easily dissolved at the end of the grant period. This is reflected in the fact that the host universities only offer labour contracts beyond the lifespan of the CoE to a limited number of employees.[8]

Fields of science and co-operation

Even though the primary field of science for CASE and Synthetic Biology is the natural sciences and the primary field of MINDLab and Food, Fitness and Pharma are the medical sciences and health, they all collaborate across disciplines to work towards their research goals. Indeed, one of the main characteristics of the four centres is that they are cross-disciplinary and cover between two and five fields of science.[9]

The call did not require collaboration between research groups at the university or with other universities. However, many of the objectives of the research goals could not be reached within the boundaries of one academic discipline and required co-operation with other disciplines. This cross-disciplinary orientation is now supported in the organisational setup (i.e. management and co-ordination, the composition of the individual research groups, and the training of young researchers).

It is the overall view of the informants that the amount of funding and the timespan of the grant have made it possible to establish collaborations that would not have been undertaken under the normal research funding systems owing to the terms of the call and the cross-disciplinary issues the researchers seek to address. Because the grant is large, the participants can operate independently, and within their university they have become academic leaders.

The main co-operative relationships seem to be most intense with different departments of the host university and with international researchers and research institutions specialised in the same area of research. Co-operation is less intense with other Danish universities or national research institutes and partners from the private sector.[10]

The informants agree that the CoE status has helped to establish contacts with research-intensive institutions abroad. Not only has it helped to attract outstanding researchers from abroad for temporary or permanent engagements at the CoE. It has also given the centre access to funding sources from abroad.[11]One informant emphasised that the grant made it possible to work strategically with all stakeholders involved in the area of research and to develop strong and scientifically directed collaborations across disciplines.

Interestingly, most of the present co-operative links already existed before each UNIK was founded, but since inception these co-operative links have been considerably enhanced.[12]

Internal management

Each of the four CoEs has its own internal management and some kind of delegation of authority.

Three CoEs state that important decisions are taken by the director of the CoE in a top-down manner. Yet many decisions are taken after consultation with an internal management/advisory group or an external advisory body. These auxiliary bodies consist of people with scientific expertise in the research field and supervise the centre's performance. In their day-to-day management most CoE make target agreements with their individual units to measure progress or impact and some use a system of metrics-based indicators to monitor performance. Food, Fitness and Pharma differs from the general picture. The CoE is a distributed structure; the partners allocate the grant among themselves upon reception and the core staff of the centre is not directly involved in the research activities.[13] Their tasks mainly relate to fundraising, lobbying, initiatives for young scientists, creating initiatives to promote cross-faculty and interdisciplinary collaborations, etc. Decisions are taken by an executive board following consultation with a research support unit and the scientists in the different initiatives.

Staff

As regards staff, the CoEs are organised very differently. The centres have a core academic staff of approximately 20 (average, full-time equivalent) with a group employed by the host university and a smaller group, of various sizes, not employed by the host university.[14] The average administrative staff working solely at the CoE is nine full-time equivalents.[15]

According to informants none of the universities uses special recruitment strategies to employ top-level personnel for the CoE. Only one CoE uses employment procedures different from those of the host university in order to speed up or facilitate employment. The salaries of researchers at the CoE cannot be negotiated more freely than at the host institution. Moreover, none of the researchers is relieved from regular administrative tasks and from normal teaching obligations. Only two of the universities offer employees at the CoE labour contracts beyond the grant period. One CoE notes that almost all scientific staff members paid by the grant are PhD students and post-docs so that their employment is limited to two to four years and will end during or soon after the funding period. In general the host university only expects to establish a limited number of permanent faculty positions for CoE staff. However, MINDLab and Synthetic Biology expect that more than half of the academic staff will continue to work for the host university after the initial funding period.

Funding and the problem of embedment

The call stated that the grant could be used as freely as university core funding for research, which is provided as block grants. In 2011 and 2012, the grant covered 75-100% of the total running costs of three of the four centres. For Food, Fitness and Pharma the grant only covered 25% of expenses in 2011.[16]

Funding from the UNIK initiative is primarily used for research activities, doctoral and post-doctoral training, and research infrastructure. However, some money is also used to attract international personnel and talent and to collaborate with research institutions, higher education institutions and private firms. A small amount is used for teaching programmes at bachelor's and master's levels and for different outreach activities.

The host universities support the CoE mainly by providing at no charge the equipment and infrastructure (laboratories, information technology services, buildings, etc.) needed to conduct its research. They also contribute to the total overhead costs of running the CoE and most contribute to running costs.[17] This last contribution is not part of the terms of the grant but is given to help the CoE accomplish the tasks agreed with the funding agency, to enhance its performance, and to give it further potential for development.[18]

The management of all four centres feels that the grant terms make it possible for the staff to aim at higher standards of excellence and orient their research towards longer timelines. Moreover, the grant gives opportunities to work across disciplines internationally and to work towards dissemination and exploitation of results. The grant also puts management and staff under greater pressure to deliver outcomes such as publications and patents. A special worry is the future funding of the on-going research activities. As one informant states: "This considerable investment will… evaporate unless it is possible to obtain funding that allows these projects to continue." Apparently, this applies especially at the Technical University of Denmark, which believes firmly in the principle that the continuation of the CoE beyond the grant period is best demonstrated by the ability of the CoE to attract competitive external research funding.[19]

It was expected that successful parts of the UNIK would be integrated in the university's activities and regular budget after the grant period. All informants from the CoE are convinced that their centre will continue to exist and get funding from other sources and that co-operation with partners will endure. Moreover, they are convinced that the results and insights produced by the CoE will influence scientific discourse, that innovations generated by their research will be successfully marketed, and that young researchers trained at the CoE will become leading scientists.[20]

Two of the three universities are developing a strategy for integrating the CoE structure into the host university after funding expires. They are considering how to finance permanent faculty positions or to prolong key staff positions at the level of associate professor and professor.

All of the universities plan to raise funds from third parties and intend to make arrangements with the CoE about transitional funding. However, the centres' success in attracting competitive external third-party funding is uneven. For instance, one centre has already received approximately DKK 78.5 million in third-party grants and the university expects this positive trend to be sustained and expanded to maintain the most promising activities of the centre.

Impact and lasting effects of UNIK

For the informants, the UNIK research excellence initiative is important because the grant allows them to pursue long-term goals in a cross-disciplinary research framework. Furthermore, they agree that the REI has financed new kinds of research activities that would otherwise be hard to finance through project funding or institutional funding.

Cross-disciplinary research is risky and it takes time to establish infrastructure and collaboration across institutions and disciplines. The CoEs have initiated successful new research and generated a number of peer-reviewed publications and pipeline papers, many of which are in highly ranked journals. Furthermore, in several cases the CoEs have initiated successful international collaboration and have provided important core facilities at the university. For some, the grant has made it possible to dedicate resources to shaping calls in the EU Seventh Framework Programme and the future content of Horizon2020.[21] On this basis they find that the CoEs fulfil a role model function in terms of science management and/or research practice in a national context. The informants emphasise that the visibility of the host university has risen both in the fields of research in which the CoE is active and in general. This makes it easier to obtain third-party funding for research projects and to attract top-level researchers or the best qualified students to the host university.

In addition, the host institution's overall structural development and its research identity have been promoted and strengthened by the foundation of the CoE. None of the centres finds that its existence has caused tensions at the host institution.[22] All informants agree that the usual tasks of the departments that contribute to the CoE are positively affected by the additional funds, the new and excellent staff, and the new lines of research opened up by the CoE. In the opinion of most informants the departments that do not contribute to the CoE are also positively affected by the co-operation originating from the work of the CoE, the increased reputation of the host institution, and a new sense of competition for excellence within the university.[23]

Finally, the informants find that their results give their institutions some goodwill that improves their negotiating position with funding bodies such as the Danish Ministry of Science, Innovation and Higher Education and other research funding bodies. The results of the CoE will also increase the host university's block grant from national performance-based funding as a result of its improved research performance.[24]

The UNIK initiative has thus had a long-lasting impact not only on the development of new kinds of research activities in the CoEs, but also on the host university.[25]

Overall, both centre and host informants find that UNIK has enhanced national research competitiveness and has helped to internationalise Danish research by creating collaboration between national and international research institutions. However, the informants do not find that the centres have triggered a restructuring of the national research landscape or that the initiative has favoured the creation of more and stronger links between existing national research institutions, but this was not the intention of the initiative.

Notes

1. DNRF was set up as an independent body by Act of Parliament in 1991. Since the first grants in 1993 most of the funds have been spent on CoEs in Denmark. The funded centres are expected to create outstanding research of high international calibre that may be described as ambitious, highly creative, original, scientifically daring and potentially ground-breaking.
2. Each SPIR is typically linked to one or more strong, well-established research environments, with the involvement of other research environments. Once funding ceases, the SPIR is expected to have become an internationally leading research environment and to continue its collaborative activities with public-sector, private-sector and international partners.
3. Denmark in the Global Economy - Progress, Innovation and Cohesion Strategy for Denmark in the Global Economy - Key Initiatives and the UNIK call for proposals http://en.gi.dk/apply-for-funding/calls/2007/unik-call-for-proposals.
4. USD PPP in 2011.
5. OECD/RIHR Host questionnaire, Q4.
6. OECD/RIHR Host Survey Q11.
7. OECD/RIHR Host Survey Q 9.
8. OECD/RIHR Host SurveyQ7.
9. MINDLab covers five of the six fields of science, i.e. the natural sciences, engineering and technology, medical sciences and health, social sciences, and the humanities. Synthetic Biology covers the natural sciences, engineering and technology, medical sciences and health, and the humanities. Food, Fitness and Pharma cover the natural sciences, medical sciences and health, social sciences, and the humanities. CASE covers the natural sciences and engineering and technology. None of the funded centres covers agricultural science and only two out of the four cover social sciences.
10. OECD/RIHR CoE Survey Q 19.
11. OECD/RIHR CoE Survey Q 22.
12. OECD/RIHR CoE Survey Q 21. Only MINDLab specifically states that it partly existed before the application for funding.
13. The partners are from six faculties (18 departments) at the University of Copenhagen.
14. In one centre this group is significantly larger than the others, in another it is significantly smaller and in two centres it is approximately the same size.
15. The data are very uncertain. For instance, at one centre the scientists are employed by 18 departments and therefore do not have a general view of the centre's full-time and part-time employment covered by the grant.

16. This figure is highly uncertain because the grant has been distributed to more than 18 departments and the centre's management notes that it does not have a general view of the centre's full-time and part-time employment covered by the grant.
17. OECD/RIHR Host Survey Q 5
18. OECD/RIHR Host Survey Q 6.
19. OECD/RIHR CoE Survey Q 24.
20. OECD/RIHR CoE Survey Q 25.
21. OECD/RIHR CoE Survey Q19.
22. OECD/RIHR CoE Survey Q 12.
23. OECD/RIHR Host Survey Q14 and Q 15. Only DTU answers that the departments are not affected to a considerable degree by the CoE.
24. OECD/RIHR Host Survey Q16.
25. OECD/RIHR CoE Survey Q 27 and OECD Host Survey Q 18.

Chapter 6

The German Excellence Initiative

Anton Geyer, Technopolis Group Austria
Conducted on behalf of the German Federal Ministry of Education and Research[1]

This chapter discusses the German Excellence Initiative (EI) and its three lines of funding. It considers the universities' approaches to and views on the initiative, the main features of the funding, governance structures, recruitment strategies, collaboration with other universities and with non-university research institutions, co-operation between departments and scientific disciplines, the international visibility of German research, and doctoral training. The EI has had a positive impact on a variety of measures and this has prompted federal and state governments to agree on a second five-year funding phase. More generally, the EI has triggered broad public debate about university research, priority setting and specialisation.

Background and framework conditions

In January 2004 the then federal minister of education and research, Edelgard Bulmahn, called for an initiative to identify Germany's top universities with a view to increasing their competitive funding. The objective was to give universities stronger incentives to pursue excellence in research and doctoral training and thus become internationally more visible and more attractive to top academic researchers and students alike.

According to the German constitution, the states are responsible for universities and their financing. The German constitution allows the federal government to fund project-based science and research at universities but not to make general or permanent financial contributions. After almost 18 months of negotiations during which the original concept of the initiative was considerably expanded, the federal government and the states finally signed an agreement on the Excellence Initiative (EI) in June 2005. The total budget was EUR 1.9 billion over a five-year period, of which 75% from the federal budget and 25% from the states. The overall third-party funding of research and development (R&D) at German universities over 2006-10 was about EUR 24 billion (Federal Statistical Office, 2012). With a share of almost 8% of total third-party funding, the Excellence Initiative provided a significant additional funding for the German university sector at a time when governments generally faced increasing pressure to curtail their budgets. The representatives of the leading German science and research institutions welcomed the initiative as a critical and timely way to tackle chronic underinvestment in universities and their perceived diminishing relevance as locations of top quality research (Winnacker, 2005).

The Excellence Initiative has three lines of funding. First, it funds graduate schools. Graduate schools provide high-quality doctoral training and stimulating research environments. They attract the brightest doctoral candidates in Germany and from abroad and provide the best support and supervision. They also encourage early-stage scientists to achieve autonomy and independence in their research.

The second programme line funds clusters of excellence. These are internationally visible and competitive priority research areas at universities and their non-university partner institutions. Based on clearly defined visions and goals, they carry out top-level academic research that contributes to the university's strategic research priorities, strengthens scientific networking and co-operation among the participating institutions, and provides an attractive training and research environment, especially for early-stage researchers.

Universities with at least one graduate school and one cluster of excellence may receive additional funding under institutional strategies, the third funding line, which supports specific university-level activities that strengthen international excellence in research and training. The funding helps universities to establish and maintain themselves among the leading world research institutions in their priority research areas.

This last funding line comes closest to the original idea of the programme to identify the top German universities, as set out by the federal minister in 2004. The Excellence Initiative is supposed to finance the institutional strategies of only a small number of universities. As this funding line is highly selective it carries the most prestige. It is widely regarded as the official seal of an elite German university.

Only universities that have the right to confer doctorates are eligible for the Excellence Initiative. All applications have to be supported and submitted by the universities' management to ensure that the proposals are in line with the universities' overall strategic priorities. The general criteria for funding are:

- excellence in research and training of early-stage researchers in at least one broad branch of science
- a comprehensive concept of the integration of disciplines and international research collaborations
- co-operation with other universities or with non-university research institutions, as a rule documented by binding co-operation agreements.

These general criteria are specified in more detail for each of the three funding lines (DFG and WR, 2010).

The mobilisation of universities by the first call for proposals in late 2005 exceeded all but the most ambitious expectations. The German Research Foundation (DFG), which runs the Excellence Initiative in collaboration with the German Council of Science and Humanities (WR), received a total of 319 draft proposals from 74 universities. A total of 108 German universities were eligible to participate, of which 84 run by the states. Not all of these universities had sufficient research capacity to participate in the Excellence Initiative. In the 2002-04 period only 77 universities received DFG funding for research projects of at least EUR 500 000 (DFG, 2006); this roughly indicates the number of German universities with the minimum top-level R&D capacity needed to take part in the competition.

International panels of experts evaluated the draft proposals. Based on the results, the Joint Committee of DFG and WR asked 90 draft applicants to submit full proposals. After a second round of international peer review, the Joint Commission, together with representatives of the federal government and the states (the Grants Committee), selected 38 proposals at 22 universities for funding.

The second call for proposals in late 2006 triggered almost the same level of mobilisation. Applicants submitted 305 draft proposals; after the two-stage evaluation and selection procedure, 47 proposals from 28 universities received funding. In total the Excellence Initiative provided in its first phase funding for 39 graduate schools, 37 clusters of excellence, and 9 institutional strategies (jointly referred to as excellence establishments in this case study).

The average funding was about EUR 1 million a year for graduate schools and about EUR 6.5 million for clusters of excellence. In addition to project-specific costs the universities could claim top-up funding of 20% of direct costs for indirect expenses. Universities with successful institutional strategy applications received up to EUR 13.5 million a year from Excellence Initiative funds.

The Excellence Initiative does not require any formal cost sharing or matching funds from the universities for the proposed activities. However, the universities and the states had in fact to make very substantial commitments to support their applications. The universities aligned spending priorities and allocation of resources with their areas of excellence. The states had to pledge additional long-term funding earmarked for excellence establishments at their universities as the applicants had to prove the financial sustainability of their activities beyond the funding period of the excellence initiative.

In 2008 the DFG and the WR drafted a first report on the implementation of the Excellence Initiative that demonstrated strong positive effects in line with the programme's objectives (DFG and WR, 2008).

The success of the first phase of the Excellence Initiative, combined with a wish to keep the momentum of structural change stimulated by the programme alive, prompted the federal and state governments to agree on a second five-year funding phase. Taking into account the lessons of the first phase, the DFG and WR increased the flexibility of some rules for participation and funding and issued a call for proposals in March 2010. The call had a total budget of EUR 2.7 billion and was open both to new applicants and to applicants that had received funding in the first phase of the programme. After the two-stage evaluation and selection procedure, the Grants Committee selected 45 graduate schools, 43 clusters of excellence and 11 institutional strategies for funding. In total 44 universities receive financial support in the second phase of the Excellence Initiative in the 2012-17 period.

The universities' approach to the Excellence Initiative

According to the interviewees, the universities welcomed the Excellence Initiative. For universities wishing to carry out top-level research, the Excellence Initiative was essential. Research-intensive universities, in particular, were keen to apply. Many interviewees reported that at the time of the calls, researchers and university management accorded the Excellence Initiative the highest priority.

As the universities are the applicants for all three lines of funding, the first task of the university management was to liaise with research groups that were planning to put forward proposals and to organise the internal deliberation and selection process. At universities with few areas of excellence, this was a rather straightforward issue, in that the university management supported the initiators as much as possible. At universities with strong research records in a broad variety of scientific fields, more formal procedures were required, especially with regard to ideas for clusters of excellence.

The interviews suggest that there was somewhat less internal competition for graduate schools. One reason is that structured doctoral training had to be part of any cluster of excellence proposal. Graduate school proposals often came from departments and fields of sciences that did not consider themselves strong enough in terms of their research resources to initiate a cluster of excellence. As the rules and conditions of funding allow funding basically the same activities under both funding lines, initiators in the social sciences and humanities in particular preferred the graduate school line. Another explanation might be that at least some proposals for graduate schools focused on doctoral training in general in order to change the overall organisation, content and process of doctoral training at the university.

The university management usually collected ideas from the departments, assessed them internally and then decided which proposals would be developed further and submitted to the DFG. At some universities this was done by organising internal calls for proposals. Internal assessment groups then discussed the scientific merits of the submissions. For institutional strategies, the universities had to carry out a SWOT (strengths, weaknesses, opportunities, threats) analysis and discuss the results in the application documents. Often the university management invited key researchers from the departments to contribute to this strategy-building exercise.

The final decision about the internal selection of proposals lay with the university management. This clearly made sense for the universities as it ensured the selection of the best ideas in line with the university's strategy and early co-ordination between the university and the initiators. In some cases the universities assigned central administrative staff to support the application process. This was also meant to ensure the overall coherence of the university's applications in all three funding lines.

According to the interviewees, university management was more selective in the second phase of the Excellence Initiative. Universities could draw on their experience in the first phase and better understood the qualities required of good applications. The universities also had to ensure the overall consistency of their portfolio as in the second phase of the Excellence Initiative renewal applications of already funded establishments competed with new proposals.

What makes the Excellence Initiative special?

In many ways the Excellence Initiative's three funding lines were uncharted waters in German university funding. There were, of course, the long-established DFG programmes to promote research excellence, maximise the potential of research locations through collaboration with other research institutions, improve the research conditions of early-stage researchers, and promote strategic priority setting at universities. In particular, the DFG has administered the Collaborative Research Centre (CRC) programme since the late 1960s. Since the 1990s, a dedicated funding scheme called Research Training Groups (RTG) has sought to raise the quality of doctoral training and improve conditions for early-stage researchers at German universities. However, in comparison with the Excellence Initiative the scale and scope of these programmes were limited in terms of their ambition, visibility, reputation and funding. They focus more narrowly on clusters of high-quality research projects. Their structural dimension is less prominent than in the Excellence Initiative, and their structural impacts are more or less assumed to come from the spillovers of high-quality research projects.

In contrast, the funding lines of the Excellence Initiative directly address organisational and structural aims and objectives. In the CRC and RTG programme research excellence is the main criterion for funding. The Excellence Initiative asks for much more: a proposal should have ambitious overall objectives, particularly innovative approaches to research and training, and a convincing strategic vision for the long-term institutional development of the university. This is most obvious in the design of the institutional strategies funding line which had no direct precedence in Germany's research funding. The WR had however much experience with institutional evaluations of federally funded research institutions and research infrastructure.

One could argue that all three funding lines of the Excellence Initiative pursue the same set of objectives with quite similar activities and measures but different starting points. These activities and measures coalesce either around doctoral training, strategic research priorities or the university as a whole. Graduate schools do need to pursue ambitious research objectives in terms of scientific networking, interdisciplinarity and international visibility. Clusters of excellence include a structured doctoral training module. The institutional strategies address organisational development in general and may include specific measures for innovative doctoral training, cutting-edge academic research through new organisational structures, more flexible recruitment and payment schemes, more effective administrative structures and support services for researchers, especially for early-stage and female researchers, and research infrastructure investments.

The Excellence Initiative provides funding as a temporary stimulus to trigger and facilitate institutional change at the universities. The universities' activities and measures should lead to permanent improvements in the quality and organisation of top-level research and the academic training of early-stage researchers. Therefore, already in the proposal phase, the universities had to describe how they planned to sustain the proposed activities beyond the funding phase.

The overall high level of mobilisation and the total number of successful universities might obscure the fact that conditions at universities varied widely. Universities with internal cultures that were already well aligned with the basic principles of the Excellence Initiative, such as research excellence through meritocratic incentives, interdisciplinarity and a focus on early-stage researchers, seem to have found it easier to apply than more traditionally organised universities. This is particularly true for the institutional strategy line of funding. Some universities with performance indicators such as international university rankings and the German research grants statistics collected by the DFG ranked quite high among the leading German universities, but failed with their institutional strategy proposals because – as a university president put it in the interview – they assumed that more of the same in terms of excellent research would be enough to succeed. They had not understood that the point of the Excellence Initiative is to rethink the notion of a university. In this respect university culture – and openness to change with regard to university culture – mattered a lot as a factor of success in the Excellence Initiative.

Some universities had started long before the Excellence Initiative to implement measures similar to those at the core of excellence establishments. Excellence Initiative funding enabled these universities to be even bolder in pursuing their strategies as they had more money to finance their activities. At other universities, the Excellence Initiative was instrumental in initiating change. The Excellence Initiative broke down barriers between departments and the university management. It challenged stakeholders' views on "how things should be run around here". The process of change usually started in the application phase as the researchers that took the initiative, the representatives of participating departments and the university management had to communicate and work together closely in order to come up with convincing proposals.

It is also worth mentioning that some of the universities that initially failed to obtain institutional strategy funding decided to implement some of their proposed activities without the extra funding. According to the president of one of these universities, there was an understanding that the pursuit of institutional excellence should not depend on Excellence Initiative funding or require the external label of an elite university. In this sense there seems to be a substantial level of additionality triggered by the Excellence Initiative at universities that did not receive funding for some of their planned activities.

Interviews were conducted with some representatives of excellence establishments that received funding in the first phase of the Excellence Initiative but were not selected for funding with their renewal application. Besides the fully understandable disappointment expressed in these interviews, it was surprising to hear the constructive and forward-looking responses of the representatives and their universities to a certainly unpleasant, and financially and socially challenging, funding decision. Basically all these interviewees indicated that they and their universities aim to carry on and build upon what has been established and achieved over the funding phase. There was virtually no talk of closing down. There was even an indication that in some cases the negative funding decision has sent a wake-up call to address shortcomings that had not been sufficiently dealt with in the past.

The universities' view on the application and selection procedures

Most of the interviewees considered the application and selection procedures in the Excellence Initiative as open, transparent and generally fair.

In the run-up to the Excellence Initiative, some stakeholders had expressed concerns about whether the new funding instruments would be suitable for all branches of science and all types of universities. Specifically, there were doubts whether the Excellence Initiative could provide a level playing field for the social sciences and the humanities, where researchers often do not collaborate in large clusters. The open competition among all scientific disciplines raised the issue of whether the international experts and the selection boards could avoid a bias with regard to the perceived societal relevance of the research in question: What safeguards ensure that literary studies receive the same level of attention as oncology? Further, concerns were voiced about the participation of small universities, which might not have the resources to manage the amount of funding foreseen in the three lines of funding.

Experience with the Excellence Initiative suggests that these concerns were in large part unfounded. Both in the first and the second phase of the Excellence Initiative research groups from the social sciences and humanities participated actively. The share of funding for the social sciences and humanities in the first phase of the Excellence Initiative was higher than the share of funding in the other DFG programmes (DFG and WR, 2008). The social sciences and humanities preferred the graduate school funding line to the clusters of excellence funding line, as applicants considered the former better suited to the framework conditions in social science and humanities research. The universities that received institutional strategy funding also often used these resources to benefit departments and research groups that were too small to have graduate schools and clusters of excellence.

The interviews suggest that, more than in other branches of science, co-ordinators in the social sciences and humanities took the opportunity to kick-start and facilitate changes in the way research and training are organised and delivered in their departments. It is also worth noting that in the interviews the representatives of graduate schools and clusters of excellence in the social sciences and humanities were particularly proud of their achievements, both because they succeeded in the competition and because of the impacts on research, doctoral training and organisational change.

This does not mean that all universities and applications had the same chances to succeed. Larger universities found more opportunities internally to develop proposals than smaller universities with similar research quality. Owing to the interdisciplinary orientation of the proposals, the background of the panel of experts that reviewed the (draft) application also mattered. A small number of the interviewees reported that certain competences that were missing in their expert panels would have been critical for the sound assessment of their proposals.

The assessment and selection procedure for institutional strategies presented evaluators with a real challenge. For graduate schools and clusters of excellence, the structural selection criteria were easier to handle since the research programmes at the core of the proposals provided overall guidance. Comparing and selecting institutional strategy applications proved much more difficult since the scope of activities and the priorities described in the applications differed significantly. In order to avoid potential issues of political interference in the funding decisions, the boards painstakingly followed an appraisal protocol based on purely scientific and research-related evaluation criteria.

There were no predefined quotas for certain fields of science. Neither were regional criteria (i.e. distribution of funding among the various German states) taken into account. In fact, this approach led to funding decisions that many stakeholders had previously considered unimaginable on political grounds, such as the concentration of universities with successful institutional strategies in the south of Germany in the first call. This approach further strengthened the universities' perception of the integrity of the selection process and their overall view of the Excellence Initiative.

Internal governance

The graduate schools and clusters of excellence are required to have bylaws that specify their status within the university, their organisational structure and their operations. The DFG provided model bylaws that the universities could adapt to the specific requirements and circumstances of their graduate schools and clusters of excellence. Usually, the graduate schools and clusters of excellence have at least a general assembly, an executive board led by a co-ordinator, a managing director who is in charge of the office and day-to-day operations, and a scientific advisory committee. Members of the university management often sit on the executive board but hardly ever take a direct or active role in day-to-day management. As the initiative to set up a graduate school or cluster of excellence usually comes from the leading researchers in the respective research areas, there is little need to recruit the top leadership. In most cases one of the initiating senior professors acts as co-ordinator.

The organisational structures of the graduate schools and clusters of excellence can be understood as a second layer of management that reaches across traditional boundaries between departments and the overall university administration without replacing them. In many cases the management structures of the schools and clusters help facilitate decision making in the competent university bodies and support internal reorientation and reorganisation.

In some universities the graduate schools and clusters of excellence are distinct university units, either central departments or interdepartmental establishments. In others they act as large cross-departmental projects. Even though the graduate schools and clusters of excellence have a physical presence in terms of infrastructure, facilities, research programmes, training activities and identity, they may also be somewhat virtual organisational bodies. Their leading representatives still work as professors in a department. The graduate schools and clusters of excellence also allow their members to pursue their research interests and implement their research management ideas within the university's traditional departmental structure.

University management often includes co-ordinators and representatives of graduate schools and clusters of excellence in strategic consultation and decision making at university level. The universities usually want the schools and clusters to contribute to the strategic steering of the university. In many cases this happens informally, as the high standing of the Excellence Initiative virtually ensures that co-ordinators have privileged access to the president and other members of the university management. In general, there is regular communication between the management of the graduate schools and clusters of excellence and the university management. Some universities have set up an Excellence Council to support university management in strategy design and implementation. Co-ordinators of the university's excellence establishments are among its members. Some institutional strategies also established councils with external experts, who were entrusted with co-ordinating internal competitions for research funds and/or giving advice on the allocation of internal research funds.

Budget and administration of funds

It is difficult to put a definite or comparative number on the total budget of a graduate school, cluster of excellence or institutional strategy since the Excellence Initiative funding only provides a variable share of the total budgets. There are usually no clear organisational or legal boundaries to the funded activities. The graduate schools and clusters of excellence have "members". Any researcher from the university and other participating research institutions who works in the relevant areas may become a member. A very broad definition of the total budget might therefore include all the research resources that are directly or indirectly linked to the members of the graduate schools and clusters of excellence. The narrowest definition of the total budget is the amount of funding received directly from the Excellence Initiative. This is a view often taken by university management as it indicates the extra money that flows into the university budget. The amount of money managed and allocated by the executive boards of the graduate schools and clusters of excellence might be considerably bigger, depending on the internal procedures of the departments and the university. Usually the excellence establishments have a mix of direct funding through the Excellence Initiative, other third-party project funding from various sources (DFG, project-based funding from the ministries and from private research funding foundations, EU grants, etc.) and institutional funding (research infrastructure, staff, etc.) to implement their core activities. The co-ordinators and managing directors of the graduate schools and clusters of excellence usually draw the boundaries on the basis of these activities. What different stakeholders may label as activities under the umbrella of a graduate school or a cluster of excellence may vary.

Excellence Initiative funding is very flexible and can be used for a broad variety of purposes and cost categories. For example, the funds can be used to cover expenses for research activities, staff costs, graduate training programmes, gender mainstreaming activities, dual career support, public relations and communication activities, and management costs. The share of funding for indirect expenses can also be used for infrastructure investments. The universities were able to set their own priorities on how to spend the funding, provided that the overall strategy and implementation concept was convincing. The funding can also be used to establish new professorships at both senior and junior levels.

The rules for the reallocation of funds between cost categories are quite flexible compared to other forms of third-party funding. Overall, the universities and their graduate schools and clusters of excellence are very satisfied with the rules and conditions of funding. The only critical issue that came up regularly in the interviews concerned the annuality rule. Funding cannot easily be carried over from one year to the next. If total expenses in one year are lower than planned, the remaining balance cannot simply be added to the funding for the next year, and at least part of it may be lost, according to some interviewees. Smaller universities (and their graduate schools and/or clusters of excellence) with limited alternative spending options seem to have more difficulty with this than larger universities that can bring forward spending in other areas if there is a delay in some planned expenditure.

As a share of total third-party funding for research, Excellence Initiative funding is usually quite substantial. In some cases the Excellence Initiative accounts for more than a third of universities' total third-party funding for research.

According to interviewees, the co-ordinators and the management of the graduate schools and clusters of excellence administer the Excellence Initiative funding themselves in most cases. They decide on the allocation of resources and spending priorities. However, general university spending rules have to be taken into account, as the graduate schools and clusters of excellence are not legal entities in their own right, and they may also be bound by the financial management regulations of the states.

University management mostly play a supporting role in the management of the graduate schools and clusters of excellence. The universities get the top-up funding for indirect costs and usually return a significant share to the graduate schools and clusters of excellence. They allocate the remaining amount centrally. These funds may be used for research infrastructure investments and various support activities that benefit the universities as a whole, such as gender mainstreaming activities, research platforms, establishing new chairs in strategic research areas, and postgraduate training activities.

Recruitment and recruitment strategies

The Excellence Initiative had a significant impact on the recruitment of professors and the universities' overall recruitment strategies. The universities have used the Excellence Initiative funding in all three funding lines to establish new full professorships in strategically important areas of research. The new professorships are part of an overall university development plan to strengthen research capabilities in identified priority research areas. In many cases the universities looked at strong international candidates to complete and expand existing competences at the university. Some universities paid particular attention to recruit candidates that specialise in research at the interfaces of traditional disciplines.

Some universities created central pools for vacant (professorial) posts that were then reallocated to the strategic priority research areas. Strategic reallocation of research posts is a prominent feature of many institutional strategies. At least one university advertised a number of full professorships without a thematic orientation or specific limitations. The rationale was to encourage applications from top international researchers who could make a substantial contribution to the university's strategy regardless of their field of research. Some universities introduced similar concepts for the recruitment of junior professors and established "free floater" groups that were not bound by any thematic or departmental restrictions.

However, not all universities took such an approach. In some cases new professors were mainly recruited to replace professors that would retire in the coming years. Funding from the Excellence Initiative made it possible to bring replacements forward and ease the transition from one generation to the next.

The funding flexibility also made it possible to offer candidates for professorships very attractive packages in terms of research facilities and support staff. In addition, many universities stretched the limits of Germany's statutory salary framework for professors to attract leading researchers. For some candidates the prospect of being part of a German excellence establishment was an incentive to accept a professorship. In most cases the universities were able to hire highly qualified candidates. According to the interviewees, the share of candidates recruited outside Germany has grown significantly since the start of the Excellence Initiative.

Along with the more strategically orientated allocation of professorships, many universities also experimented with new recruitment processes. Traditionally, the university or the department advertises an open post and sets up a selection panel. From the applications received, the selection panel identifies suitable candidates, invites them for hearings and draws up a ranked list of the most qualified. After securing approval of the list from the department and the university management, negotiations can start with the first-ranked candidate (e.g. discussing the professional and personal terms of the appointment). This process can be quite time-consuming and may fail if an agreement cannot be reached with any of the candidates on the list.

To speed up the recruitment process for key professorships in excellence establishments, some universities used headhunting approaches and targeted specific candidates for open professorships. Other universities introduced procedures to allow for discussions with suitable candidates before the formal list of candidates had been agreed upon in order to check the candidates' availability and assess the prospects for successful negotiations. These steps led to significantly faster appointment procedures than before the Excellence Initiative.

Excellence Initiative funding was also used to recruit significant numbers of associate professors and (usually temporary) junior professors. The universities introduced competitive recruitment procedures to identify the best candidates for strengthening the overall research potential of the graduate schools, the clusters of excellence or other priority research areas identified in the institutional strategies. Most of the junior professors are only expected to contribute for a limited period of time – perhaps three to six years – to the research programme and training framework of the excellence establishments. The co-ordinators regard it as an important indicator of the quality of their graduate school or their cluster of excellence if junior and associate professors receive offers for full professorships at other universities. Many of the interviewees confirmed that a significant number – in some cases the large majority – of junior and associate professors with term-limited contracts had already received offers for more senior academic positions at other research establishments in Germany and abroad. This is considered a positive contribution to "brain circulation" among leading research universities rather than "brain drain". Scientific contacts with former colleagues would remain at least to some extent and strengthen the institutional research network in the long run.

Universities have started to introduce, often as one element of their institutional strategies, tenure track systems for their junior professors as part of their Excellence Initiative activities. These universities will offer tenure-track candidates lifelong positions that lead to a full professorship, subject to performance evaluation after a certain period of time. Also part of the tenure-track system is a set of support measures to provide mentoring, supervision and other forms of career development for tenure-track candidates.

Collaboration with other universities and with non-university research institutions

The Excellence Initiative strengthened co-operation with other universities, both nationally and internationally. Two or three universities often collaborate in various clusters of excellence. Collaboration with other local and close regional universities has received a substantial boost from the Excellence Initiative. The interviewees generally regarded these collaborations as very fruitful. Inter-university collaboration provided additional opportunities for excellent research at small universities that might not have

had the critical mass to carry successful Excellence Initiative applications on their own. There is also a case of co-operation between a state university and a private university; the latter brings specific competences and qualities that go beyond research, such as stronger international orientation, an internationally more diverse faculty and more experience with communication and public relations activities. In another case, two universities established an inter-university department with the view to establishing the cluster of excellence on a permanent basis. The planning horizon for this cluster of excellence already extends well beyond the funding period.

Many interviewees mentioned that their universities have established new formal and informal co-operation agreements with partner universities abroad. Some have set up strategic individual partnerships with leading universities abroad. Others have drawn up a partner model for international research co-operation, focusing on collaboration by individual research teams.

For postgraduate training as well, the universities built new bridges to partners abroad. A German university has set up a joint annual conference scheme with a world-leading research university in the United States that is specifically dedicated to early-stage researchers. Universities have also established graduate school co-operation agreements with international universities.

The Excellence Initiative explicitly mentions co-operation with non-university research institutions as a general funding criterion. At the same time, the DFG and the WR communicated to applicants that the core of excellence had to lie with the universities. Simply buying in excellence from third parties would not have met the aims or fulfilled the spirit of the Excellence Initiative.

Although collaboration by university research groups with non-university research institutions, most notably the institutes of the Max Planck Society, the Helmholtz Association of German Research Centres, the Leibniz Association and the Fraunhofer-Gesellschaft, has a long tradition in Germany and some DFG funding instruments such as the CRC programme have long been open to thematic collaboration to build local critical mass and integrate research resources, the Excellence Initiative went a step further by encouraging more intensive and more formal research collaboration agreements. It also eased the administrative burden of collaboration as research groups or members from non-university research institutions could be funded along the same lines as research groups from the universities.

The funding of clusters of excellence and institutional strategies in particular provided a significant boost to long-term, strategic collaboration by universities with non-university research institutions. Even at universities with a long and well-established history of collaborations of this type, the interviewees mentioned that the Excellence Initiative has intensified their scale and scope and put universities on a more equal footing with non-university research institutions. Many interviewees reported that new collaborations had been established, especially interdisciplinary collaborations. In some cases the integration of resources led to the establishment of joint research teams or to the establishment of research teams from non-university institutions at the university premises of the cluster of excellence.

International visibility

A key objective of the Excellence Initiative is to increase the visibility of Germany and of its leading universities as locations of cutting-edge research among top researchers and early-stage researchers. Besides the general internationalisation effects of attractive graduate schools and clusters of excellence, the universities can also establish measures such as fellowship programmes in specific organisational settings (e.g. institutes of advanced studies) and other forms of visiting researcher programmes, which often form a part of the universities' institutional strategies.

Basically all the interview partners confirmed that the Excellence Initiative had a strong positive impact on international visibility, both for the individual graduate school or cluster of excellence and for the university as a whole. Only in a very few cases did interviewees report little additional effects because the university had been well known internationally even before the start of the Excellence Initiative.

The most frequently cited indicators for increased international visibility were the number and share of international candidates for open professorships, fellowships and post-doc positions and the number and share of non-resident candidates in doctoral programme calls. Almost all graduate schools and clusters of excellence reported that the share of international candidates for research positions at every seniority level had increased substantially over the past few years. Further, applicants from outside Germany have shown increasing interest in the doctoral training programmes of the graduate schools. In this respect the Excellence Initiative helped universities to access the international doctoral candidate market more effectively.

The universities can now choose from a broader base of highly qualified candidates who meet their requirements. However, the increased international visibility requires universities to have adequate procedures for assessing and selecting the most suitable candidates. Especially for doctoral candidates this can be a demanding task as it can be difficult to check even formal qualifications when the applicants come from higher education and science systems with which the assessment and selection bodies are unfamiliar.

Some graduate schools require all doctoral students to have a supervisor abroad. There are also cases in which English is the main language of communication in the excellence establishment in order to broaden its international appeal. Some universities have intensified their alumni activities to maintain contact with former doctoral students abroad. Others interviewees mentioned that they more actively present the university at international higher education fairs, especially in Asia, as postgraduate education has become an increasingly competitive international market.

Higher visibility often means becoming a more attractive partner for collaboration on international research and training. According to some interviewees, some ten years ago Germany was hardly on the international radar as a location for innovative doctoral training, but the Excellence Initiative has increased interest in German universities' approaches to doctoral training and research even in leading world institutions.

Collaboration between departments and scientific disciplines

Collaboration across traditional disciplines is a prominent funding criterion in the Excellence Initiative. In this respect it differs from other DFG funding programmes. As its assessment and selection procedures focus primarily on the overall strategy and on a convincing operational concept for innovative transdisciplinary and interdisciplinary research, it leads to more risky research. The graduate schools and clusters of excellence select the individual projects to be funded. Many of these projects might not survive the standard DFG project appraisal procedures, where peer reviewers usually put more emphasis on an existing track record for research results and scientific publications.

Both in graduate schools and clusters of excellence the universities developed various approaches to transdisciplinary and interdisciplinary research. Many are thematically quite open and focus particularly on structural requirements. One graduate school requires candidates to have a doctoral project that combines engineering with natural sciences but sets no thematic constraints. It has set up small interdisciplinary research groups, always led by two principal investigators, one from the natural sciences and one with an engineering background to supervise the doctoral researchers. In another case the trans-departmental concept of the graduate school facilitated organisational change at the university. The traditional department structures virtually disappeared and old university hierarchies were broken down in the process.

Clusters of excellence are also trans-departmental, which makes boundaries between scientific disciplines permeable. Communication between departments has increased and departments have built new bridges between disciplines. The notion that researchers need to be able to communicate effectively across the borders of their own scientific discipline has gained acceptance. There is widespread belief among the interviewees that departments and scientific disciplines have all gained by learning to talk and listen to each other.

The clusters of excellence often provide an experimental basis for new forms of trans-departmental research at the universities. Some specifically recruited junior professors and junior research group leaders to carry their trans-departmental work programme forward. Several interviewees reported that the experience gained in the Excellence Initiative with new forms of internal collaboration convinced them to transfer the concept of cross-departmental research to other third-party funding programmes such as the DFG CRC scheme.

Impact on doctoral training

The Excellence Initiative has changed doctoral training and the framework for doctoral training at German universities quite substantially. In the graduate school funding line several successful applications aimed at changes in the doctoral training regime for the university as a whole. The main objective was to harmonise procedures and raise the overall quality of doctoral programmes. Other graduate schools focus on selecting candidates that show potential to stimulate research in the participating departments and research groups.

The right to confer doctoral degrees usually lies with the university departments. This has created a situation in which universities have a number of doctoral study statutes, and the university management is not in a position to set common quality standards. This can pose problems, for example, for doctoral students with trans-departmental research topics,

so that more than one doctoral study statute applies. Further, doctoral students have historically been quite dependent on their supervisors and receive little additional support from central university services. Most doctoral students at German universities contribute directly to their supervisors' research by carrying out a specific project or being assigned to a project team. Supervisors often chose their doctoral students without any formal application and selection procedure, which limited getting the best-qualified candidates for doctoral training. Furthermore, there were few checks and balances to ensure that supervisors supported the research independence of their doctoral students and post-docs in order to help develop their full scientific potential.

Many university managements were well aware of the shortcomings of past doctoral training. Since the 1990s efforts were made to modernise doctoral studies through the introduction of structured doctoral programmes such as the DFG RTG scheme. However, most of these initiatives remained firmly within traditional departmental structures. This changed with the Excellence Initiative. The funding concept for graduate schools specifically asks for implementation of the planned activities in at least one broad branch of science, which usually includes several university departments. This implies trans-departmental co-ordination and adaptation of doctoral training principles and procedures.

Some universities had developed plans for a trans-departmental or even university-wide graduate school before the start of the Excellence Initiative. Some of these early initiatives failed, however, as departments were reluctant to support the idea of a centralised statute for doctoral studies. They wanted to maintain their authority and their autonomy to set their own standards without what they considered undue interference by the university management.

The large sums of money held out by the graduate school scheme allowed universities to present the departments with more appealing incentives for their underlying objectives. The link between doctoral training structures and services and an innovative trans-departmental research programme proved attractive to many departments. In the process of preparing and implementing their graduate school concepts some universities clustered departmental competences and defined new trans-departmental priority research areas. As a positive side effect of these activities, the level of collaboration between departments increased substantially. At the same time it became possible to introduce common standards and central support services for doctoral training in participating departments while responsibility for scientific training and academic supervision remained vested in the departments.

Usually the graduate schools standardised the application and selection procedure for candidates on a competitive basis. There is a clear emphasis on selecting the most qualified applicants. Some graduate schools look particularly for candidates that come with innovative, self-defined doctoral projects that fit in the overall research profile of the participating departments. A grant scheme is also part of the graduate schools as are specific support measures for post-docs.

Many universities with graduate schools have also started to harmonise their doctoral study statutes. Many of the new statutes include a requirement for structured doctoral training and at least two academic supervisors from different areas of research. Some graduate schools introduced fast-track schemes that allow qualified bachelor graduates to enter the doctoral programme directly.

Among the services offered to doctoral students are generic skills training and doctoral pre-training courses such as how to write a good research proposal or how to become a good reviewer. Besides the focus on research, some models also aim to provide experience in teaching. Other concepts include mentoring and career support services after completion of the doctoral programme. The doctoral students usually receive the support they need and want. There are hardly any fixed curricula that force doctoral students into courses they do not want. However, graduate schools do set minimal requirements for participation in doctoral programmes. In one case the minimum requirements are that the doctoral students shall have submitted at least one scientific article, attended one international conference and participated in one summer school.

A considerable number of universities have set up graduate study centres that serve the university as a whole. These centres serve as umbrellas for the graduate schools and other settings of structured doctoral training at the universities with a view to establishing and maintaining overall quality standards for doctoral studies. In clusters of excellence and institutional strategies as well, a considerable share of funding can be earmarked for the training and career development of early-stage researchers.

Summary and conclusions

Since 2006, the Excellence Initiative has supported research groups at German universities and their partners at non-university research institutions that had very high research standards even before the start of the funding period. The funding has mainly aimed to facilitate additional structural and organisational change in order to make German universities more productive, effective and attractive for academic talent. These structural measures have focused on the reorganisation of departments, investments in new research infrastructure, the recruitment of leading professors and generally the creation of a stimulating framework for early-stage researchers, including gender mainstreaming and dual career offers.

The underlying research programmes of the graduate schools and clusters of excellence support high-risk and innovative research that crosses traditional scientific disciplines. Some universities have introduced new formats for carrying out research and providing strong researchers with the time and academic freedom to concentrate fully on their scientific programme. In this sense the Excellence Initiative funds university strategies rather than high-quality research projects. This is most visible in the funding line institutional strategies that connect graduate schools and clusters of excellence in an overall long-term university strategy.

The interviews with the representatives of the universities and the funded graduate schools and clusters of excellence suggest that the Excellence Initiative has done considerably more than foster excellent research at German universities. Although originally meant as a programme to distinguish the outstanding few, the Excellence Initiative has contributed to the on-going transformation of the German university sector as a whole. It has channelled various internal and external pressures on universities: international competition, pressure to focus on research priorities and create a more visible institutional identity, increased organisational autonomy in combination with new and challenging financing and governance models. It has also provided an additional stimulus for organisational and structural change at universities. In particular, it has supported the modernisation of research management and the organisation of research and doctoral training.

The interviews provide clear evidence that the Excellence Initiative has strengthened communication and co-operation between departments and university management. It has increased trans-departmental collaboration within the universities, considerably strengthened the links with non-university research institutions and contributed to improving the visibility of German academic research internationally.

The mobilisation of the German university sector that was triggered by the Excellence Initiative seems to go well beyond the funded graduate schools, clusters of excellence and institutional strategies. The Excellence Initiative set in motion a broad, public debate about research at universities. Priority setting and specialisation became a more pressing issue for the universities and the states that finance them. The response of the German universities to the calls for proposals indicates that the universities have accepted competition as a tool to achieve priority setting and specialisation. The Excellence Initiative has encouraged universities to understand themselves as institutions with specific identities rather than as administrative shells for departments and research groups. The interviews have also revealed that universities have implemented these activities even when they failed to secure funding from the Excellence Initiative.

In spite of the positive impacts of the Excellence Initiative, some university representatives and researchers have questioned its rationale and the long-term effects on the German university sector. Competition and structural change at the universities inevitably means that some may be disadvantaged or lose out. The results of a recent empirical study on research conditions of professors at German universities seem to confirm this (Böhmer et al., 2011). Some academic researchers reported that the Excellence Initiative has caused considerable friction and conflict within the universities (Ash et al., 2010). Some also argue that the Excellence Initiative reduces variety within the German university landscape and does not help universities to develop distinct research profiles (Flink et al., 2012).

Overall, the Excellence Initiative has had many, if not solely, positive results. The broad mobilisation of the German university sector and changes in attitudes and views may have been the most beneficial effects of the Excellence Initiative.

Note

1. This case study is based on 24 semi-structured telephone interviews with representatives of graduate schools and clusters of excellence (scientific co-ordinators; managing directors) that had received funding in the first phase of the German Excellence Initiative. Representatives (presidents, vice-presidents for research, and representatives of the university's strategic planning units) of five universities (host institutions) were also interviewed. The telephone interviews took place in January 2013. Semi-structured qualitative interviews with representatives of the German Research Foundation (DFG) and the German Council of Science and Humanities (WR) provided additional input. For a general description of the Excellence Initiative the available documents on the Excellence Initiative from the DFG and the WR were analysed. Unless clearly indicated by references to the interviews and documents, the views and opinions expressed are those of the author. The structure of the case study follows broadly the main sections of the OECD case study template.

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Chapter 7

Japanese experience with centres of excellence

Shinichi Kobayashi, Professor, Research Centre for University Studies,
University of Tsukuba
and
Yoshiko Saitoh, Assistant Professor, Centre for the Studies of Higher Education,
Nagoya University
Conducted on behalf of the Ministry of Education, Culture, Sports,
Science & Technology (MEXT)

This chapter describes two examples of research excellence initiatives (REIs) in Japan: the Global Centres of Excellence (GCOE) Programme, which aims to strengthen the education and research functions of graduate schools and improve the development of human resources in doctoral programmes, and the World Premier International Research Centres (WPI) Initiative, which aims to create world-class research centres, with a superior research environment and extremely high research standards, by supporting systemic reform at universities. It presents the background and historical development of the two programmes, describes the programmes and ends with a general overview.

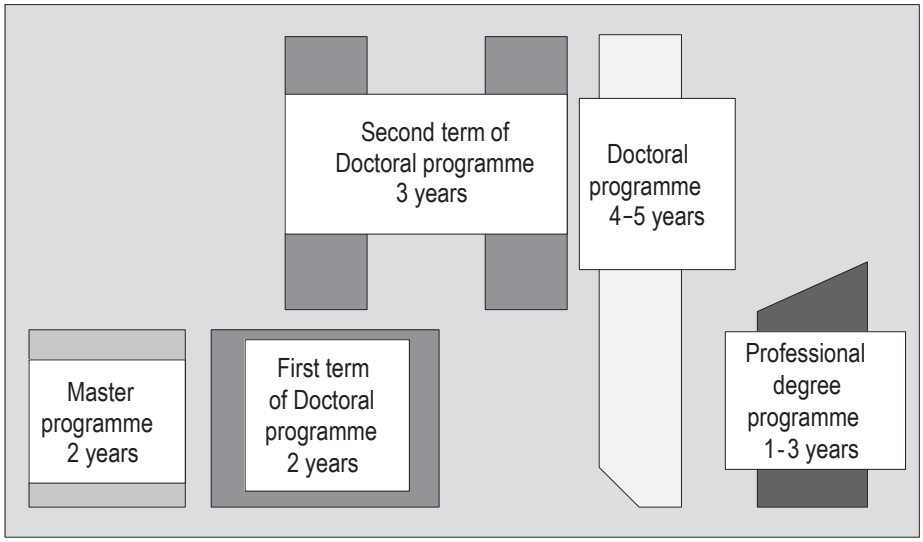
R&D activities and tertiary education in Japan

Japan is one of the world's most active nations in terms of research and development (R&D). In 2010, it had some 840 000 researchers (including those in humanities and social sciences), of which 490 000 worked in companies, 309 000 in universities and 33 000 in public research institutes (PRIs). Although research expenditures in that year accounted for 3.57% of GDP, government-financed R&D expenditure was just 19.3% of the national total. Universities performed 20.1% and PRIs 8.3%. Universities account for the major share of publicly funded R&D.

Japan has three types of universities: national, (non-national) public and private. In 2010, national universities accounted for 45% of researchers in the university sector, public universities for 7% and private universities for 48%. In financial year (FY) 2010, national universities accounted for 41% of research expenditure, public universities for 5% and private universities for 53%. National universities are only 11% of the total number of universities, however, while non-national public and private universities represent 12% and 77%, respectively. As these figures indicate, research activities are concentrated in the relatively fewer national universities, particularly for the natural sciences.

Japan's postgraduate system mainly involves a master's programme (first term of doctoral programme) and a doctoral programme (second term of doctoral programme). A professional degree programme was added in 2003 (Figure 7.1).

Figure 7.1. Japan's graduate education, with standard number of years for completion



Source: Ministry of Education, Culture, Sports, Science & Technology.

The number of graduate students has skyrocketed since the 1990s. They numbered 90 000 (of which 28 000 in doctoral programmes) in 1990; 153 000 (44 000) in FY 1995; 205 000 (62 000) in FY 2000; 254 000 (75 000) in FY 2005; and 271 000 (74 000) in FY 2010.

The development of research excellence initiatives

Political background

Japan's science and technology policy conforms to the Science and Technology Basic Plans, the five-year plans based on the Science and Technology Basic Law. Current policy follows the Fourth Basic Plan, drawn up in 2011. Policy for human resource development at graduate schools mainly concerns the Central Council for Education and was discussed in the council's September 2005 report, Graduate School Education in the New Era, and its January 2011 report, Graduate School Education in a Globalized Society.

In addition to these basic plans and policies, other factors that affect the allocation of R&D funds include: Japan's 2001 administrative reform, the building and maintaining of a competitive R&D environment since the Second Science and Technology Basic Plan, and the incorporation of national universities in 2004. Also exerting a major influence on R&D funding policies is the change of government in 2009 and the new government's budget screening process, called *jigyo shiwake*.

History

Research funding programmes, including the concept of centre of excellence (COE), have existed in Japan, but they were extensions of existing project funding. Research excellence initiatives (REIs) as such, as a means of allocating some of the core funds of universities and PRIs as long-term, large-scale, competitive block grants, were only introduced following the 2001 administrative reform and the Second Science and Technology Basic Plan. The Super COE and the 21st Century COE programmes were run under the Second Basic Plan and preceded the GCOE Programme and WPI Initiative discussed here.

The Super COE programme (Special Co-ordination Funds[1] for the Promotion of Science and Technology, Promoting the Establishment of Strategic Research Centers)[2] was designed to reform research organisations in order to build research centres capable of developing internationally competent human resources and outstanding research under good vision and leadership in order to make distinguished achievements, develop highly competent human resources and establish a progressive R&D system. The period of support was five years, and the annual funds amounted to several 100 million yen (less than JPY 1 billion).

The support went to national research institutions as well as to the departments and research centres of universities, inter-university research institutes, independent administrative agencies, special quasi-governmental corporations, and government-approved corporations, for programmes in natural sciences and areas that merged the natural sciences, humanities and social sciences. Calls for applications and selection of research centres took place between FY 2001 and FY 2005, with two or three selected each year for a total of 13 centres. The programme ended in FY 2009.

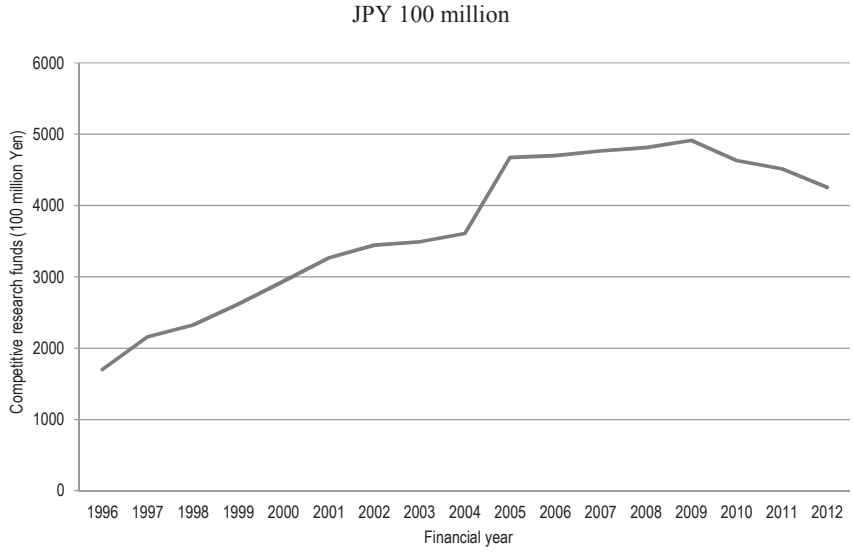
The 21st Century COE programme[3] was a programme of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), newly established in 2002. The programme provided subsidies for the establishment of research centres, based on A Policy for the Structural Reform of Universities (MEXT, June 2001), drafted as part of the administrative reform. The 21st Century COE programme "aimed to cultivate a competitive academic environment among Japanese universities by giving targeted

support to the creation of world-standard research and education bases (centres of excellence) in each academic discipline. By thus raising the standard of both education and research at these centres, the program sought to elevate Japanese universities to the world's highest echelons, while fostering people of talent and creativity who will be qualified to assume roles as world leaders."

This was in light of the background emphasising "the importance of further cultivating a competitive environment based on independent, third-party appraisal and robust intercollegiate competition covering national, public and private universities in order for Japanese universities to conduct education and research at the level of world-leading universities". Support was targeted at: i) one or a combination of disciplines at graduate schools (doctoral programme level); ii) one or a combination of research organisations at research institutes and centres attached to universities (with a research level equivalent to doctoral programmes); and iii) a combination of the two previous targets. The applications for support were made by the president of the university. The period of support was five years, with grants up to about JPY 500 million. The calls for proposals took place in FY 2002, 2003 and 2004, and the field targeted changed each year. In FY 2002 113 projects were selected, 133 in FY 2003 and 28 in FY 2004, for a total of 274. The programme was terminated in FY 2008.

The years around 2004 were a time of massive systemic reform of tertiary education as well as science and technology policies, all part of the administrative reform. Competitive research funding was increased as part of the building of a competitive R&D environment (Figure 7.2).

Figure 7.2. Competitive research funds in the government's original budget



Source: Ministry of Education, Culture, Sports, Science & Technology.

National universities, which were owned by the government, were made corporations in 2004. Previously, the central government covered all of their basic operating costs (other than competitive research funding), including education and research costs. With their incorporation, national universities became responsible for covering their basic operating costs out of their own revenue (e.g. from tuition, university hospitals). The

central government covered other expenses. The result was a division of university revenue into three pillars: independent income, government subsidies to cover operating costs, and competitive funding, the second and third of which were covered by government support. Each year, targets were set to reduce government subsidies to cover operating costs, while block grants under the 21st Century COE programme were used as part of the government's effort to bolster competitive funding. Thus, while the 21st Century COE programme may be viewed as increasing research projects, its dominant effect was a shift from basic funding to competitive funding.

In this respect, the programme is a textbook example of the new type of incentive funding system. In the OECD-RIHR Project, Diana Hicks in 2010 cited Japan as a typical example of the centre-of-excellence approach as an alternative to performance-based research funding systems: "The future of PRFS (Performance-based Research Funding Systems) also depends on how successful they prove to be in comparison to the alternative centre-of-excellence approach in which governments award a limited number of very large, long-term block grants to universities based on competitive proposals. Germany, Japan and Poland use this approach" (Hicks, 2010). The programme can also be considered an early example of the REI approach.

Current research excellence initiatives

The GCOE Programme and the WPI Initiative are the current REIs and are based on the experience of their predecessors. The details of the two programmes are described in the following section.

A related programme, the Programme for Leading Graduate Schools, which aims to strengthen human resource development in doctoral programmes, commenced in FY 2011. It was based on Graduate School Education in a Globalized Society, the Central Council for Education's January 2011 report. The aim is to reform existing doctoral education not only to continue to develop excellent researchers but also to encourage outstanding students to become leaders with vision and creativity who can succeed on the world stage in industry, academia and government. To do this the programme seeks: to bring together first-class domestic and foreign teachers and students; to support radical reform of graduate education through internationally recognised quality-assured degree programmes that combine the first and second doctoral programmes; to blur disciplinary boundaries and gain the participation of industry; and to establish leading graduate schools on a par with the most prestigious institutions of learning.

A leader able to succeed on the global stage in industry, academia and government is likely to need: the ability to act with courage, based on a solid value system, and to co-operate with others; the ability to recognise problems, build well-founded hypotheses and attack the problem creatively; and the ability to "see the big picture" owing to a broad range of knowledge and a high level of expertise. The programme aims to form three types of leaders: all-around leaders, multi-field leaders and "only-one" field leaders.

The period of funding can be up to seven years. Calls for proposals were announced in FY 2011, FY 2012 and FY 2013. In FY 2011, the programme was to cover costs up to JPY 400 million for all-around programmes and JPY 300 million each for multi-field and only-one programmes. In both FY 2012 and FY 2013, the maximum was JPY 300 million for all-around programmes, JPY 250 million yen for multi-field and 150 million yen for "only-one" programmes. In FY 2011, three all-around centres, 11 multi-field centres and six only-one centres were selected, for a total of 20. The number of centres in FY 2012 was 2, 17 and 5, respectively, for a total of 24.

The Programme for Leading Graduate Schools can be considered a type of REI but is not treated in detail here as its focus, human resource development, is different from that of the 21st Century COE Programme and the GCOE Programme.

Global COE Programme

The decision to establish the Global COE Programme was based on assessments of the 21st Century COE Programme and verification of its results by MEXT[4]. The programme will provide financial support for education and research centres of global excellence in order to increase the international competitiveness of Japanese universities. Its aim is to enhance and strengthen the education and research functions of graduate schools in order to foster highly creative young researchers who can become world leaders in their fields through research of the highest standard. Preparations for the GCOE Programme began in the wake of Graduate Education in the New Era, the September 2005 report of the Central Council for Education, an advisory board to MEXT. The programme was started in FY 2007.

The GCOE Programme is designed to reinvigorate Japan's universities and to strengthen basic research in all academic disciplines. It boosts universities' ability to prepare young researchers, particularly doctoral students. The programme only concerns universities. Application is made by the university president and applications are prepared by each research centre that seeks to be included. Calls for proposals were announced in FY 2007, FY 2008 and FY 2009, and targeted fields were specified. Funding is for five years. In FY 2007 and FY 2008 grants amounted to JPY 50-500 million a year and in FY 2009 they amounted to JPY 50-300 million a year. A total of 140 centres were chosen: 63 in FY 2007, 68 in FY 2008 and 9 in FY 2009. The programme is scheduled to terminate at the end of FY 2013. According to the application guidelines, indirect costs equivalent to 30% of direct costs were to be granted; however, these were eliminated in FY 2010 (see below).

The centres chosen during the first year of the 21st Century COE Programme ended in FY 2006, so that the GCOE Programme succeeded the 21st Century COE Programme directly. The new programme was required "to be a programme to develop further the results at centres selected under the 21st Century COE Programme". However, the GCOE Programme modified the programme's objective and expanded the scale of support while nearly halving the number of centres selected.

Selection of centres

Screening for grants is carried out by the GCOE Programme Committee, which was established by the Japan Society for the Promotion of Science (JSPS), an independent administrative institution under MEXT. The committee sets up a working group to discuss screening policy, and screening/evaluation subcommittees in each field then review the documents submitted and select eligible centres. Candidate centres are then chosen during the subcommittee's hearings. When necessary, the chairs of each sub-committee convene a general meeting to discuss results before reporting to the GCOE Programme Committee. Finally, the centres are selected.

The criteria used to screen the centres include:[5]

- The proposal should embody a concept for developing the university that reflects its specific institutional character and should include means of creating a high-level education and research centre to be managed by the university president.

- After the five years of funding ends, the university's COE should be able to continue operating as an internationally excellent education and research centre.
- The programme aims to build an education and research centre that fosters highly creative young researchers. To this end, the centre must conduct creative, leading-edge research at the highest world level. It should have the potential for future expansion.
- Proposals, particularly in "interdisciplinary, combined fields, new disciplines", should incorporate strategies to make existing research groups or departments innovative, e.g. through organisational and/or curriculum reform.
- COEs established under the 21st Century COE Programme should have achieved the expected results under that programme.
- If a university wishes to implement its COE programme in co-operation with other institutes (domestic or foreign), it must formulate a clear concept of its own future development and of the proposed centre and show why co-operation with other institutes is necessary to realise its goal.

There are two overall points of concern:

- In screening, attention should focus on the potential for human resource development, the potential of the centre itself and international considerations, while also emphasising the centre's future developmental potential, regardless of its size or scale, and the operability of the proposed education and research activities.
- Care should be taken to ensure a wide range of fields and to avoid a bias towards particular academic disciplines or areas of research.

Evaluation

An interim evaluation of selected programmes is conducted after two years and a final evaluation is conducted after the programme is completed. Follow-up hearings and site investigations may also be conducted if deemed appropriate. Evaluations involve document and panel reviews by the subcommittee of each field.

The interim evaluation is conducted by researchers with expertise and experience in the relevant field(s). It ascertains the progress made in the project and advises on how to improve operational effectiveness and achieve the objective of establishing a centre of excellence. It also assesses the project's potential to become an internationally excellent education and research centre. The results of the evaluation are used to determine the allocation of subsequent funding.

The ex-post evaluation considers the degree to which the objectives of the institution's implementation plan have been achieved. It also considers the appropriateness of the measures taken in response to the results of the interim evaluation. It serves as an opportunity to offer advice to the institution on the sustainable advancement of their education and research programmes after GCOE funding ends and on ways to improve the programme's quality further. Furthermore, by defining the achievements of each core institution and disseminating this information to society, the evaluation serves to increase public understanding of the institution's education and research activities and therefore to gain greater public support for them.

Both interim and ex post evaluations address: i) project implementation (vision for university's future, organisational support, overall development in terms of human resources and research activities, and appropriate and effective use of grant); ii) measures to deal with points of concern; iii) future prospects; and *iv)* other: what impact will creation of an internationally top-level education and research centre have on the university both internally and externally?

Performance and results

Table 7.1 lists each year's applications and projects selected. The average success rate over the entire period is just under 20%. Table 7.2 shows the total budget for each year, and has declined rapidly since FY 2010.

Table 7.1. Numbers of GCOEs by field and fiscal year

		FY2007	FY2008	FY2009	Total
Applications	All fields	281	315	145	741
Selections	All fields	63	68	9	140
	Interdisciplinary, combined fields, new disciplines	12	12	9	33
	Life sciences	13			13
	Chemistry, material sciences	13			13
	Information sciences, electrical and electronic sciences	13			13
	Humanities	12			12
	Medical sciences		14		14
	Mathematics, physics, Earth sciences		14		14
	Mechanical, civil engineering, architectural and other fields of engineering		14		14
	Social sciences		14		14

Source: Ministry of Education, Culture, Sports, Science & Technology.

Table 7.2. Total GCOE funding by fiscal year

	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
Number of GCOEs (A)	63	131	140	140	140	77
Original budget (JPY billion) (B)	15.8	34.0	34.2	26.5	23.7	13.1
Average budget (JPY million) (B/A)	251	260	244	189	169	170

Source: Ministry of Education, Culture, Sports, Science & Technology.

The GCOE Programme rapidly bore fruit. The interim evaluations compiled changes in indicators between the period just prior to implementation and two years after implementation at 140 selected centres. Table 7.3 illustrates the rise of all indicators in selected centres. The programme has clearly led to enhanced education, particularly for students in doctoral programmes, and to superior research outputs.

Table 7.3. Changes in indicators before/after GCOE programme

GCOE research indicators	Before implementation	Two years after implementation	Increase	
			Number	%
Number of joint research projects	16 589	21 141	+4 552	+27.4%
Joint research with foreign institutions	3 304	4 355	+1 051	+31.8%
Number of keynote and/or invited speeches of programme participants	4 205	5 060	+855	+20.3%
Number of reviewed papers published by programme participants	16 724	17 513	+789	+4.7%
GCOE educational indicators	**Before implementation**	**Two years after implementation**	**Increase**	
			Number	%
Employment rate of new graduates from GCOE programmes	81.8%	84.4%	-	+2.6%
Number of students with research assistantship in doctoral programmes	2 205	3 484	+1 279	+58.0%
Number of international conference papers published by students in GCOE programmes	4 020	5 328	+1 308	+32.5%
Number of reviewed papers published by students in GCOE programmes	5 203	6 236	+1 033	+19.9%

Source: Ministry of Education, Culture, Sports, Science & Technology.

Subsequent development

In November 2009, the new Democratic Party of Japan (DPJ) government instituted a type of policy evaluation, jigyo shiwake, to streamline the budget and end wasteful spending. In the first round, views ranged from demanding an end to the programme to allocating the budget requested. The responsible working group decided to recommend cutting the budget by a third.

MEXT reduced its budget request from an initial JPY 34.1 billion to JPY 26.5 billion, a figure 21.3% below the FY 2009 budget. This meant foregoing new selections, overhauling needed costs, and eliminating indirect costs (JPY 7.9 billion in FY 2009, equivalent to 30% of direct costs). It also meant changes in the grants in the FY 2010 budget for centres selected in FY 2007 based on the interim evaluation. Specifically, the ten centres judged superior received a 10% increase from the previous fiscal year, while the 21 centres graded B received a 10% decrease. Competitive funds for the country as a whole declined (see Figure 7.2) as the Global COE programme was removed from the framework for competitive funding.

Since this reduction still failed to meet the target set in the first round of *jigyo shiwake*, the need to reduce by a third was reaffirmed in November 2010, and appraisers required the cut recommended in the first round to be properly implemented. They requested a further "decrease of at least 10% in the FY 2011 budget request".

In consequence, MEXT budgeted JPY 23.7 billion in FY 2011, although it had originally asked for JPY 26.4 billion, the same amount as the previous year. The final figure is a 30.7% drop from FY 2009, so that, although it came a year late, the budget was cut almost by the third recommended after the first round of *jigyo shiwake*.

As a result, the average budget for each selected centre was cut by about 30%. Eliminating all indirect costs was insufficient, and direct costs were reduced by about 10%. These budget cuts, implemented midstream, had an enormous impact on plans at each centre.

At the end of FY 2011 (March 2012), support for centres selected in FY 2007 ended, and the entire programme is scheduled to end in the near future.

World Premier International Research Centre Initiative

The World Premier International Research Centre Initiative (WPI)[6] was launched in FY 2007 by MEXT in a drive to build "globally visible" research centres that boast very high research standards and an outstanding research environment, sufficiently attractive to prompt frontline researchers from around the world to want to work in them. These centres have a high degree of autonomy, which allows them virtually to revolutionise Japan's conventional modes of research operation and administration[7].

The programme is based on the 3rd Science and Technology Basic Plan. The plan states: "It is expected that these initiatives will create about 30 research centres at Japanese universities that will be positioned as the world's top-class centres according to various evaluation indexes on research activities, i.e. centres of world's top-20 in the field in terms of citation index."

The programme covers many areas of basic research. Whereas only universities could apply to the GCOE Programme, universities, inter-university research institutes, incorporated administrative agencies, and public interest corporations can apply to the WPI Initiative. The funding is for a decade, with five-year extensions granted to particularly successful centres. An interim evaluation is conducted every five years. Calls for proposals took place in FY 2007, FY 2010 and FY 2012[8]. In the FY 2007 selection, funding for each centre amounted to some JPY 0.5-2 billion a year, in the FY 2010 selection to JPY 0.5-1.4 billion a year and in the FY 2012 selection to JPY 250-700 million a year. Five centres were selected in FY 2007, one in FY 2010 and three in FY 2012. For the FY 2007 and FY 2010 selections, indirect costs equivalent to 30% of direct costs were paid, but indirect costs were not covered for the FY 2012 winners.

Rather than providing funding for specific research, the WPI Initiative provides funds to create research centres and focuses on operational components. To undertake the centre's research projects, the host institutions, including the centres themselves, must obtain resources in addition to the amount of the WPI grant.

Selection of centres

The WPI Programme Committee, established by MEXT, is composed of experts, at least 30% of whom are eminent foreign scholars, Nobel laureates and former university presidents. The Programme Committee selects awardees through a two-stage process consisting of document reviews of submitted application materials, by a working group that includes foreign specialists, and panel reviews by the Programme Committee of the programme director and programme officers of each project. After receiving the results, MEXT then makes the final decision after receiving the results

The screening takes careful note of the centre's proposed characteristics (research field, research targets, operation, researchers and other staff, environment to be created, indices to evaluate in light of global standards, securing of research funds), the appropriations plan, the host institution's commitment, etc.

The FY 2012 selection targeted not only new centres, but also schemes with the potential to achieve world-level status by combining WPI support with programmes at existing centres. In such cases, the condition is that once the projects at existing centres

are completed, efforts at roughly the same scale will be made through independently secured funding.

Follow-up and interim evaluation

The WPI Initiative conducts each year a detailed follow-up as well as a careful reckoning of the situation with a view to building truly top-level centres. The WPI Programme Committee conducts a strict follow-up (specialist advice and instruction) with the programme director (PD) and programme officers (POs) at each centre. The follow-up involves submission of a progress report by each centre on the level of its research, interdisciplinary integration (number of interdisciplinary papers and posters), internationalisation (percentage of foreign researchers), system reform and other topics. There are also site visits by groups of six to eight experts (about half of whom are foreigners), and the Programme Committee holds hearings with the director of the centre and the head of the host institution. The results are announced and used each year as the basis for determining the budget allocation.

An interim evaluation was conducted in FY 2011 on the five centres selected in FY 2007 after four full years. The purpose was "to evaluate the progress of centres selected in FY 2007 in order to build a solid 'visible centre' under the WPI programme". The interim evaluation is conducted by the WPI Programme Committee, with the co-operation of a subcommittee set up at each centre by the PD, POs and the Programme Committee. The Programme Committee makes the interim evaluation based on hearings conducted by the subcommittee at each centre and the reports compiled after site visits. A comprehensive evaluation is made after taking into account all aspects: research level, interdisciplinary integration, internationalisation, system reform, and future prospects. The results of the interim evaluation are reflected in the reports of the Programme Committee. The reports may recommend changes in the centres, including discontinuation of the centre, a change of director, partial changes to principal investigators and/or subjects of research, or partial changes to research targets.

Performance and results

Table 7.4 shows the calls for applications and the selections made. The average success rate is about one in six. Table 7.5 shows each year's grants and each centre's total activities costs. Table 7.6 lists the currently active centres.

The six centres active as of April 2012 had 571 academics/researchers, 292 postdocs and 125 research assistants, for a total of more than 160 participants per centre.

In the interim evaluation, 2 500 papers published between 2007 and 2010 by the five centres selected in FY 2007 were examined. The average number of citations per paper was 13.9. This would put the centres, as a group, in fifth place among leading world universities, behind Rockefeller University at 22.6, Massachusetts Institute of Technology at 15.9, Harvard University at 15.5, and California Institute of Technology at 14.9. Some 5.1% of the papers are in the top 1% in terms of citations, and thus in second place, behind only Rockefeller University, with 6.6% of papers in the top 1%. Although the comparison is not rigorous, it seems clear that the centres achieved strong results quickly, with papers of a quality comparable to that of the world's top universities.

Table 7.4. WPI applications and grants by fiscal year

	FY2007	FY2010	FY2012	Total
Selections	5	1	3	9
Applications	33	9	15	57

Source: Ministry of Education, Culture, Sports, Science & Technology.

Table 7.5. Total amount of WPI grants by fiscal year

	FY2007	FY2008	FY2009	FY2010	FY2011
Number of centres	5	5	5	6	6
Total amount of WPI grant (JPY billion)	3.4	7.0	7.0	7.2	8.0
Total expenditure of all centres including WPI grant (JPY billion)	7.9	20.0	28.3	29.0	24.4

Source: Ministry of Education, Culture, Sports, Science & Technology.

Table 7.6. Current centres with WPI funds

Opening year	Host institution	Name of centre	Outline of centre
FY2007	Tohoku University	Advanced Institute for Materials Research (AIMR)	Establishment of a leading world research organisation in materials science
	University of Tokyo	Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU)	Cross-disciplinary research centre to study the origin and evolution of the universe
	Kyoto University	Institute for Integrated Cell-Material Sciences (iCeMS)	Creating a new field of integrated cell-material science in the mesoscopic domain
	Osaka University	Immunology Frontier Research Centre (IFReC)	Observation of immune reaction - unveiling dynamic networks of immunity
	National Institute for Materials Science	International Centre for Materials Nanoarchitectonics (MANA)	Materials nano-architectonics; new paradigm of materials development
FY2010	Kyushu University	International Institute for Carbon-Neutral Energy Research (I^2CNER)	The grand highway for a carbon-neutral energy fuelled world
FY2012	University of Tsukuba	International Institute for Integrative Sleep Medicine (IIIS)	World-class institute for sleep medicine, aiming to solve the mechanism of sleep/ wakefulness by conducting basic to clinical research
	Tokyo Institute of Technology	Earth-Life Science Institute (ELSI)	Advanced interdisciplinary research hub for exploring the origins of Earth and life
	Nagoya University	Institute of Transformative Bio-Molecules (ITbM)	Changing the world with molecules: synthetic chemistry and plant/animal biology

Source: Ministry of Education, Culture, Sports, Science & Technology.

Subsequent development

Building facilities and equipment with supplementary budget

The WPI Initiative provides funding to cover the cost of forming a research centre, while the funds for research activities need to be acquired separately. The initiative does not cover the costs of building facilities, but this has gone forward thanks to the government's supplementary budget.

In the wake of the economic crisis of 2008, the Liberal Democratic Party (LDP) government added a supplementary JPY 2 billion (about USD 22 million) to the FY 2009 WPI Initiative budget for each centre as economic stimulus, to be used for buildings and facilities. Because the funds had already been allocated when the DPJ government took power in 2009, the five WPI centres active at the time were able to build their research facilities. In particular the concept and design of IPMU's new building facilitate communication and collaboration among physicists and mathematicians.

In the FY 2009 supplementary budget, the Cabinet Office also launched the Funding Programme for World-Leading Innovative R&D on Science and Technology (FIRST). This programme invests large amounts in research aimed at innovation. FIRST allocates an average of JPY 3 billion (about USD 33 million) to each of 30 research challenges over five years. Seven principal investigators (PIs) and other researchers in WPI centres are involved in these efforts.

The FY 2012 supplementary budget provided JPY 8 billion to build facilities and JPY 2 billion to build equipment at the four new centres selected since FY 2010 in order to accelerate the formation of research centres and move forward the construction schedules for research facilities in order to make high-level research equipment available rapidly and attract world-class researchers.

When the supplementary budget funds for facilities and equipment are included, the WPI financing package is quite significant.

Jigyo shiwake *budget streamlining*

The DPJ government's the first round of *jigyo shiwake* budget slashing targeted competitive funding, including the WPI Initiative, for "cuts to budget request" in terms of the budget for the invitation of foreign researchers. MEXT responded by reducing its initial request of JPY 9.3 billion for the initiative to JPY 7.3 billion. It also reduced the number of new centres to be recruited in FY 2010 from 3 to 1. The budget for the five existing centres was cut by 3% to an average of JPY 1.35 billion (about USD 15 million) per centre. As a new centre was added, the overall WPI budget grew by 2%.

The DPJ government's third round of *jigyo shiwake* involved a review of competitive funding that included the WPI Initiative. Indirect costs were eliminated in FY 2011 (they represented JPY 1.7 billion in FY 2010) since the WPI Initiative was made a non-competitive funding scheme as the result of the third round of *jigyo shiwake*. This drove the WPI Initiative out of the framework for competitive funding, as in the case of the GCOE Programme.

Centres interviewed for the case study

Among the universities that had acquired funds from the GCOE Programme and the WPI Initiative, Osaka University and the University of Tokyo had much experience and many GCOE centres. Interviews were conducted with the vice presidents for research, representatives of the centres, administrative directors and others at each of the universities. The centres interviewed are listed in Table 7.7.

Table 7.7. Overview of centres interviewed

University	Osaka University		University of Tokyo	
Staff numbers	Faculty, 3 111; Others, 2 877; Total, 5 988; Contract workers, 3 335		Faculty, 3 830; Others, 3 772; Total, 7 602; Contract workers, 2 434	
Number of students	Undergraduate, 15 541; Graduate, 8 017		Undergraduate, 14 018; Graduate, 13 624	
Number of COEs	21st Century COE, 15; GCOE, 12; WPI, 1		21st Century COE, 28; GCOE, 17; WPI, 1	
Centre Interviewed	Centre for human-friendly robotics based on cognitive neuroscience (GCOE)	Immunology Frontier Research Centre, IFReC (WPI)	Global Centre of Excellence for Mechanical Systems Innovation (GCOE)	Kavli Institute for the Physics and Mathematics of the Universe, Kavli-IPMU (WPI)
Director of centre	Hiroshi Ishiguro (Graduate School of Engineering Science)	Shizuo Akira (Research Institute for Microbial Diseases)	Mamoru Mitsuishi (School of Engineering)	Hitoshi Murayama
Project summary	Interdisciplinary research integrating studies in robotics, cognitive science, and brain science	The fusion of immunology, imaging technology and bioinformatics	Construction of an "extended mechanical engineering" scheme, in which the unique phenomena and sophisticated characteristics of the nanoscale are actively used	Cross-disciplinary research centre for addressing the origin and evolution of the universe, with close collaboration of mathematics, physics and astronomy
Grant period	FY2009-13	FY2007-16	FY2008-12	FY2007-16
Total amount of grant	JPY 631 million (four years, through FY 2012)	JPY 6 291 million (five years through FY 2011), plus facility construction costs	JPY 1 463 million (five years through FY 2012)	JPY 6 137 million (five years through FY 2011), plus facility construction costs
Number of researchers (FTE)	27 (Solely employed to work at the COE, 9; also employed to work at the host institution, 18); with foreign citizenship, 0 (2012)	117 (103 hired at centre; 14 professors at host organisation); 40 foreign researchers (2011)	30 (7 hired at centre; 23 host organisation professors); 3 foreign researchers (2011)	95 (74 hired at centre; 21 host organisation professors); 48 foreign researchers (2011)
Other staff (FTE)	4 (solely employed at the COE, 3; also employed at the host institution, 1); with foreign citizenship; 0 (2012)	85 (78 hired at centre; 7 host organisation professors); 6 foreign staff members (2011)	4 (4 hired at centre); 0 foreign staff members (2011)	35 (25 hired at centre; 10 host organisation professors); 0 foreign staff members (2011)
URL	www.gcoe-cnr.osaka-u.ac.jp/english/	www.ifrec.osaka-u.ac.jp/index-e.php	www.gmsi.t.u-tokyo.ac.jp/gmsi/en/	www.ipmu.jp/

Summary of interviews: GCOE Programme

The GCOE centres of both Osaka University and the University of Tokyo aimed to create an internationally oriented, interdisciplinary education and research environment that went beyond conventional organisational structures. However, while both universities relied on their existing organisational structures for the GCOE Programme, the centres were not part of the ordinary organisation of the university and their administration was somewhat autonomous. Osaka University's centres are seen as roughly equivalent to university-wide education/research centres. Both universities made use of this intermediate characteristic to provide interdisciplinary and innovative education and research opportunities that would have been hard to provide within the universities' existing organisational structures. The centres can therefore be understood as a force for reform.

Led by the director of the centre, the centres hire for the project professors/researchers and postdoctoral fellows, who engage in education and research in the centres. In addition, graduate students are hired as research assistants. Since the universities do not administer the GCOE centres, a small administrative staff is hired using grant funds; professors and specially appointed project professors are primarily responsible for administration of the centre. However, the administration of the host university does provide support for accounting and processing. Also, as the university has several GCOE centres, there is some joint administration, for example for university-wide public relations.

Both universities actively engage in exchanges with related centres in Japan and abroad in addition to the collaboration that takes place among the university's GCOE centres.

Programme results

One result of the programme seems to have been advances in joint research on high-risk topics and new disciplines, which is hard to do with small project budgets, and the formation of interdisciplinary research groups that span a broad range of fields. This resulted in some cases in acquisition of new funds. Some centres believed that this helped them gain prestige both within and beyond the universities.

A venue was created to foster PhDs and young researchers in areas that go beyond existing academic disciplines. Opportunities were provided for exchanges between domestic and foreign researchers through exchanges as well as internships, project-based learning and summer camps. A change in awareness among students was apparent and students praised the programme.

At the University of Tokyo, dialogue with corporations regarding the fostering of PhDs progressed, along with a common understanding of the abilities that needed to be developed. Improvements in problem-setting ability, problem-solving ability, and the tendency to take an entrepreneurial perspective were noted.

Other issues

People involved in the research centres noted the following challenges:

- The rules and regulations regarding the handling of funds make administrative procedures so complex that they interfere with the proper expenditure of allocated funds.
- The GCOE Programme involves five years of financial aid. But at five years, things are just getting off the ground. A ten-year period would be better, and should be extended even if the annual amount of support must be cut commensurately.
- The timing of the interim evaluation is 18 months after full-scale project launch. This is too early.
- Since indirect costs were eliminated, the centres must cover their own administrative costs with money other than the GCOE grant, including government subsidies for management expense of national universities.
- The GCOE Programme was only one target of the government's *jigyo shiwake* budget streamlining, but this made some students suspect there might be problems with the GCOE Programme itself.

Summary of interviews: WPI

Integrated interdisciplinary research and the creation of an international research environment are the defining features of the WPI centres at Osaka University and the University of Tokyo. Both centres are quite big, with 100-120 FTE researchers. Of these, at least 40 are foreign post-doctorates and researchers. Creating centres with an international research environment is a major WPI goal. Unlike ordinary large-scale projects, researchers come together to work at certain facilities, some of which were established for the WPI and paid for by the supplementary budget, as described above. WPI centres are not only large-scale research projects, they are also research organisations. They are unique in terms of the funding programme and as part of the internal organisation of the university.

WPI centres have many researchers, but most are employed on the WPI grant. In contrast, most researchers in the GCOE Programme are professors employed by the host organisation. WPI centres have a great deal of autonomy within the universities, strong operating principles, and their own administrative staff. As centre directors have the authority to make personnel decisions, this helps give the centre the flexibility needed to operate effectively. Both universities recognise the centres as organisations on a par with their departments and schools, and centre directors attend the university-wide meetings of department heads.

A small group of about four executives, including the director, the deputy directors and the administrative director, are in charge of day-to-day operations so that researchers can concentrate on research. The centres' administration is large, with several dozen staff members. They support the management of the research centre and work with the administration of the host institution. The administrative director is hired for the WPI Initiative rather than drawn from university administration. The administrative directors at both centres have experience as researchers running a research organisation. The administrative departments have managed to bolster their planning function and international-level research support function, functions for which the administrative departments at the host institutions are not particularly prepared. As foreign researchers are numerous, the administrative staff acquires a broad range of expertise through day-to-day activities performed mainly in English, frequently implemented international projects, and international-level research support actions. This expertise and internationalisation spills over to the host universities. Typical administrative functions involving personnel and accounting are handled by university administrators or in conjunction with them. The administrative staff hired using WPI funds are in principle appointed to fixed one-year to three-year terms.

Programme results

It is recognised that the WPI Initiative has achieved or at least advanced cross-disciplinary research. IFReC links research on immunology and imaging; IPMU combines research on physics, astronomy and mathematics.

It is also recognised that the centres are flexibly managed, unlike existing university departments and research institutes. Japanese university research support systems had not been able to keep up with changes in research activities, but the WPI Initiative has influenced research support throughout the universities. Support for foreign researchers has also been bolstered and has contributed to the internationalisation of the universities as a whole.

The WPI Initiative thus fulfils its role as a pioneer for university reform in terms both of research and of the research system.

Other issues

IFReC at Osaka University has had difficulty finding senior-level specialists. It is particularly difficult to convince those with achievements in informatics to participate in immunology research. Finding young researchers and postdocs is easy.

The WPI Initiative has a fixed term of ten years. Future challenges will include continuing the programme into the future and securing essential personnel. Headhunting for highly skilled researchers began after passing the five-year point, with five years remaining.

The WPI Initiative involves more than selecting research centres and allocating funds. Programme officers have to make frequent site visits. Although some criticism is harsh, there should be a common understanding between the funding body and people in each centre.

REIs from the perspective of host organisations

Benefits

The following benefits were mentioned by host organisations:

- Centres become pioneers of university reform and are assimilated by the university
  - Centres of both the WPI Initiative and the GCOE Programme are deeply embedded in their universities in spite of their independence and autonomy. The original aim of the GCOE Programme was reform of doctoral education and had a basis in many existing disciplines. The WPI Initiative set up a new type of organisation within the university. During the funding period, the centre is not completely independent, but it has autonomy and is considered almost on a par with university departments.
  - The WPI Initiative managed both to hire foreign researchers and build an environment dedicated to research, tasks that were difficult to achieve as part of ordinary university administration.
- Development of integrated and high-risk research
  - The GCOE Programme was beneficial in terms of providing a new opportunity for high-risk research and joint research by different disciplines and for tackling socially important challenges. Once the central government defines the field it intends to develop, policy initiatives to create large research centres such as WPI become effective.
- Contribution to internationalisation of the university
  - A WPI centre implies that the university has globally competitive, world-class research centres. The GCOE Programme was effective in promoting global development of education and research.

- Contributing to university prestige
  - It is agreed that GCOE and WPI centres raise the morale of those in universities as well as the prestige of the universities themselves. The GCOE centres demonstrate innovative efforts in the area of graduate education, help to bring together Japan's highly skilled students, and as a result bolster the research infrastructure of universities.
- Contributions to university finances
  - At the beginning indirect costs were included, so there was a financial advantage for the universities as well.

Issues

The following issues were noted regarding GCOE Programme and WPI Initiative:

- Continuation of the centres
  - The period of support for some GCOE centres has already ended, as will the period for WPI centres. The GCOE Programme has had no follow-up programme. The host institution has to continue to support the centres on its own in some form or another. The continuation of support is debated at each university, but if possible the GCOE Programme should make the programme renewable. It is wasteful to end a programme after five years, just when it begins to bear fruit.
- COE-style funding and disparities between universities and between academic disciplines
  - The GCOE Programme brought into stark relief the disparities between universities and between disciplines. It also tended to overemphasise currently popular topics. It would be better if it enabled the needed basic research.
- Global COE Programme evaluation
  - Interim and ex post evaluations are conducted for the GCOE Programme, but they are too detailed and create too large a burden. COE-style funding is good, but it would be better for the university if administration were easier. Ex post evaluation is conducted after funding period ends, particularly for the GCOE Programme. While this makes sense, difficulties have arisen as some staff members deal with ex post evaluation after leaving their universities.
- Harmful effects of losing support for indirect costs
  - Administrative and research support staff are necessary to support the centre's activities, but when indirect costs were cut in the middle of funding period, the centres and the host institutions were no longer able to hire such staff. The WPI Initiative can hire nearly all of its staff as direct costs, but this was a problem for many GCOE Programme centres. While universities have administrative systems, COE-style programmes differ in various ways from ordinary university administrative operations, making it impossible for existing structures to provide full support. Thus, professors in charge of the programme, particularly the GCOE programme, had to take up the slack. Paying the indirect costs for COE-style programmes is of paramount importance.

Other

The following points were noted:

- Clarification of the role of COEs in the host institutions
  - Of the four GCOE and WPI centres studied, Osaka University's Centre of Human-Friendly Robotics Based on Cognitive Neuroscience and the University of Tokyo's Kavli Institute for the Physics and Mathematics of the Universe (IPMU) were incorporated into the universities' organisational structure as new types of organisations. Osaka University created the Institute for Academic Initiatives (IAI) and, by positioning its GCOE centre as an IAI Research Division for Cognitive Neuroscience, is in the process of securing a base for future operations.
  - The University of Tokyo's IPMU started as an organisation that reports directly to the university president, but currently it is positioned as a research institution under a university-wide organisation established as the Todai Institute for Advanced Study (TODIAS). TODIAS has authority over personnel decisions and is an organisation equivalent to existing academic departments or research institutes. Through TODIAS, the IPMU has authority for personnel and can make independent budget requests. These organisational formats represent a new organisational model, different from the traditional academic departments and colleges.
- Issue of indirect costs
  - Support for indirect costs was eliminated in FY 2010, but COE-style funding would likely have been more effective if indirect costs had been sufficiently covered.
- Issue of securing labour costs and tenure posts
  - The competitive funding scheme in Japan does not cover personnel expenses for tenure. It should be covered to pay higher salaries for higher skilled researchers and the reform that aims to reduce total personnel expenses in national universities should be stopped. The reform has made it difficult to attract highly skilled researchers from overseas. Personnel expenses for professors applying to the GCOE Programme and the WPI Initiative are not covered by the grant. If applicants' salaries could be paid out of the project budget, the programmes would be able to attract highly skilled researchers from around the world under conditions (high salary) that would encourage them to apply. But they cannot. Even if universities wish to hire such researchers in advance, the government's wish to reduce total personnel expenses at national universities makes it difficult to pay a particular professor a high salary.
  - In the end, they have no choice but to use their existing professors and use the funds acquired to hire researchers on terms that keep up with international standards. Universities want at least to be able to guarantee an income equivalent to that paid by researchers' parent institutions, not only when recruiting those on a level with leaders but also foreign researchers. This is nearly impossible within the framework of the reforms to reduce total personnel expenses.

- Tenure is necessary to ensure that the research centres take root, but this is also difficult due to limited tenure posts. Even if a sufficient number of tenure posts are provided, giving tenure to researchers based in Japan is good, but it is not enough to attract researchers from countries where employment conditions are better than in Japan.
- Japan's severance pay and pension systems premised on lifetime employment are also an obstacle. The severance pay system is a bottleneck that hinders researcher mobility. In addition to the recent unification of the public pension system, the severance pay system should be abolished and an annual salary system introduced to increase mobility between universities and between universities and industries.

Conclusion

Comprehensive evaluation

Japan's funding system has undergone major changes over the past decade: the full-scale introduction of proposal-based competitive research funding programmes since the mid-1990s; the switch to independent administrative institution status of many public research institutions as part of the administrative reform of 2001; the creation of a core funding system through incorporation of national universities in 2004; and the setting up and expansion of the system of competitive research funding around the turn of the century. The funding system has been moving towards more transparency in the flow and use of public funds for research by strengthening research under such programmes and increasing the independence of institutions. The funding system of the COEs was introduced to make more efficient use of public funds through selection and concentration of the allocation of research funds.

The GCOE Programme had a stronger focus on developing human resources than the 21st Century COE Programme. It contributed to reforming doctoral studies in graduate schools but also encouraged more interdisciplinary or multidisciplinary efforts in both education and research.

The WPI Initiative is a unique programme. Universities need to build research facilities and secure researchers and research funds in order to conduct research at an adequate scale in new fields. In the past, Japan's national universities belonged to the central government, which took responsibility for building research facilities and filling research posts. MEXT made decisions on funding allocations based on requests from the universities. The money was part of Japans' tertiary education budget, but this process was not always transparent. In contrast, the WPI Programme created a competitive and transparent method of allocating the funds needed to build the research infrastructure, rather than fund research projects as in the past. When the WPI was launched, this was not understood; some thought that project funds were unnecessary since research funds would be allocated to WPI centres.

Today WPI is praised not only by the researchers and universities implementing the initiative; it is also lauded as a part of Japan's overall science and technology policy. This is because it can take on new and interdisciplinary research; it starts by building the research infrastructure and then proceeds to conduct research activities.

The schemes for establishing centres, such as 21st Century COE Programme, GCOE Programme and the WPI Initiative, have become better known, but much research funding is still competitive project funding. Yet "selection and concentration" have moved forward. Higher concentration means relatively lower screening and other costs for the funding agency in comparison with grant figures as a whole. At the same time, many candidate centres may be rejected. The costs of applications cannot be recouped and are a significant financial burden for research institutions. The host institutions that run the programmes also face large financial and non-financial costs. Today, when indirect costs are not covered, the increasing operating costs for host institutions whose centres are selected are significant.

Interestingly, COE-style funding took hold in Japan before performance-based funding was implemented. Today, policies have begun to be introduced to fund institutions in a simpler way, based on various indicators, similar to performance-based funding.

Implications

The remaining challenge for the GCOE Programme and the WPI Initiative is their five- or ten-year term limit. The GCOE Programme must be terminated after five years because there is no way to continue, by selection, evaluation or even by reducing the scale of funding. A common hope, expressed by many involved, is to double the aid period even if it means halving the funding.

The WPI Initiative already has a ten-year funding period, with the possibility of a five-year extension. Still, once the grant stops, it is easy to imagine the plunge in the number of researchers who can be hired and an inevitable drain of researchers. From a global perspective, the drain of highly skilled researchers is not necessarily a bad thing, but if they leave for self-protection rather than the further development of research, the research funding's "multiplier effect" will be lost and the return on research investment will be paltry.

Both the GCOE Programme and the WPI Initiative were targeted by the government's *jigyo shiwake*. The result was a loss of support for indirect costs in the middle of the funding period. This was not foreseeable at the beginning, and it was a "disaster" caused by a political decision. This has taught many lessons. First, because of the amount of funding, major changes in the middle of programmes had a significant impact. The large amount of the funding is itself a weakness when the environment changes. Second, cutting indirect costs to cover budget cuts appears to absorb the shock of the budget costs because in the short term direct spending can be maintained. But because the host institutions must cover on its own the indirect costs of running the centres, the impact is significant. If funding must be reduced, the programmes must be designed with care to deal with such shocks.

Notes

1. The Council for Science and Technology Policy had determined the policy for allocating special co-ordination funds, including the basic orientation of science and technology and selection of priority areas. The programme's allocation operations were run by the Ministry of Education, Culture, Sports, Science and Technology.
2. www.jst.go.jp/shincho/en/program/senryaku_kyo.html.
3. www.jsps.go.jp/english/e-21coe/index.html.
4. www.jsps.go.jp/english/e-globalcoe/index.html.
5. www.jsps.go.jp/english/e-globalcoe/01_outline_review.html.
6. www.jsps.go.jp/english/e-toplevel/index.html.
7. The Message from the chair of the WPI Programme Committee, issued at the time of the first recruiting in 2007, noted the following as well as its background: "Over recent years, global competition in recruiting the best and brightest researchers has intensified. To maintain and improve Japan's scientific and technological standing, we will need to position ourselves within the global flow of outstanding human resources while creating research platforms that will naturally attract and amass such human resources in Japan. Given this imperative, it is the aim of the WPI Initiative to establish research centers of a caliber that will win high esteem throughout the world for the outstanding results they produce. Like Bio-X at Stanford University, the Robotics Institute at Carnegie Mellon University, Janelia Farm at Howard Hughes Medical Institute (HHMI), or MRC Laboratory of Molecular Biology in the United Kingdom, these research centres should be capable of attracting frontline researchers from around the world and of advancing research that integrates cutting-edge fields while pioneering new domains of scientific pursuit." (www.warp.ndl.go.jp/info:ndljp/pid/286794/www.mext.go.jp/english/wpi/006.htm)
8. The FY 2012 recruitment was called WPI Focus and was intended to form research centres in cutting-edge domains.

Reference

Hicks, D. (2010), "Overview of models of performance-based research funding systems", in OECD (2010), *Performance-based Funding for Public Research in Tertiary Education Institutions: Workshop Proceedings*, OECD Publishing, Paris, pp. 23-52.

Chapter 8

Norwegian Centres of Excellence

Siri Brorstad Borlaug and Liv Langfeldt
Nordic Institute for Studies in Innovation, Research and Education (NIFU)
Conducted on behalf of the Research Council of Norway

This chapter presents the Norwegian Centre of Excellence (CoE) scheme and its impact on research activities and organisational structures. The scheme is found to increase the visibility, reputation and internationalisation of Norwegian research, but the temporary nature of the CoEs presents challenges for the organisational structures of universities and their faculties. These challenges relate particularly to the allocation of financial resources, the boundaries and autonomy of the centres, the wind-up of centres and responsibility for personnel.

Introduction

The Norwegian Centres of Excellence (CoEs) scheme is one of Norway's three research excellence initiatives (REIs). Its primary aims are high scientific quality and internationalisation. The other two schemes are the Centres for Research-based Innovation and the Centres for Environment-Friendly Energy, which also aim at innovation and include a requirement of formal collaboration with industry and/or public agencies.

There are presently 21 CoEs located at various host institutions (universities, university hospitals, research institutes). They are very diverse and the scheme's impact on research and organisation depends on the disciplines involved and the characteristics of the host institution. The following gives a general description of the scheme and illustrates it with information based on a particular CoE and its host university, and hence describes the perceptions and experiences of one host university, host department and centre. These are illustrative examples; other CoEs and hosts may have different experiences and perceptions. The presentation is based on the survey data collected for the OECD-RIHR study, previous evaluations and studies of the scheme (Langfeldt et al., 2010; Aksnes et al., 2012; Borlaug, forthcoming), and interviews at the selected CoE, its host university and host department.

A small country with centralised research funding

In order to contextualise the CoE scheme, a brief overview of the Norwegian research system is necessary. There are four major types of public research organisations: universities, university hospitals, university colleges and research institutes. Generally speaking, there is a division of work between the universities and the research institutes. The latter are the primary providers of applied and contract research, and the former primarily conduct basic research. In terms of finance, Norwegian universities still enjoy considerable block funding compared to other European universities, which are often more dependent upon project-based grants.[1] Moreover, Norway has only one research council, the Research Council of Norway (RCN), which administers all grant schemes, including the REIs. The centralisation of competitive funding schemes for research, combined with the division of tasks among the different kinds of research-performing organisations, means that CoEs can potentially have a substantial impact on the national research landscape.

Norwegian excellence policy

The emergence of explicit policies for excellence in research is relatively recent in Norway. Policies for generous, selective funding of the very best researchers and research groups began to appear during the later years of the 1980s and the first half of the 1990s, albeit with very limited effect on overall research policy (Aksnes et al., 2012). This may be typical of the experience of small countries; several evaluations of Norwegian research at the time emphasised the relatively flat research landscape, with the distribution of resources based on the principle of equality and few research groups of high international quality (Walløe, 2008). The idea of a scheme to promote excellence in research was launched in the 1999 White Paper on research (KUF, 1999). While there were already a few single-standing schemes to promote excellence in research by forming centres and/or for long-term funding for the very best, the White Paper introduced what was to be called the CoE scheme as the first general scheme for excellence in research (Aksnes et al., 2012). The scheme was first announced in 2002, through an open call for applications (Box 8.1).

Box 8.1. The Norwegian CoE scheme

Governed by the Research Council of Norway (RCN)

Established/first call: 2002

Main selection criteria: Scientific quality, high international standard

Number of centres: 13 centres in 2003 (ended in 2012): 8 centres in 2007; 13 centres in 2012

Yearly funding: EUR 1-1.8 million from RCN, substantial co-funding/in-kind funding from host institution

Duration: 5 + 5 years, mid-term evaluation after 3.5 years

Organisational model: aims at co-localised research groups

Host institutions: universities, university hospitals and research institutes

General characteristics of the CoEs

The aim of the scheme is to "establish time-limited centres characterised by focused, long-term research efforts of a high international calibre, and where research training is an important aspect" (RCN, 2005). It is the prime national research policy instrument for:

- promoting high scientific quality in national research
- promoting cutting-edge basic research through long-term, generous funding
- strengthening the internationalisation of Norwegian research
- creating added value by establishing centres in host institutions
- building strong research groups
- promoting researcher recruitment.

The RCN has recently announced the third generation of these centres. During the scheme's lifetime some changes and adjustments have been made. In the first call, one of the selection criteria was the social relevance of the research field. Fields differ considerably in how much relevance is an inherent part of their typical research or is readily identifiable. With the introduction of a new scheme for centres for research-based innovation in 2005, this criterion was removed from the CoE scheme as it was considered covered by the new scheme. In addition, the RCN encouraged host institutions to limit the number of applications. As such, the CoE scheme can be seen as an instrument for prioritising strong research environments in host institutions.

Illustrative case

The illustration of the CoE scheme in this chapter is based on the experience of the University of Oslo, which has hosted 12 CoEs (three from the first CoE call, five from the second, and four from the latest). The illustrative examples concern the university, one CoE at the university, and the host department and faculty of the CoE. The selected CoE, here called CoRG,[2] employs 40 persons who represent 24 full-time equivalents (figures for 2012). The main purpose for establishing CoRG was to strengthen research capacities and enhance the research field. The centre performs basic research and its scientists teach at the bachelor's and master's levels to some extent. It is a temporary unit and is highly dependent upon funding from the CoE scheme.

Funding and internal governance of the Norwegian CoEs

The RCN provides each centre with between NOK 8 million and NOK 20 million a year; the average is NOK 12.8 million. The RCN requires co-funding from the host institution, which defines the characteristics of these funds. Co-funding may include infrastructure investments, funds from its own budget or external grants. Hosts are required to cover infrastructure and overhead costs for the CoEs. However, the practices of hosts vary. While some interpret co-funding literally and provide funding from their own budgets, others define infrastructure as their co-funding. The first strategy has resulted in organisational tensions. Some CoEs appear to have been formed at the expense of other research groups in the same department, and some CoEs have become large and unmanageable. Based on experience so far, it seems that host institutions now have two strategies: i) rewarding CoEs through additional funding; and ii) using infrastructure for co-funding in order to avoid organisational tensions. These two strategies apply primarily to the universities. Research institutes face other types of challenges, especially if they are a partner in a CoE rather than the host. A host institution can define infrastructure as co-funding, but partners have to provide funds. This is a challenge owing to the relatively low basic funding of research institutes.

In some fields, the CoE grant is a small percentage of the CoE's overall budget; on average, it is 20%. There are large differences between the public research organisations (PROs) and between research fields. CoE funding represents most of the budget for CoEs in the humanities and the social sciences, and for CoEs hosted by research institutes. In the life sciences, the CoE grant is important, but represents a relatively small share of the total budget. These centres tend to be large; one has more than 200 researchers. Table 8.1 shows the total yearly funding from the scheme per research area and the average funding for each centre. The large number of centres in the geosciences reflects the Norwegian context.

Table 8.1. Yearly total and average funding of Norwegian CoEs, by fields

Field	Number of CoEs	Annual NOK (million) from the CoE scheme	
		Total funding	Average funding per CoE
Geosciences	6	79.3	13.2
Engineering	5	64.7	12.9
Life sciences	12	169.5	14.1
Hum & social sciences	7	77.9	11.1
Natural sciences	4	54.6	13.6

Notes: Field categorisation by NIFU. Includes the three first CoE generations, budget years 2009 and 2013; see notes to Table 8.2.

Source: RCN web pages, www.forskningsradet.no/en/Home_page/1177315753906.

The scheme's success has led to an increase in the CoE budget, with a substantial increase in funds from the first to the third generation (Table 8.2).

Table 8.2. Yearly total and average funding of Norwegian CoEs

CoE generation	Number of CoEs	NOK (million) from the CoE scheme	
		Total funding	Average funding per CoE
2003	13	151.2	11.6
2007	8	87.8	11.0
2013	13	207.0	16.0

Notes: Current prices. Figures for the 2003 and 2007 generations are for budget year 2009. (Langfeldt et al. 2010). Numbers for the 2013 generation are for budget year 2013

Source: RCN web pages, www.forskningsradet.no/en/Home_page/1177315753906.

The selected centres are expected to generate enough additional funding to be self-sufficient after the termination of the CoE grant. However, access to alternative grants varies among fields. While a life sciences centre might have a number of funding opportunities, these seem to be rather limited in fields such as the humanities, which is composed of many rather specialised subjects. Hence, some centres will tend to continue at the same level of activity after the grant period, while others will have to scale down their activities considerably.

Funding and governance at the University of Oslo

The University of Oslo has faced a steep learning curve in terms of providing for the CoEs. Concerning financing, the university first decided to award each centre an annual lump sum of NOK 2 million. This strategy changed in 2012 when the first centres were in their final phase. In order to sustain some of their activity and to ensure the centres' smooth transition into their departments, this lump sum allowance is now allocated to the faculty. The grant is permanent, i.e. it marks a general increase in the faculty budget. The faculty now has the authority to decide on the continuance of the centres. Making the faculty responsible for the grant is a new budget model; the practice is also being applied to the new generation of centres; they will not receive a direct grant, which will be allocated via the faculty.

Behind this new funding strategy was the concern that the centres tended to grow quite large. Strained faculty finances do not allow for a great deal of specialisation in selected research topics or a concentration of resources in a particular field. As the faculties and faculty administrations have different perceptions of the CoEs – some are enthusiasts, others are sceptical – they may choose practices for administrating the grants different from those preferred by the university.

The University of Oslo's annual reporting to the RCN has illuminated challenges for co-ordinating their reporting systems in order to provide assistance for the reporting expected of the centres. In particular, different authorities seem to use different definitions of key terms; this complicates the reporting process. For example, the Ministry of Education, the RCN and the university all have different definitions of "a stay abroad"; reporting a researcher as having had a stay abroad involves reporting on the basis of three different definitions, which obviously generates an extra workload.

The CoRG is administered as part of a department and, like other parts of the department, relies on the department's and the faculty's administrative resources. The CoE grant constitutes 38% of its total funding (Table 8.3). External funding is moderate

but higher than the average in its field of research. CoRG's leader credits the CoE scheme for its increased success in Norwegian open-mode funding, which is very competitive. Applying for a CoE is thought to have professionalised application writing in the group. Together with the prestige associated with CoEs, this is seen as having led to their improved success rate regarding RCN project grants.

Table 8.3. CoRG's income sources

CoRG's sources of income	%
Grant from the REI directly	38
Funds from the host institution	36
Other public grants (mainly RCN)	26
Total	100

Centres use the CoE grant for various purposes, such as improving infrastructure, attracting guest researchers, conference travel and buying out of teaching duties. For CoRG, much of the grant has been used to hire senior international scholars and post-docs and buy out teaching duties. This last has had consequences for CoRG's field of research. Buying centre staff out of teaching duties means that the department has to find replacements. This can be challenging, and the easiest option is often to rely on people already working in the department. Most departments have tight budgets. Thus, the buy-out money offers the host department some flexibility and autonomy and they prefer not to spend it on temporary teachers. The buy-out strategy also affects education, since CoRG's research speciality is not covered well at the bachelor's and master's levels. To the authors' knowledge, problems relating to buy-out of teaching duties concern only a minority of the CoEs.

Responsibilities and division of labour

The Norwegian CoE scheme presupposes certain organisational structures. Most centres have a board, but it has no formal authority, which remains with the department, the faculty or the central university management. The board functions as a reporting body and approves the allocation of resources within the CoE. Some CoEs do not have a separate board and instead report directly to their host department's board. All centres have a centre leader and an administrative leader, and are organised into research groups with certain scientific goals. Important decisions are made by the research groups.

In general, the host unit is represented on the CoE board. It is unusual for the centre leader to be part of the management group of the department, even though he/she is responsible for many of the temporary employees in the department. Boards of centres composed of local representatives seem to have less impact than centres with a combination of local and external board members (Langfeldt et al., 2010).

The division of responsibilities between the host department and the CoE presents some distinct organisational challenges. An evaluation of the CoE scheme found great variety in the extent to which CoEs are embedded in the host institution (Langfeldt et al., 2010). In most centres, the centre leader works full-time at the centre, as do its PhDs and post-docs. The remaining staff are affiliated on the basis of a certain percentage and have their main positions and teaching obligations in their home departments. The RCN generally prefers affiliated researchers to be physically located (co-location) in the centre.

In 2010, 14 out of 21 centres were co-located, one was partly co-located and six were virtual. Generally, the virtual centres are large and in fields such as the life sciences and the natural sciences. Co-location requires significant resources from the host institutions and has generated a variety of solutions, from centres as independent units under the university dean to centres as a research group in a department. A university may adopt both types of solutions. The host departments encounter the greatest challenges for integrating the centres and they cater for and engage the centres in various ways. In general, it seems that centres with a good relationship with their host report more positive results (Langfeldt et al., 2010).

Overall, universities and departments have a positive view of the CoEs. When they are sceptical, this mainly relates to problems for handling the administrative aspects of CoEs: responsibility for CoE personnel, organisation of co-payments, distribution of publication credits, physical location of the CoE, and appointment of board representatives. Individual departments have their own ways of handling these issues, as the RCN has no overall expectations or guidelines on these matters. Obviously, the more complex the centre in terms of crossing the organisational borders of departments and even faculties, the more challenges arise concerning the division of responsibility between the host and the centre.

As noted above, responsibility for personnel is one challenge. In general, the CoE leader enjoys great autonomy in matters such as recruitment. Given the limited duration of the centre, this may have a significant impact on the host department. Providing permanent positions for eminent post-docs is one such challenge. The host's flexibility as regards hiring is restricted by increased concerns about "the four years rule"; in short and strictly interpreted, it means that after four years on temporary contracts researchers may have the right to a permanent position. Given the shortage of new permanent positions, hosts seek to avoid situations in which the rule can be enforced, as it will reduce their autonomy.

Moreover, the CoE leader often manages a large number of employees, without having formal responsibility for them, since this lies with the host department. For some host departments, the size of some CoEs means that they can become relatively autonomous and challenge the host's authority. Obviously the ability to handle the CoEs varies and largely depends on the relation between the department leader and the CoE leader. In an evaluation of the CoE scheme, Langfeldt et al. (2010) observed cases in which conflicts and tensions were relieved by a shift of department leader and/or faculty dean.

One strategy for more thoroughly integrating CoEs and hosts has been to involve the CoE leader in the department's leadership. However, some departments and faculties see CoEs simply as a large project and treat them as such, with no particular influence on the host. The CoEs are now generally being organised closer to the department level and included in departments' and faculties' strategic plans and priorities than was the case in the first generation of CoEs. Because research institutes are project-based organisations, the CoEs do not represent important challenges in terms of integration, internal collaboration and impact on host institution.

In general, host institutions have become more familiar with the centre schemes and seem to handle and integrate the centres in a more considered way.

Responsibilities and division of labour at the University of Oslo

Considering the egalitarian structure of the Norwegian research system, the CoE scheme represents a chance for the university and its research groups to strengthen their research capacities. Informants claim that the CoEs have increased the visibility of the University of Oslo and thus the number and quality of applicants, among both students and employees.

The CoE scheme focuses on forefront research and the main output variable is international scientific publications. CoEs at the University of Oslo all conduct basic research, but several also carry out applied research and experimental development, depending upon the characteristics of the academic field. CoRG is administered by one department and handled like any other research unit. In terms of research, it is relatively specialised and the affiliated researchers devote all of their research time to the centre. They are not involved in consultancy or technology transfer. There are few points of interaction between the centre and other researchers in the department. Most seminars are open but there is a clear demarcation between those in the centre and those outside the centre, which is primarily maintained by the latter. The department and the centre have taken measures to diminish the conflicts between the centre and the other researchers, but so far these have had little effect. The low degree of synergy is particularly detrimental for the outsiders, who could have profited in terms of research quality and networks by interacting with the centre. A contributing factor is the fact that the centre is not physically co-located with the department. This decreases interaction, but helps to develop the centre's identity and visibility. All informants agree that the centre has increased the visibility of the academic field internationally, as demonstrated by the increased number and quality of applicants for positions in the department, among other things.

CoRG collaborates with internationally renowned researchers and groups. The sudden increase in funding has, according to some informants, led to a situation in which the CoE demands little from their collaborating partners. For instance, partners are not required to contribute to teaching, which is a loss for the department. Still, few problems are reported. As the centre's partners are mainly non-Norwegian, this entails additional challenges; local researchers undertake all administrative tasks, while their international partners can concentrate fully on their research.

At the organisational level, experience with the CoE scheme has contributed to the professionalisation of the faculty and the university, particularly for handling large temporary research units. There has been a remarkable change from the first to the third generation of CoEs. It is now generally considered that the best organisational form is for the centres to be well integrated in the host department.

Establishing a new organisational structure is resource-intensive, especially because the CoEs are time-limited units. In some cases, they may engage in "symbolic compliance" by establishing temporary structures more to satisfy the formal terms of the CoE scheme than to contribute to better research performance.

Staff and recruitment

The impact of the CoE scheme on staff and recruitment varies. In the geosciences, life sciences and mathematics, CoEs account for a large share of personnel resources (excluding recruitment positions). In 2009, the centres averaged 68 researchers, for 44 full-time equivalents. The centres have higher shares of PhD positions, part-time affiliations and guest researchers than other research groups, and they are popular among

PhD students. This represents a challenge for the host institution since the high quality of the centres and the need for co-payments often mean that internal recruitment positions are allocated to the CoEs, leaving less for those outside.

Although the grants represent opportunities to attract international scholars, this is a problem in some fields, especially in those such as economics where "star" academics expect high salaries. Moreover, as industry typically provides far better conditions than universities, this makes it difficult to recruit promising young scholars. In addition, international scholars find Norway a less attractive location. However, the grant has led to more successful recruitment of both young and senior researchers. It has made it possible to invite more guest researchers and hire adjunct professors, and has facilitated more travel and tighter links with other international research groups.

Typically, the universities' administrative procedures for hiring researchers are bureaucratic and time-consuming. Given their limited time frame, the CoEs require fast and flexible recruitment processes, especially for hiring a star academic. In general, the CoEs seem to have had sufficient flexibility in this respect.

CoE funding often offers young researchers leadership opportunities. Several CoEs have a strategy of appointing young scholars to project leader positions; this is especially evident in the geosciences and life sciences. Research in the CoEs is generally driven by PhD students and post-docs, who often embody the new research direction of the centre. Moreover, CoEs often have more seminars and workshops than other research units and emphasise interaction between senior and junior researchers.

CoE staff and recruitment at the University of Oslo

The CoRG has sought out well-known and highly recognised researchers with impressive activities and publication records. It also gives high priority to post-docs. Internationally, young researchers seeking an academic career in CoRG's field of research have few possibilities, making the CoRG post-doc positions especially attractive. In fact the applicants are from the highest ranked and best-known universities; CoRG can pick from the best talent in the field. In contrast, PhD candidates still seem to prefer universities such as Harvard and Oxford, so that the quality is less impressive than for post-docs. Moreover, the quality of local PhD candidates has decreased in the CoE period.

As mentioned above, senior researchers have used part of their funding to buy out their teaching obligations for bachelor's and master's courses. A combination of circumstances has meant that the department has not replaced the senior researchers in the centre with staff with similar research competence. The centre's post-docs teach but only on a temporary basis, and they do not take part in setting the content of the teaching programmes.

Overall, the CoE seems to provide an environment for good interaction between seniors and juniors. So far, the latter have not had any difficulty pursuing a career and appear to be attractive candidates.

Because CoEs cannot apply for a second CoE grant, they have to be integrated into the organisational structure of the university once the grant period ends. However, most CoEs are quite specialised and often require technical support personnel with specific competencies, which makes it difficult to integrate them. The University of Oslo is therefore considering instructions for recruitment to ensure a smoother wind-up of the centres, which would entail shifting some authority from the centre leader to the department and the university. This may not be well received by CoE leaders who may already struggle to find their place within a long-established and rigid organisational structure.

At the end of the CoE funding period, the contract of about half of the academic staff of the CoRG will be terminated. Recently, the CoRG has been allocated four out of five new positions in the department, which will secure some continuity in the research area. However, there is a danger of skewing the balance between the different subfields of the discipline, which are small. If too many resources go to one of these, the others might suffer. All parties are conscious of this issue.

General assessment and experiences

The CoE scheme is open to all disciplines and research groups, has no strategic priorities and relies on a single model. For example, there are no general differences in the funding of centres in different fields of research. Norwegian scientists find these terms very attractive and the CoE scheme has a lot of prestige.

The application process is quite lengthy. In the 2010 evaluation of the scheme, several informants mentioned the professionalisation of the application-writing process. This meant that, after making a CoE application, it is easier to write applications for other large grants, such as EU grants.

In the 2002 call the RCN received 129 applications, in the 2007 call, 98, and in the 2011 call, 139. In the third call the distribution of applicants by fields of research was relatively balanced (Table 8.4). The success rate varies somewhat between fields.

Table 8.4. Number of applications and selected centres in 2012 (third generation) by field of research

	Natural science, engineering	Life sciences	Humanities and social sciences
Applicants	56	46	37
Centres	5	6	2

Source: RCN web pages, www.forskningsradet.no/en/Home_page/1177315753906.

As with most prestigious schemes, the application and selection process is widely discussed and criticised. Neither geographical distribution nor distribution of research areas is among the selection criteria. Still, critics claim that such concerns affect the selection process. In particular, some critics felt that geographical considerations played a part in the selection of the first generation of CoEs. Critics also claim that the selection process lacks transparency, and that the review panels do not always make clear why some centres are selected and others are not. Even though the selected CoEs, and the CoE scheme itself, have high standing, researchers ask for more transparency and better justification by the RCN.

The general perception of the mid-term evaluations of the CoEs (performed 3.5 years after the centres are established) was that they had positive effects. The CoEs seem generally to see the evaluation as a way to gain recognition of the centre's research and often as a way to gain valuable input from evaluators (Langfeldt et al., 2010). Moreover, and perhaps more importantly, tensions and challenges between the centres and hosts are brought out and sometimes solutions are found. On the negative side, the mid-term evaluation is yet another time-consuming demand for reporting on the CoEs' activities and results. As the terms and definitions for reports to the RCN are open to interpretation, centres' reporting procedures differ. Some tend to report all publications of all affiliates,

making it difficult to define the list of publications produced by the CoE grant. Other centres have sharper boundaries, which often result in more modest reporting.

The added value of the scheme differs somewhat between fields of research and the size of the centres. Large centres, for which the CoE grant makes up 10% of the total budget, are less dependent on the CoE grant than smaller centres such as the CoRG, for which the CoE grant accounts for 38% of the budget. Yet, most CoEs report that the grant provides far more flexibility than other grants, which often have a shorter time span and are for specific projects.

Given the large number of applications, the RCN encourages the universities and institutions that apply to limit the number of applications. While some do so, the University of Oslo views the CoE selection process as a chance to identify excellent research groups which might not be recognised in the university's strategy and priority processes. Therefore, they allow all groups to apply. Moreover, university sources emphasise that, as the selection of CoEs is rather unpredictable, the university has no reliable criteria for selecting the groups most likely to win the competition.

The CoE scheme requires hosts to provide co-funding. Hence, the scheme ties up much of the limited financial resources of the host university and department, and affects the balance between those with a centre and the rest. Yet, the investments pay off; the centres attract a great deal of external funding. The CoRG is reported to have increased the income of its host department. Compared to other departments at the same faculty, the host department is now relatively well off. As a result, researchers outside the CoRG have more resources, for example for participating in international conferences, than prior to the CoRG's establishment. In this case, the risk of impoverished environments around a CoE seems exaggerated. Nonetheless, the research done by the CoRG attracts more attention than the research performed elsewhere.

Concluding remarks

The national research landscape

Considering the egalitarian norms and structures of Norwegian research, the CoE scheme represents something new. Its long-term, lump-sum funding model enables the building of strong research communities and creates opportunities to attract highly qualified scholars. The internationalisation of research is strengthened by sponsoring international projects, senior researchers in part-time positions, inviting guest researchers and providing funds for travelling to international conferences. Moreover the scheme has enhanced national and interdisciplinary collaboration both across fields and between subfields.

Another significant impact of the scheme is the increased national competition it has encouraged. The CoE scheme heightens ambitions and raises the bar in Norwegian research. In an otherwise egalitarian research landscape, it has legitimised the concentration of research resources for selected research groups and strengthened adherence to the academic norms of excellence.

This study has concentrated on an analysis of the experience of universities. There are, however, considerable differences in the CoE scheme's impact on universities and research institutes. The evaluation of the CoE scheme (Langfeldt et al., 2010) revealed that the impact on organisational structures was relatively small in research institutes, which already had structures for organising temporary research efforts. However, it has

had important impacts on the relationships between universities and institutes. It has given research institutes the opportunity to employ more PhD candidates. As these have to be enrolled in a university PhD programme, the CoE scheme has increased the interaction between the institutes and the universities involved. Moreover, the long-term, lump-sum funding model enables research institutes to match funding requirements in Framework Programme applications. This leads to more opportunities for international collaboration at research institutes with low block-grant funding.

The organisational aspect of the CoE-scheme

In addition to enhancing research excellence, the CoE scheme has an important organisational aspect. A temporary unit with specific organisational structures presents challenges for host universities and departments in terms of handling and institutionalising a relatively powerful research unit, positioned somewhat outside of traditional structures. At the same time, these traditional structures present challenges for centres, which have to find their place and create a new organisation in an environment that to some extent opposes initiatives like CoEs. After ten years of experience, it is possible to conclude that the centres have unravelled some of the tenacious structures of the university by showing the need for better administrative procedures and strategies to cater for and integrate the centres.

Notes

1. About 60% of total R&D expenditures at Norwegian universities are based on general university grants (figures for 2011, sources: Det norske forsknings- og innovasjonsystemet, www.forskningsradet.no/prognett-indikatorrapporten/Forside/1224698172624, Table A.7.2).
2. CoRG is an alias to protect the anonymity of respondents.

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Chapter 9

Research excellence in Portugal and its funding

Isabel Reis, Maria João Corte-Real, Luisa Henriques
Portuguese Science and Technology Foundation

This chapter discusses Portugal's centres of excellence (CoEs) and associated laboratories (ALs), which are supported by a multi-year funding programme of the Foundation for Science and Technology (FCT). A considerable share of public research in Portugal takes place in research centres supported by the FCT. The centres are closely linked with higher education institutions and they perform a variety of functions, combining research with training, education and technology transfer, among others. The programme has strengthened research institutions and enhanced research quality by building research capacity.

Introduction

Portugal's centres of excellence (CoEs) and associated laboratories (ALs) are supported by a multi-year funding programme of the Foundation for Science and Technology (FCT). This programme has strengthened research institutions and enhanced research quality by building on the research capacity of the CoEs/ALs. It accommodates a diversity of research bodies in terms of size, legal status, and number of autonomous units (Hicks, 2012; Conceição and Heitor, 2005). In 2010, around 30% of Portugal's total researchers (full-time equivalent, FTE) (DGEEC, 2012) were in research centres funded by the programme, 14% of whom are associated with CoEs or ALs. The programme accounted for 30% of the FCT's total funding over the previous decade.

The multi-year funding programme has evaluated Portuguese public and semi-public research centres every three to five years since 1994. The first evaluation was based on a national peer review (awarding ratings of 1 to 3). The second, in 1996, was an international peer review and awarded the "excellent" label for the first time (Conceição et al., 2003, p. 591).[1] Funding of research institutions is mainly determined by the evaluation rating and by the number of doctorate holders working at the institution. The 1996 programme was a milestone in the adoption of international best practices (Santos Pereira, 2004) and the basis for the identification of CoEs, which are those rated as excellent in the international peer reviews.

All of the centres labelled "excellent" by the multi-year funding programme may apply for AL status. ALs may be made up of one or more centres. The FCT awards this status for up to ten years, following government approval, in order to promote excellence in certain scientific fields and build critical mass. The funding targets the growth of qualified human resources in ALs. The ALs also advise on the formulation of public policies and help to achieve national science and technology policy goals As the AL status is linked to national policy making, each application is considered on its merits in a top-down approach. There are currently 26 ALs. The first generation of 15 ALs was established between 2000 and 2002; two other rounds in 2004 and 2006 established several more. In 2008, the ALs were evaluated (international peer review); all but one had their status renewed for a further ten years.

The multi-year funding programme is a key instrument for promoting research excellence in Portugal (Conceição et al., 2003). It is complemented by other instruments that aim at promoting high-quality research. For example, the Science Programme (2007, 2008) recruited national and foreign talent and awarded more than 1 200 five-year contracts to doctorate holders. In 2012, a new programme, with the same rationale, the FCT Investigator, replaced the Science Programme.

The management of the funding programme includes regular monitoring and evaluation of the activity of the centres and ALs. This plays a key role in the decision on whether to continue to fund the centres. The assessment is based on the CoEs' reports and strategic plans and on site visits, which include meetings with staff.[2] Bibliometric indicators are also taken into consideration. After each assessment, the research centres are awarded a qualitative grade, from poor to excellent.[3]

The following description of Portuguese CoEs highlights those with AL status. It is based on FCT data, on the OECD RIHR survey, and on interviews of 12 directors of CoEs.

Portuguese centres of excellence

A considerable share of public research in Portugal takes place in research centres supported by the FCT. The centres are closely linked with higher education institutions because they are part of them and mobilise their personnel and resources.

Distribution by size

Portugal has 84 CoEs, which represent 26% of the 318 R&D units (i.e. research centres and ALs) funded by the programme. Some CoEs, alone or in combination with others, have the status of AL. The 26 ALs have significant critical mass and excellent quality in specific themes or fields of science.

In terms of size, the ALs are on average larger than the other CoEs. The largest AL has over 300 FTE research staff and the smallest fewer than 50. The CoEs that are not ALs have 44 researchers on average, but may have as few as 8 FTE researchers (Table 9.1).

Table 9.1. Researchers (FTE) by type of institutions funded by FCT, 2010

Typology	Mean	Minimum value	Maximum value	σ
CoEs (not AL)	44	8	108	24
AL	148	48	312	77

Source: Foundation for Science and Technology internal data, multi-year funding programme.

The goal of excellence has received increased attention through the promotion of ALs, for which FCT funding increased between 2003 and 2010 by an average annual 28%.

Distribution by field

The research centres funded by FCT are almost equally distributed among fields of science, except for medical sciences (11%) and agriculture sciences (4%) (Table 9.2). However, researchers in the CoEs are concentrated in three domains: engineering and technology, with the highest number of researchers per CoE, medical sciences and natural sciences. The fields with the greatest number of CoEs (not ALs) are social sciences (17), natural sciences (16) and humanities (14) (Figure 9.1).

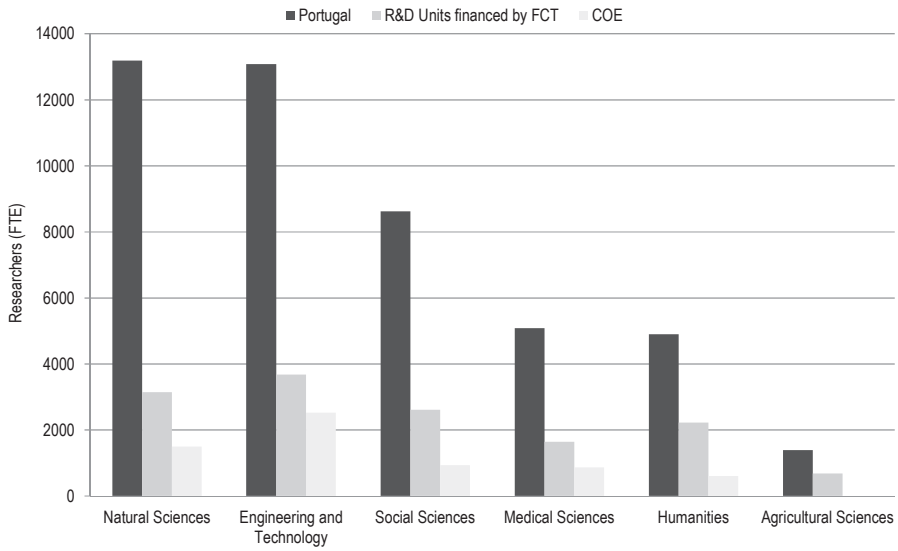
Agricultural sciences have no ALs or CoEs, and the humanities have no ALs.

Table 9.2. Distribution of CoEs by scientific field in 2010

Scientific field	Number of researchers per CoE				CoEs				Total number of research centres	
					CoEs (not ALs)		ALs			
	Mean	Min	Max	σ	No.	%	No.	%	No.	%
Natural sciences	120	15	215	51	16	28	6	23	76	24
Engineering and technology	169	14	312	96	8	14	13	50	65	20
Medical sciences	128	14	229	68	3	5	5	19	34	11
Social sciences	84	8	102	29	17	29	2	8	69	22
Humanities	49	13	81	19	14	24	0	0	62	19
Agricultural sciences	---	---	---	---	0	0	0	0	12	4
Total	141	8	312	67	58	100	26	100	318	100

Source: Foundation for Science and Technology internal data, multi-year funding programme.

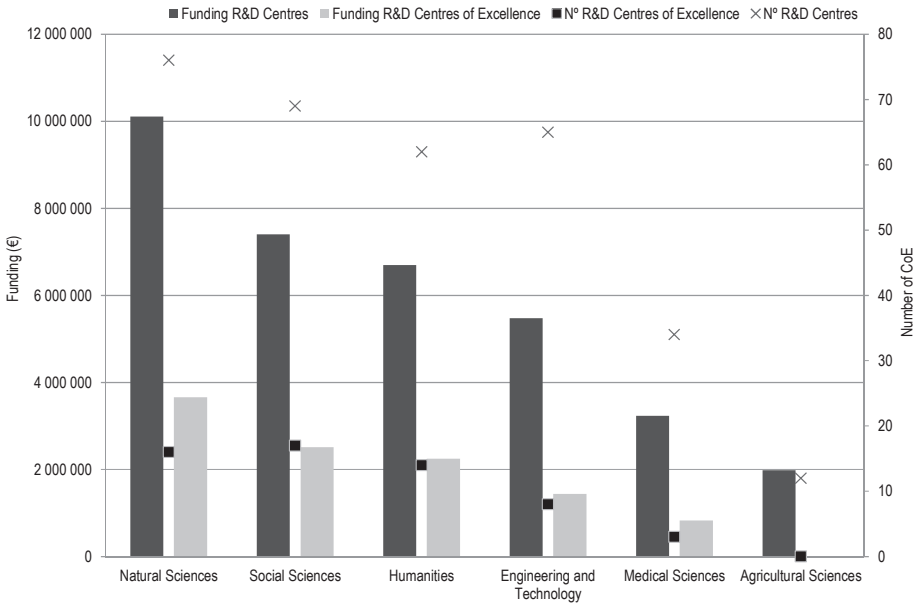
Figure 9.1. CoEs by number of researchers and scientific fields in comparison with the total number of centres funded by FCT and total number of researchers in Portugal, 2010



Source: Foundation for Science and Technology internal data.

The CoEs with the highest amounts of FCT funding are in natural sciences, social sciences and the humanities (Figure 9.2), while the ALs with the highest amounts are in engineering and technology (52%), medical sciences (24%) and natural sciences (18%); this funding rose steeply in 2006 (Figure 9.3). In parallel, the number of researchers in ALs grew steadily until 2010, when it increased significantly (Figure 9.4).

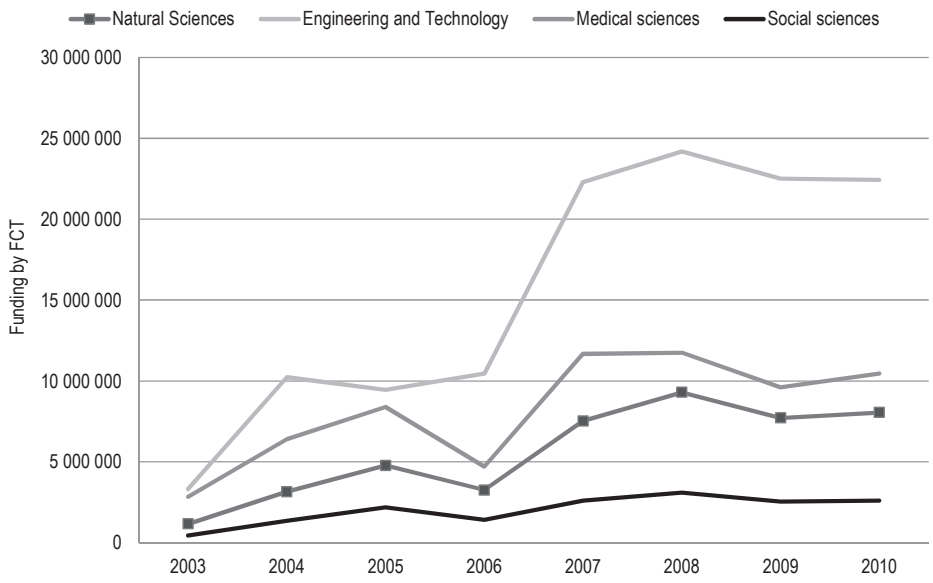
Figure 9.2. Number of CoEs and funding by scientific field, 2010



Source: Foundation for Science and Technology internal data.

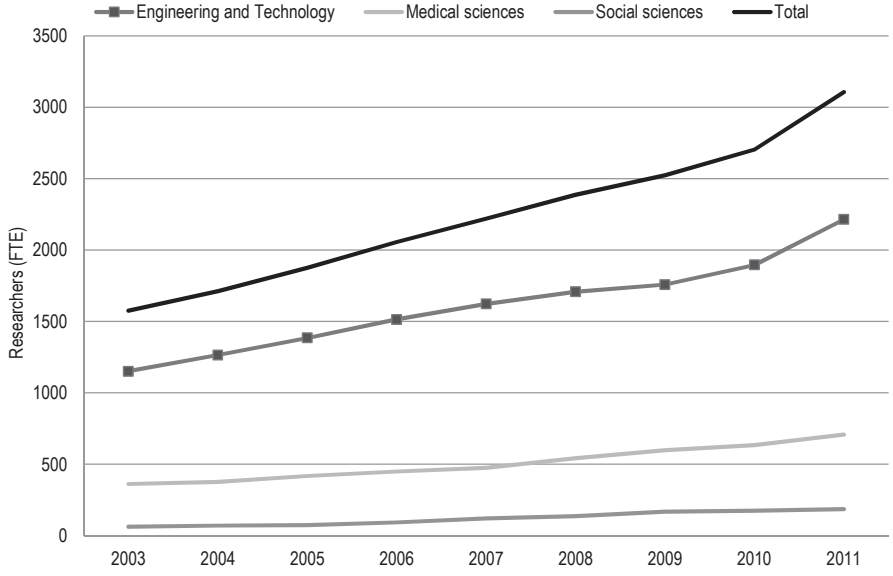
Figure 9.3. Evolution of funding to ALs by scientific field, 2003-10

Euro



Source: Foundation for Science and Technology internal data.

Figure 9.4. Evolution of researchers (FTE) in ALs by scientific field, 2003-11



Source: Foundation for Science and Technology internal data.

Distribution by location

Most CoEs are located in Lisbon and the Tagus Valley (39), the north (22) and the centre (17). The Azores, Alentejo and Algarve only have one CoE each. This pattern is in line with the traditional geographical concentration of research in Portugal.

Distribution by gender

In Portugal two-thirds of researchers are female (EC, 2012), but most co-ordinators of CoEs are male. Only 24 CoEs (37.5%) have a female co-ordinator.

Distribution by function

CoEs perform a variety of functions, combining research with training, education and technology transfer, among others. Generally, they:

- Perform leading-edge R&D
- Offer postgraduate studies and advanced training to early-stage researchers, professionals and citizens, in order to help improve societal skills and lead to better quality of life
- Transfer technology to Portuguese and foreign industries through collaborative research, contract research, prototyping and consulting
- Create start-up at ALs, which usually convert intellectual property rights into start-up equity
- Diffuse science to create awareness of the contribution of science to the well-being of citizens.

Funding and internal governance

Organisational structure

CoEs are often located on university campuses, but have their own legal status. They may be: i) without specific legal status; ii) part of a legal entity, such as public research; and iii) a non-profit organisation.

The organisational structure of public and semi-public research centres and institutes is set by law (Decree nº 125/99 of April 20). There are at least four bodies: the executive body (director or executive board of directors); two scientific committees (one internal and one external); and a control body (the auditing committee). The internal scientific committee is composed of all doctorate holders of the organisation, regardless of position or nationality, and advises on annual reports and the organisation's plans. The executive body is in charge of the management of the organisation and runs the day-to-day operations. The external scientific committee is composed preferably of renowned foreign researchers; it provides strategic advice and evaluates results. The auditing committee controls quality and approves the accounts. Most centres with a non-profit legal statute and with more than one shareholder have a general assembly, which is the top decision-making body of the organisation for strategic issues.

When a CoE has a legal status, the board of directors is supervised and elected by the general assembly. Members of the management structure of the university at which the centre is located generally do not sit on the executive board and almost never take a direct or active role in the centre's daily management. Some 84% of survey respondents considered that the CoE's director is responsible for decisions on funding, staffing and the centre's research strategy, probably after consultation with the internal or external advisory bodies. Important decisions are also made in a bottom-up way.

The internal scientific committee meets in plenary or in sub-groups and is responsible for the centre's strategic and scientific management. Depending on the size of the scientific committee, centres such as the Instituto de Telecomunicações (IT) create specialised sub-committees (Box 9.1).

Box 9.1. The scientific committee of the Institute of Telecommunications

The Institute of Telecommunications is a large institute with several centres across the country. The scientific committee is composed of 220 researchers with doctoral degrees. Because of its size, the scientific committee was sub-divided into more manageable sub-committees. Two permanent sub-committees were created: the Science and Technology Committee and the Research Group Co-ordination Committee. This has resulted in faster response to requests and more effective specialised advice, without the need for lengthy negotiations to reach a decision.

Relationships with the host institution

The host institutions provide the infrastructure required to conduct research (laboratories, IT services, etc.) and support the centres' activities. The relationship between centres and hosts are generally co-operative, and the co-location tends to favour co-operation with different departments. Box 9.2 provides an example of a CoE relationship with a host institution.

Box 9.2. The relationship with the host institution: The example of ITQB Associated Laboratory

Various centres participate in the Institute of Chemical and Biological Technology ITQB AL: ITQB (New University of Lisbon); IBET (a non-profit organisation); IGC (a research institute of the Gulbenkian Foundation); and the Centre for Chronic Diseases (Medical School of the New University of Lisbon). The concern of the host is to ensure that all of the AL's outputs are normalised to allow for benchmarking and impact assessment of the research performed. The host considers this information critical for the decision-making process, particularly for strengthening emerging areas.

One of the main constraints faced by CoEs is the difficulty of recruiting staff on a more permanent basis. The universities' framework conditions hamper recruitment of new researchers for CoEs that lack legal independence. In the case of non-profit organisations, permanent and temporary staff regulations are based on private labour market laws, which are rigid in terms of the duration of contracts (maximum of three years for temporary contracts). This is considered insufficient for research activities. Medium-term contracts and fellowships are available, however, through an FCT initiative. Usually, the host does not provide direct research funds to the CoE but contributes with facilities and personnel who do not charge for their research time.

Funding

The CoEs are funded by the FCT's multi-year funding programme. The financial support is divided into core funding for the centre's main activities and programmatic funding. The core funding is calculated on the basis of a value per doctorate holder and therefore varies according to their total number. The programmatic funding is proposed by the panel on the basis of the budget requested and the centre's proposed strategic plan; it aims to address the strategic development of the centre and to meet specific needs that evaluators consider important to fulfil the centre's potential.

Most interviewees and survey respondents noted the flexibility of the multi-year funding in comparison to other forms of third-party funding, as it can be used for personnel, networking, diffusion activities, productivity bonus and management costs. However, they also noted the difficulty of transferring unspent budget to the following year. According to interviewees, the share of total funding from other sources to CoEs is usually quite substantial.

Responsibilities and division of labour

As mentioned, every CoE has, at the least, an executive board, an internal scientific committee, an external scientific committee and an auditing committee. The CoEs have autonomy in terms of resources, research agenda setting and management of resources, even in cases where a third party is required to act on their behalf, particularly for infrastructure and staffing. In general, they tend to maintain their autonomy in term of management and strategy. Nonetheless, they are very dependent on their host institutions, as they require approval for many procedures and operations.

In terms of the relationship between the CoEs and their hosts (mostly universities), the latter generally act as facilitators of the centres' activities and benefit as well from the dynamics produced by the relationship. One of the most important features of this relationship is the sharing of staff contractually employed by the host. Indeed, the vast majority of the members of CoEs are university staff, who conduct their research at the centres but whose salaries are paid by the universities. By integrating staff from various departments/faculties working in the CoEs' research field, the CoEs promote co-operation among researchers from different disciplines and scientific backgrounds and from different faculties. This communication and co-operation between researchers and the added value associated with cross-disciplinary approaches facilitate the development of successful international and industry collaborations, the discovery of new and unexpected pathways in research, and the joint development and implementation of enhanced training programmes. In addition, the international reputation and visibility of the CoEs has a positive impact on the image of their host institutions. In the end, the host also attracts more financial resources and more and better qualified students, researchers and staff.

Most research is performed in the CoEs owing to Portugal's history of university research and research funding (Teixeira and Koryakina, 2013, p. 185; Frølich et al., 2010, p. 14; FCT, 2013, p. 90). Research is rarely performed in the departments or faculties. The activities of CoEs and their hosts mainly intersect on postgraduate training, with benefits for both parties. There is, therefore, a quite clear-cut division of labour between the CoEs and their hosts in terms of research.

Staff and recruitment

As mentioned, funding for CoEs allows for the short-term recruitment of researchers on the basis of contracts with a possibility of renewal for a second period. The FCT's complementary initiatives to fund the recruitment of talent for a period of five years are targeted at early-stage researchers or at established scientists wishing to develop their careers in Portugal (in the most recent call). Together, these programmes have played an essential role in the recruitment of excellent early-stage researchers, independently of their nationality, as the programmes are open to all researchers.

While the CoEs have been able to attract the personnel they need, it has been difficult, mainly since the economic crisis, to keep them, given not only the temporary nature of the contracts and the associated longer-term uncertainty but also the difficulty of moving to permanent positions, as there are few job openings for permanent or medium-term positions in Portuguese universities [Conceição et. al., 2003, pp. 591-592). The poor career prospects of PhDs and post-doctoral researchers may lead the top talent to move to other countries. In addition, in areas closer to industry, there is the possibility of better and more competitive post-doctoral schemes (Box 9.3).

CoE co-ordinators generally express the desire to create a culture of independence and autonomy among early-stage researchers, while facilitating their co-operation and

networking with senior members of staff through mixed research groups and leadership of research projects. There are also systems for evaluating the nature and quantity of publications of CoE members, which reward success and penalise a lack of scientific results. This environment is stimulating for early-stage researchers but also for the university staff that are part of the CoEs, as it improves their prospects of promotion, among other advantages.

Box 9.3. Institute of Mechanical Engineering and Industrial Management (INEGI) case study

INEGI is a non-profit organisation. It owns its facilities, including equipment and infrastructures, having taken advantage of the European structural funds. INEGI has developed, since its inception, very strong and successful links with industry (e.g. automobile, wind energy, aeronautics), which have produced important spillovers to Porto University, particularly through an AL in which INEGI participates. These links with industry have allowed INEGI to develop and implement, with Porto University, joint advanced training programmes and to achieve financial sustainability, with grants from the multi-year funding programme constituting only a small share of its resources. INEGI has a core group of human resources, mainly university staff and researchers contracted by INEGI. It also has a mobile group of early-stage researchers with temporary contracts associated with specific projects and those financed under the multi-year programme and the FCT's 2007 and 2008 initiatives mentioned above. INEGI offers early-stage researchers excellent opportunities to develop research projects in industry, encouraging them to start up their own businesses (an average of two or three start-ups a year for the last ten years). The best researchers are also given the opportunity to move to the core group.

Conclusion

The policy on research excellence in Portugal since the mid-1990s has centred on the promotion of CoEs through a multi-year funding programme that awards competitive funding based on international peer review and international best practices. Recruitment is not restricted to Portuguese talent.

A distinctive feature of the policy is the AL status, which is awarded by the FCT to foster excellence and critical mass in given fields and to promote participation in the design of public policy.

CoE researchers are concentrated in engineering and technology, medical sciences and natural sciences; funding goes mainly to the natural sciences, the social sciences and the humanities. The CoEs are concentrated geographically in three main regions: Centro, Norte and Lisboa. The CoEs cover most of the traditional functions of research centres: research, advanced training, technology transfer and spin-offs as well as scientific diffusion.

The CoEs are quite autonomous academic research centres in terms of their relationship with their hosts. Their autonomy mainly concerns research agenda setting and the management of resources. They tend to be formally dependent on their hosts for recruitment and infrastructure management.

The CoEs' relationships with their hosts are mutually beneficial, as they foster co-operation among the academic staff, interdisciplinary research and high quality post-graduate training. They increase the visibility of both the universities and the CoEs, thereby improving the ability to attract talent and financial resources.

The capacity to recruit is a constraint, as the available positions are mainly non-permanent and short-term. Poor career prospects have increased the mobility of highly talented researchers to other countries, particularly since the economic crisis.

Notes

1. For details on the evaluation process see: http://alfa.fct.mctes.pt/apoios/unidades/avaliacoes/1996/index.phtml.pt (in Portuguese).
2. The overall grading reflects the unit's performance in the past and the future research proposal.
3. www.fct.pt/apoios/unidades/avaliacoes/1996/index.phtml.pt#Distor%C3%A7%C3%B5es%20na%20composi%C3%A7%C3%A3o

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Chapter 10

Research excellence initiatives in Slovenia

Radojka Verčko,
Directorate for Science, Ministry of Education, Science and Sports of the Republic of Slovenia

This chapter reviews research excellence initiatives (REIs) in Slovenia. It discusses priority research and technology areas and measures adopted to build interdisciplinary research. The current CoE programme is Slovenia's largest and most concentrated investment in research and development (R&D). The mid-term evaluation of the programme found signs of progress in international scientific excellence and in linking different spheres of research. The Ministry of Education, Science and Sports plans further support for REIs as a result of the performance of the CoE programme.

Policy setting in Slovenia

Slovene scientific and technological policy documents have always emphasised the generation of ideas and knowledge, acquisition of experience, delivery of products, services and technologies that are relevant for Slovenia, along with the efforts to enhance the mobility of researchers. In addition, Slovene research policy recognises the importance of research for social and economic development and the international nature of science for a small country like Slovenia. Research excellence has been supported by national programmes for basic and applied research; in the late 1980s a special initiative, the Young Researchers Programme, was set up and has continued, under several forms, until the present.

Nevertheless, there have been few instruments to stimulate and support interdisciplinary research in Slovenia's national research system, even if it is known that such instruments can help meet the needs of the national economy. Such instruments require establishing priorities in technology fields that are of key importance for the economy's international competitiveness and have potential for international recognition. The European Fund for Regional Development made such an instrument available in the form of the centres of excellence (CoEs), which are based on partnerships with the academic and industrial sectors. Their introduction addressed one of Slovenia's main difficulties, the insufficient transfer of the results of the knowledge arising from R&D to products and services.

The "centres of excellence" research excellence initiative

Centres of excellence (CoE) focus on priority technology areas and on horizontal linking along the entire chain of knowledge development. They involve partnerships between the private sector and academia. They aim at promoting the transition to an energy-efficient economy with low greenhouse gas emissions and a low-carbon society.

The CoE programme concentrates on knowledge and research infrastructure in priority research and technology areas and opens up possibilities for participation by different parts of the scientific community and the private sector, for participation in international activities and for addressing prominent social challenges. It also creates a platform for the preparation of PhD and MSc theses. The CoEs are high-quality multi-disciplinary groups of researchers from academia and the business sector. The centres combine a critical mass of knowledge and adequate research infrastructure and have the potential to reach the top of world science and/or become part of international networks of excellence. The scheme is not considered state aid.

Implementation of the programme

During 2004-08 Slovenia's first round of CoE programmes was mainly financed from the European Union (EU) structural funds. Ten centres were financed with a total of about EUR 15 million for three years.[1] An evaluation of the economic relevance of this instrument demonstrated that the centres are, despite certain shortcomings, a good way to support co-operation between the public and industrial sectors. The CoEs were evaluated in November 2008 with a focus on the economic relevance of the results and programmes.[2]

The evaluation exercise concluded that the CoEs are one of the few instruments promoting an interdisciplinary approach to R&D and are therefore well suited to the needs of the economy. They help to concentrate resources and R&D efforts on technology areas that are crucial for the competitiveness of the economy. They contribute to the efficient flow of knowledge and applications to products and services. The evaluation report proposed that the measure should be continued.

The positive feedback encouraged the government to publish a call for eight new CoEs in 2009-13. The tender represented Slovenia's biggest investment ever in R&D, with available funding of around EUR 85 million. EUR 77.5 million were awarded to eight CoEs. The budget for individual CoEs ranges between EUR 8.4 and 10 million. The eight centres chosen, out of over 60 applications, are in the fields of:

- nanoscience and nanotechnology
- biosensors, instrumentation and process control
- chemistry and biology of proteins
- low-carbon technologies (hydrogen and lithium batteries)
- non-metallic materials (ceramics)
- plastic materials
- space science
- nuclear magnetic resonance studies.

The research programme of each CoE focuses on the transition to an energy-efficient economy based on a low-carbon society. The eight CoEs have a total of 107 partners, of which 68 from the business sector and 39 from research organisations. The annual expenditure for R&D enterprises involved in the CoEs is EUR 270 million a year, as much as the Government of Slovenia allocated for R&D in 2009.

The consortia were requested to form a new legal entity managed by the partners. These new entities employ 420 researchers, of whom one-quarter are from industrial partner organisations.

In this four-year period the CoEs focus on reaching goals and indicators of the Operational Programme for strengthening regional development.

In 2011, the Ministry performed a mid-term evaluation to see whether the goals set by each centre were going to be reached and if there was any room for improvement for the programme.

Mid-term evaluation of the centres of excellence (2009-13)

The mid-term evaluation reviewed the results of the centres against the goals stated in the applications. It considered the quality of partnerships and R&D teams, the progress and the structure of the implementation of the programmes, organisational aspects of the work, and the centres' progress.

The findings include progress in attaining international scientific excellence, in linking research and the economy, and in achieving critical mass for research. They also note the establishment of high-quality partnerships and of sustainable organisational and business models in the CoEs, along with the potential for successful long-term development and continuation of the centres even after the termination of financial incentives.

Participation in the OECD/RIHR Research Excellence Initiatives (REIs) study also reveals positive developments in the national research sphere and confirms the findings of the evaluations for individual centres that were carried out by international experts.

The responses to the OECD/RIHR survey to CoEs and their host institutions can be summarised as follows:

1. The CoEs have had a positive impact on research, mainly owing to the interdisciplinary nature of the research, the research teams, and the management of research. Interdisciplinary research enables achievements that cannot be attained by individual scientific disciplines and stimulates international co-operation and networking:
   - The REI is seen as a role model in terms of science management and national research practice.
   - The REI has made the research landscape more diverse, and has had a strong impact on new kinds of research activities.
   - Co-operation between different disciplines is now possible, owing to research funds that could not be acquired by individual efforts or disciplines.
   - The CoE status has helped to establish contacts with research-intensive institutions abroad.
   - The research aims at internationally competitive standards of excellence and innovation. The research is more oriented towards international co-operation, and the achievements and scientific findings have benefited from the opportunity for international networking.
2. The CoEs have an impact on host institutions, their organisational structures, their visibility and international competitiveness:
   - The tasks of the host organisations are positively affected by the CoEs (new excellent staff, additional funds, new lines of research).
   - The host institution receives more attention from the media, and links with national research institutions are strengthened. The REI also helps create links between national and international research institutions as well as links between research institutions and private business. The visibility of host institutions has risen because of the CoEs, which have also promoted the structural development of host institutions.
   - Even if their excellence status is confirmed by the acquisition of a CoE, the host institutions do not receive additional funding from the core funding bodies. However, they acquire third-party funding more easily.
   - In the interest of host institutions, the positions of CoE members are to be prolonged after the REI funding expires.
   - The REI has enhanced national research competitiveness.
3. The CoEs have had an impact on capacity building and on the development of human resources in research:
   - Early-stage researchers trained in the CoE will go on to be leading scientists. They have the potential to engage in competitive research and meet future

research needs. Well-educated managers and research leaders will be needed very soon in industry and in universities. The capacity building in academia, industry and the research sector that has been made possible by the REI is therefore a valuable achievement.

– CoEs promote joint supervision of early-stage researchers with PhD advisors from different disciplines.

Summary and conclusions

The responses to the OECD/RIHR questionnaire reveal the many similarities listed above. While there are also some differences in the views of the centres, an analysis of the responses reveals no major discrepancies.

Because of the specific requirement of the national REI instrument that the CoEs function as independent legal entities after they have been established by their host institutions, it is important to point out some issues regarding the management of CoEs and on the prospects for their future functioning:

- Host institutions provide equipment and infrastructure without charge to most CoEs. In some cases they provide start-up funding as well. Administrative duties of CoEs and host institutions are separate.
- The CoE will continue to exist, with the help of other funding resources.
- Innovations generated by research of the CoE will be successfully marketed.
- CoEs have strengthened the ability to transfer research results to the economy.

The Ministry of Education, Science and Sports plans to continue to support the REI instrument by integrating it into future strategic documents and by involving the centres in smart specialisation efforts.

Notes

1. www.centriodl.si.
2. www.centriodl.si/index.php?option=com_docman&task=doc_view&gid=2&tmpl=component&format=raw&Itemid=28&lang=sl.

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Promoting Research Excellence

NEW APPROACHES TO FUNDING

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