Building Research Centers of Excellence through Competitive Public Funding

A policy approach long used by national governments is to provide competitive, merit-based research grants to select “centers of excellence” (CoEs) in order to increase the returns on public investments in R&D. With the wide variety of existing models making generalization difficult, this policy brief outlines the common foundations of CoE programs, various program design alternatives, and some of their main implementation and evaluation challenges.

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Introduction

Facing limited budgets and increasing international competition, governments often opt for programs to allocate public R&D funds to a select number of research centers through competitive funding schemes. Their aim is to increase the impact of public investments in science and technology by building critical mass, avoiding fragmentation, and exploiting economies of scale in selected scientific areas. This approach can include the consolidation of a group of R&D institutions as “centers of excellence” (CoE) that perform world-class research, appear in high positions in international rankings, attract talented researchers and students, and contribute to the national efforts of technology generation, adoption, and diffusion.

The notion of CoEs is closely related to governments’ increasing reliance on performance-based research funding systems for universities and public research institutes, whereby incentives are introduced to reward excellence (Hicks 2012). Since the 1990s, funding for public research institutes across Organisation for Economic Co-operation and Development (OECD) countries has increasingly become more competitive, more focused on building closer linkages with industry, and more supportive of international linkages (OECD 2011).

A strong argument for CoE programs is that concentrating resources in a few research centers or networks, rather than distributing them more equally among all research groups, can be
expected to increase the quality and productivity of the science and technology system. In addition, CoE programs are often designed to build closer links between research and industry, as well as closer connections to global innovation networks. Besides the direct effect of CoEs on the distribution of universities’ research funding, the competition for prestige they inspire can create powerful incentives within public research systems.

Since the late 1980s, CoE programs have become increasingly popular in both developed and emerging countries (Malkamäki et al. 2001). Some examples of CoE programs launched during the 2000s are as follows:

- In Finland, the Centers of Excellence in Research program was launched in 2000 to provide around $72 million to 26 centers in different research fields over a six-year period. This was followed by a new program in 2002 providing about $43 million to 14 research centers. The CoEs are made up of teams ranging from 20 to 200 researchers who share research objectives and a common leadership, even though they may be part of different organizations and based in different parts of the country.

- In Canada, the Networks of Centres of Excellence program was created in 1989 and expanded significantly in 2007. This program has a strong focus on fostering academia-industry linkages in the natural sciences, engineering, social sciences, and health sciences. Since its inception it has invested about $1.8 billion in research, commercialization, and knowledge translation. Those investments have leveraged $1.1 billion in contributions from industry and other partners, and have helped create more than 100 spin-off companies.

- In Germany, the Excellence Initiative launched in 2005 comprises three funding lines: (1) graduate schools to promote early career researchers, (2) clusters of excellence to promote top-level research, and (3) institutional strategies to promote top-level university research. Following the second call for proposals in 2012, a total of $3.5 billion for a 5-year period was awarded to 45 graduate schools, 43 clusters of excellence, and 11 institutional strategies.

- In Japan, the 21st Century Centers of Excellence Program was launched in 2002 to provide targeted support to research institutes and doctoral programs attached to universities. The program funded more than 200 projects in five years, with an interim performance assessment after two years. Following the program’s conclusion in 2007 the government launched the Global CoE Program (2007–12) to continue providing competitive funding to research and training programs with an annual budget of around $334 million.

- The Chile Millennium Science Initiative provided grants to a group of CoEs to promote world-class research and support the expansion of doctoral and post-doctoral training. The project was launched in 1999 with a $15 million budget for 3 years, out of which the World Bank financed $5 million. Following this pilot phase, in 2002 the project became fully funded by the national budget and was expanded significantly to reach an annual
budget of about $18 million in 2011 and 2012. Since 2012, the program has been providing competitive funding to 31 CoEs to perform advanced scientific research and train young researchers in collaboration with other national and international institutions.

Program design

Consultations with experts and the main national stakeholders are necessary to define the most appropriate policy design of a new CoE program. The many possible design choices must consider the target population and scope of the program, the timeline for public funding, the kind of support services to be offered in addition to funding, as well as types of linkages to be promoted (Table 1).

Table 1: Factors considered in CoE program design

| Target | • Will grants be provided to universities and public research institutes or to (virtual) research groups?  
|        | • Will it be open to all research areas or only to a set of priority fields?  
|        | • Should young scientists receive more support than senior scientists? |
| Scope  | • Will the focus be on education or research?  
|        | • Will the focus be on basic or applied research?  
|        | • Undergraduate or graduate training?  
|        | • What is the relative importance of each of these choices in terms of budget allocation? |
| Funding| • What will the level and timelines of support be?  
|        | • How many call for proposals will be issued and how many CoEs should be selected in each call? |
| Support| • To what extent will the program management engage in the creation, coordination, and management of the CoE network? |
| Linkages| • How will private firms participate in CoEs?  
|        | • How will private sector funding be mobilized?  
|        | • How will international linkages be promoted? |

In some cases, CoEs can be associated with a single physical location, such as a university. However, most often they are structured as consortia or virtual networks of existing research groups or as public-private partnerships.

CoE programs have also inspired innovation policy making at the international level, notably in the European Union. Within the context of the European Commission’s Framework Programmes for Research and Technological Development, competitive funding is provided to Integrated Projects, Networks of Excellence, and Specific Targeted Research Projects, with the aim of building a European Research Area where research groups from different European countries collaborate to conduct world-class research. Another example of regional initiatives, this time in Africa, is the World Bank-supported Africa Centers of Excellence Project launched in 2013 with the aim of strengthening the capacity of selected universities to deliver high-quality
training and applied research at the regional level, within areas of particular relevance to Africa’s development.

In many instances, CoE programs have evolved over time and have broadened in scope, often to include private firms as more active partners and to offer new incentives to promote international linkages. A case in point is Canada’s Networks of Centres of Excellence Program, initiated in the late 1980s. In 2007, a new line of financing called the Business-Led CoEs was introduced to fund large-scale research networks led by a not-for-profit consortium of industrial partners that collaborate with academic partners. The program was made permanent in the 2012 federal budget, with annual funding of $12 million and a matching requirement for at least half of each network’s budget to be covered by firms. In an international effort, in 2012 the Canada-India Research Centre of Excellence initiative was launched to promote collaboration in innovation between Canadian and Indian stakeholders. Through a competitive call for proposals, one large network project was selected for funding over five years.

CoE programs can stimulate collaboration with foreign knowledge sources in a number of ways. The Research Centres of Excellence program in Singapore offers an interesting example of how to coordinate CoE programs through the attraction of foreign talent. As of 2013, the program is funding five CoEs to carry out world-class research aligned with the country’s long-term strategic interests, and the directors of all five CoEs have been recruited from leading universities in the United States, Europe, and Australia. Each center comprises 15 to 25 principal investigators holding joint-faculty appointments, each with a research team of post-doctoral fellows, students, researchers, and support staff.

In addition to improving research outputs, CoE programs often aim to improve higher education, grounding advanced training needs in an active research environment. For low-income countries in particular, the interplay between research and higher education is a critical dimension to be considered in the design of CoE programs. For example, a program financed by the World Bank in Uganda (2007–13) provided competitive funding mainly for two types of centers of excellence: (1) research groups led by researchers to conduct relevant, high-quality scientific and technological projects closely connected to graduate training, and (2) undergraduate programs in basic science and engineering, either created or upgraded. With a budget of around $33 million, a total of 39 projects were selected for funding during a five-year period from the 437 proposals received.

In summary, CoE programs offer a broad and flexible policy approach that can finance a variety of activities and be designed in different ways. Some programs focus exclusively on research while others embrace higher education as well. CoE programs seek to build closer linkages between researchers and industry and to expand their international networks with the common aims of rewarding excellence and concentrating limited resources in a select group of research teams to improve the outcomes of the national innovation system.
Implementation

After the program design is approved, the institutional arrangements and organizational structures must be set up, including formation of a dedicated management team and a panel of scientific experts to act as peer reviewers. Then a call for proposals is issued to select the CoEs for funding. Proposals are selected by a set criteria deriving from the project's broader objectives. The CoE must conduct outreach and networking activities to ensure that the best research centers are made aware of the program and are encouraged to participate.

Selecting the best proposals should be guided by the following principles:

- Transparent, fair and merit-based competition for resources;
- Resource allocation based on independent review of proposals by scientific peers of international standing (both nationals and foreigners), and possibly business representatives;
- Concentration of resources for the most qualified researchers; and
- Prioritizing research projects that are more closely linked to industry needs and targeted scientific areas.

Recognizing the need for stable financing of research, CoEs usually award grants for a period of three to ten years. The continuation of the grant may be subject to interim evaluations to ensure that funded research centers have incentives to deliver results. Given their long-term nature and the uncertainty involved in R&D projects, CoE programs need to rely on ongoing monitoring and evaluation systems, as detailed in the next section.

The grant system is based on the principle of autonomy over the use of resources by principal investigators. Matching grants may be used whereby grant beneficiaries are obliged to contribute equally to the project's budget. This system is more common when private firms participate as CoE partners.

The CoE program needs to carefully define the kinds of activities that may be funded and the system for payment and financial reporting. Typical activities to be funded include:

- Scientific and technological research
- Purchase of modern laboratory equipment
- Cooperative scientific projects with research teams abroad
- Stipends for doctoral, post-doctoral, masters, and undergraduate scholars to conduct research at the centers
- Grants to attract visiting professors from leading international research organizations to teach and conduct research at the centers
- Organization and participation in international conferences and workshops.
Monitoring and evaluation

Monitoring and evaluation of funded projects includes setting performance standards for individual CoEs, using annual reports, ad-hoc surveys, and interviews with center managers. Because of the time length of typical awards, interim reviews ensure that the program is on track and enable corrective actions as necessary, including possible termination if the project consistently fails to meet objectives. After several years of operation, more in-depth evaluations of the overall program are needed to assess progress toward broader development objectives. These evaluations are generally commissioned to independent (and often international) experts.

Monitoring and evaluation of CoEs requires the use of complex, dynamic systems, balancing quantitative metrics and qualitative assessments, accommodating differences between scientific fields, and ensuring high levels of transparency in data and results. The expected returns to be measured should not be limited to the generation of new knowledge using indicators of publications and patents. Other relevant returns to be measured include researcher training, development of new scientific infrastructure and methods that firms can use, formation of networks of researchers, and creation of spin-off firms (Salter and Martin 2001). To justify the continuation and expansion of the CoE program, appropriate evaluation methods must be designed to compare the performance of funded research centers either with their performance in a baseline period (prior to the program), with the performance of a control group of researcher centers that were not selected by the CoE program, or with international benchmarks.

Indeed, measuring the returns on investment or CoE programs is very complex and must consider both direct and indirect effects, which may be intangible and hard to measure. Moreover, returns may only fully accrue over a long period and therefore depend on the sustainability and enhancement of the centers’ activities. In low-income countries, this problem may be aggravated because of the distance from the technological frontier, which means it will take more time to yield visible results in terms of publications, patents, or technology commercialization. Meanwhile, intermediate results in terms of training and building absorptive capacity are harder to measure and interpret.

Despite their advantages, monitoring and evaluation mechanisms are costly and need to find the right balance between flexibility and autonomy of research groups on one hand and transparency and control on the other. It is also critical to disseminate the results of evaluations and to build feedback loops between evaluation and program design, so that appropriate reforms are introduced and subsequent calls for proposals are designed more efficiently.

Challenges of CoEs in low-income countries

Based on the previous sections, Table 2 summarizes the main activities and challenges involved at the different stages in CoE programs. The appropriate allocation of resources to the different stages depends on the program’s specific objectives and on the country’s institutional profile and level of scientific and technological development. For example, in low-income
Building research centers of excellence in countries with poorly developed science and technology systems, stronger efforts will be needed to set up the governance structure. Facing low capabilities of existing institutions and R&D funding agencies, these countries will find it costly to build the necessary governance structures for CoE programs. But institutional capacity-building, in particular introduction of competitive and transparent research funding schemes, is in itself an important outcome of the CoE program. Similarly, in low-income countries, outreach efforts and support to potential applicants will be more crucial, because researchers and university managers often lack the experience of applying for competitive funding.

Table 2: Key activities and challenges at different stages of CoE programs

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<tr>
<th>Stage</th>
<th>Activities</th>
<th>Challenges</th>
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<tr>
<td>Design</td>
<td>• Consultations with key stakeholders&lt;br&gt;• International benchmarking&lt;br&gt;• Budget and sources of finance&lt;br&gt;• Selection of policy mix</td>
<td>• Reaching consensus&lt;br&gt;• Allocating sufficient funding&lt;br&gt;• Sustainability of funding sources</td>
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<td>Governance Structure</td>
<td>• Setting administrative structure&lt;br&gt;• Setting management team&lt;br&gt;• Managing the budget&lt;br&gt;• International expert panel and scientific peer reviewers</td>
<td>• Where to locate the program management unit?&lt;br&gt;• Institutional inertia and resistance to change&lt;br&gt;• Controlling management and administrative costs</td>
</tr>
<tr>
<td>Implementation</td>
<td>• Issuing call for proposals&lt;br&gt;• Selection process&lt;br&gt;• Providing grants to research centers</td>
<td>• Linking grant selection process to national R&amp;D priorities and strategic areas&lt;br&gt;• Providing support and mentoring to researchers presenting proposals</td>
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<td>Outreach and Networking</td>
<td>• Workshops and conferences&lt;br&gt;• Visits to universities&lt;br&gt;• Meetings with research teams&lt;br&gt;• Exchange programs for researchers and students&lt;br&gt;• Attraction of international talent</td>
<td>• Ensuring S&amp;T community is aware of the call for proposals&lt;br&gt;• Encouraging the best research teams to participate</td>
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<td>Monitoring and Evaluation</td>
<td>• Ongoing monitoring of individual CoEs&lt;br&gt;• Commissioned evaluations to assess overall progress&lt;br&gt;• Dissemination of lessons learned</td>
<td>• Difficulty of measuring the returns to society&lt;br&gt;• Hard to find the right consultants with evaluation skills&lt;br&gt;• Minimizing administrative burden and costs of evaluation</td>
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Conclusion

Selecting the most appropriate design for a CoE program given a country’s circumstances is a complex task that requires a realistic assessment of the country’s technological capabilities, broad-based consultations with experts, and a delicate balancing of the conflicting interests of
different stakeholders. A frequent challenge in large decentralized countries is that satisfying the expectations of all regions to participate needs to be balanced with the technical consideration of selecting the best institutions and networks that meet the agreed standards. The same applies for CoE initiatives at the supranational level. More broadly, since CoE programs aim for excellence, one of their clear drawbacks is that they may compromise other important values such as equity or diversity. This should not be an issue as long as other policy programs exist that help to promote diversity. Indeed, CoE programs need to be well anchored within a broader innovation policy strategy combining both supply and demand side measures.

Because the biggest challenge is the long-term and sustained effort needed to accrue returns on this type of program, it is important that the government make a strong commitment to sustain the project for at least ten years. In addition, efforts throughout the project lifecycle are needed to move the centers toward financial sustainability, balancing public and private funding and increasing their degree of self-sufficiency through other income sources, such as technology commercialization, research contracts, consulting, and additional sources of competitive funding.

In low-income countries, building centers of excellence and ensuring their sustainability will be a greater challenge due to the lack of critical mass in science and technology and the difficulty of building linkages with industry, not to mention the presence of other more pressing social priorities and the limited government budgets. Facing the need to build the foundations of their national innovation systems, CoE programs in low-income countries often place a greater focus on graduate and undergraduate science and engineering training and on technology adoption and diffusion rather than on the production of world class research.

References


Links to Additional Resources

Canada Networks of Centres of Excellence in Research [http://www.nce-rce.gc.ca/Programmes/NCE-RCE/Index_eng.asp](http://www.nce-rce.gc.ca/Programmes/NCE-RCE/Index_eng.asp)


Millennium Science Initiative [http://sig.ias.edu/msi](http://sig.ias.edu/msi)
