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Final report 18 February 2011

Revised 3 March 2011

Research Support to the Fagerberg Committee

Volume 1

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Summary

At the level of government, countries face a choice between centralising research policy in a science ministry or decentralising it to the ministries as representatives of different sectors of society. Among the countries studied, there is movement in both directions, though most favour decentralisation. This creates a coordination problem, since many aspects of research and innovation policy transcend the responsibilities of individual ministries.

Most countries tackle this problem by creating a council or committee that aims to give holistic advice about research and / or innovation policy. This council's degree of influence over policy and budgets varies a great deal, depending on the national context. Without the involvement of key ministers, these councils appear to be rather ineffective in setting policy but may nonetheless be very useful places in which to locate policy debate.

Different countries make different choices about the shape and steering of research performing institutions. Some maintain a strong research institute sector while others such as Denmark have deliberately moved away from this and increasingly integrate the institute research functions into the universities. All use 'binary' support systems for university research, but the balance between university block grants or 'institutional funding' and research council funds varies widely. In most of the countries considered, block grants are bigger than competitive funding – only in the UK is the ratio the other way round.

The non-explicit nature of national research and innovation strategies in many cases makes it hard to perceive aspects of the 'policy mix', such as the degree to which resources are directed towards basic or more applied activities. Data based on the Frascati definitions are only available in a minority of countries, but these suggest a declining role of basic research in the sense of 'blue skies' or curiosity-driven research. However, when we look at who **decides** the research topics, it becomes clear that any drift away from basic research is the choice of the research community itself: the share of researcher-initiated project funding is clearly rising. Again the UK is the exception, with the proportion of 'pure' basic research in the universities rising over the past 20 years.

We attempted to test whether recent years have seen an increase in the proportion of effort universities devote to administration, perhaps driven by the demands of the New Public Management. We were forced to conclude that this issue can not be resolved without new, primary research, which is well beyond the scope of the present exercise. However, data on employment in business, government and university research all show declines in the proportion of support staff, and to a lesser degree technicians, suggesting that if there is an increasing burden of administration then it is probably being borne in part by the researchers themselves. Time use surveys suggest there is no increase in the amount or proportion of time academics spend on administration. Looking at administration costs among research funders shows wide variations but some weak evidence of increasing efficiency over time.

Research training has expended in recent years in most countries. It is clearly available on the basis of merit and is increasingly being delivered through graduate schools rather than in the old fragmented style, focused on individual professors. Countries studied use a portfolio of funding mechanisms, including external research grants, the block grant, dedicated external funds for departments to engage PhD students and personal stipends. There are also (small-scale) 'industry doctorand' schemes for training company employees or people co-funded by industry. Completion rates are improving over time. PhDs are more quickly completed and fewer people drop out in the hard sciences than in the social sciences and humanities.

Increasingly, countries are using Performance Based Research Funding (PBRF) systems, such as the UK Research Assessment Exercise, which judge performance and

allocate parts of the block grant accordingly. Countries polarise between those who reallocate small (almost symbolic) amounts of money and those that drive the majority of institutional funding on the basis of performance. There is a trend towards greater use of performance indicators – especially publication – and increasingly mechanistic ways of reallocating money. Given the dangers inherent in such systems, they tend to apply in the cases where only small amounts of funding can be reallocated.

Performance contracts are increasingly used in steering agencies and research performing institutions. Performance indicators used do not conform to a single standard but tend to be developed ad hoc for each contract. A surprising proportion of such indicators relate to processes rather than outcomes and impacts, which is perhaps an important reminder of just how hard it is to develop meaningful indicator systems for the latter. At a lower level, project performance is increasingly being monitored, providing agencies with opportunities better to understand the activities of their beneficiaries and to consider the degree to which progress is being made towards programmatic and institutional goals.

Some countries have begun to catalogue national research outputs, in support of a PBRF system. This seems to be necessary where research is published in small languages and in order to take proper account of work in the social sciences and humanities.

Nowhere except New Zealand is there a fully developed set of tiered performance goals in use. It is well beyond what can be done here to explain the degree to which this has affected performance, but it is noteworthy (a) that New Zealand's research performance is less than stellar and (b) rigid application of New Public Management ideas such as contestability have had perverse effects. In practice, performance goals in New Zealand seem to have shifted towards process rather than outcomes monitoring and therefore are less than useful for policy. More widely, however, better goal setting, monitoring, management and evaluation of programmes appears to be gaining ground and to provide a stronger basis for policy implementation than was formerly available.

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1. Introduction

This report summarises and discusses evidence collected in order to support the discussions of the Fagerberg Committee. A companion volume presents the evidence collected country by country.

We were asked to collect and analyse data on seven issues about each of seven countries: Canada, Denmark, Finland, Netherlands, New Zealand, Sweden, UK

- A short description of the research system of the different countries with a particular view to the publicly financed part of the system. The description should, among other things, inform on the allocation of public funding to the main sectors (universities and university colleges, institutes, hospitals (if applicable), business and industry, internationally (EU)) and on the development in allocation patterns over time.
- Information on the research performing sectors with regard to spending of funds for research versus spending of funds for research administration, and on the development of this over time.
- Information on how recruitment to research (research education) is organized/financed, and by which criteria PhD scholarships are funded (if applicable).
- Information on which criteria and mechanisms form the basis for allocation of public funding for research in the different performing sectors/institutions.
- An account of how successful target achievement is operationalised in the different countries' management systems for public research grants.
- A review of the extent to which the countries analyzed have introduced or plan to introduce systems for cataloguing research production (for example number and level of publications, quotation indexes, downloads), and how this system is utilized.
- A short discussion providing examples of successful goal oriented public governance in research policy from the countries studied

2. The Research System

The country chapters contain diagrams and more detailed descriptions of the research and innovation funding structures.

2.1 Government Ministries and Agencies

At the level of government, countries face a choice between, on the one hand, centralising research policy in a science ministry or ministry for science and innovation or, on the other hand, aligning research policy more closely with the individual sectors of society for which individual ministries are responsible, as is the practice in Norway. In many of the countries, it is difficult to understand why things are organised as they are. Structures tend to be old and there is no memory of why they were designed in particular ways. Denmark and New Zealand have both centralised in recent years, with the stated aim of reducing fragmentation. Cross-sectoral coordination has increased in most of the countries, so there is in practice a convergence of ideas towards the innovation systems heuristic. The influence of innovation policy needs over research and innovation policy as a whole is increasing in most of the countries considered. Sweden lags behind these trends, maintaining a rather separate sphere where the research community sets funding priorities regardless of societal needs.

Historically, Canada took the centralising approach but decentralised more recently. Canada had a Ministry of Science and Technology until 1989, when this function was brought into the Industry Ministry sphere, causing a need to coordinate policy across 15 different departments and agencies. This more decentralised approach survived a review of science and innovation policy in 2005 and remains in place. The decentralised approach appears to rest on a view that sector ministries are best placed to understand their own research needs. The industry ministry runs three research funders (Social Sciences and Humanities Research Council, Natural Sciences and Engineering Research Council and the Canadian Foundation for Innovation) plus the National Research Council of Canada, which is an old-style research council that combines running institutes with funding external research. The health ministry runs the Canadian Institutes of Health and other ministries also have their own institutes.

Denmark moved to the centralised model a decade ago, integrating innovation and research into a single ministry. While most countries implement research and innovation policy through external agencies, the Danish ministry has a strong but rather separate directorate – *Forsknings og Innovasjonsstyrelsen – FI*, handling this in combination with four external research Councils that allocate funding for more fundamental research. The research-performing system has also been centralised, with government institutes being merged into the universities.

The Finnish government system for research and innovation is the archetypal 'two-pillar' model followed by many counties and on which the idea of a Nordic Research and Innovation Area NORIA[1] is based. It comprises an education ministry coupled to a strong research council (the Academy of Finland) and an industry and employment ministry linked to a strong innovation agency (TEKES). Since 1980, the philosophy of Finnish research and innovation policy expressed through what is now called the Research and Innovation Council has shifted away from the old linear model and relies on an innovation systems perspective. As a result, active coordination by the Council is seen as highly legitimate and communication among the ministries and

[1] Gustav Björkstrand, *NORIA Vitbok om nordisk forskning och innovation*, TemaNord 2004:502, Cophenhagen: NMR, 2004

agencies is intensive – across sector boundaries as well as between principals and agents.

The Netherlands also has a 'two pillar' system, where the ministries of economics and education provide the focus of research and innovation policy but other ministries also maintain research policies and sometimes institutes of their own. In practice, decision-making has been very decentralised, so the system has a large number of bodies that advise and coordinate. In the new government, the Ministry of Economic Affairs (EZ) has been given a stronger coordinating role in relation to innovation, so it increasingly has influence over the thematic and strategic priorities set by the Education Ministry and the NWO research council.

New Zealand has in recent decades operated with a very strict vertical separation of responsibilities within government. Ministries set policy, which is implemented by 'investment agencies', which in turn contract with providers (which may be state or private organisations, according to circumstances). In research, it operates with a 'science ministry' model. The Ministry of Research, Science and Technology (MoRST) sets policy and uses the Royal Society (ie New Zealand's academy of science) as the investment agency for researcher-initiated research and the Foundation for Research, Science and Technology (FRST) for research orientated towards societal needs and for aspects of innovation. The Royal Society has a division (the Marsden Fund) that acts as a research council. In 2011 the government merged MoRST and its research and innovation funding agency FRST in 2011 into a (Danish-style) Ministry of Science and Innovation – thereby breaking once of the central tenets of the New Public Management, namely that the policy and implementation levels should be separate. The aim is to reduce fragmentation in the system and to improve informal coordination among those involved in research and innovation.

Sweden has a traditional set of ministries, but there is a special arrangement whereby the Education Ministry coordinates research across the other ministries and the Education Minister leads discussions relating to research within government. Swedish ministries are very small by international comparison and have followed the principle of working through agencies since long before the invention of the New Public Management. Hence, in practice a lot of research policy is made in the agencies.

In the UK, over the last 30 years, ministry responsibility for science has migrated from the former Department of Education and Science to the Cabinet Office (answering directly to the Prime Minister) to the industry ministry. The current industry ministry – the Department for Business, Innovation and Skills – has responsibility for both the research councils and the Technology Strategy Board, which functions as an innovation agency. Other ministries have their own research budgets and contract with research performers directly or via their own agencies.

There appears to be no authoritative way to choose between centralised and decentralised models, though the majority of countries operate with a decentralised model. As with most organisational solutions, both alternatives have both strengths and limitations. The 'science ministry' approach has the advantage of creating a single place where differing needs and policies can be coordinated. However, this entails reduced contact between science policymakers and the sectoral and thematic realities it should tackle and therefore builds in a communications problem between the science ministry and the sectoral interests who need to be involved in policy formulation. By creating a separate ministry, the centralised solution also creates budget rivalry between the science ministry and other spending ministries. On the other hand, while decentralised solutions create closer contact between policymakers and needs, they suffer from coordination difficulties at all levels. Countries with decentralised structures therefore tend increasingly to establish a high-level body to advice on research and / or innovation policy, bringing the different interests together into a national 'arena'.

2.2 Policy Advice on Science and Innovation

Most countries operate some kind of high-level council intended to advise government on research and / or innovation.

Canada evolved several such advisory bodies during the 1980s and 1990s: the Council of Science and Technology Advisors, advising the federal cabinet; the Advisory Council on Science and Technology, advising the Prime Minister; the National Science Advisor to the government, whose post was created in 2004 and supplemented the activities of the existing departmental scientific advisors. The Assistant Deputy Ministers Committee on Science and Technology supported horizontal coordination among the ministries. In 2007, the advisory bodies were merged, together with another that had tackled ethics in relation to biotechnology, to form the Science, Technology and Innovation Council. This comprises stakeholders, providing a mixture of external monitoring and advice to the government.

The Danish Council for Research Policy comprises primarily academics and provides external research policy advice to government. There are two research funding councils and two research funding foundations that collectively fund a mix f response-mode and programmed research. However, the Council for Technology and Innovation integrates the innovation advice giving and funding activities in a single organisation. Government therefore receives separate sets of external advice on research and innovation.

The Finnish Research and Innovation Council (RIC) is internationally regarded as a role model. Unlike the external advisory councils of Canada and Denmark, the Finnish Council includes key ministers (at the minimum finance, industry and education) and is chaired by the Prime Minister. This means that it **sets** policy, rather than advising on it. However, it is important to note that it does not decide budgets and that its instructions are couched in very broad terms. The Ministries and agencies flesh out the details and integrate the wishes of the RIC with their wider activities and budgets.

In the Netherlands, the Advisory Council for Science and Technology (AWT) provides external advice to the government. It comprises well-placed stakeholders and has its own analytic staff, providing a mixture of solicited and unsolicited advice. A government-level coordination platform for bringing together the work of multiple ministries – the Innovation Platform – was shut during 2010 following 7 years of activity. Scientific advice to government is also provided by the academy of arts and sciences KNAW. Within government, the cabinet has an innovation sub-committee of ministers (REKI), whose business is prepared by a parallel inter-departmental committee (CEKI).

New Zealand does not have an advisory council but a Chief Scientific Advisor – a role that tends to be found in systems influenced by the British one. The role is to provide advice to the Prime Minister on science policy, scientific aspects of other policy issues, public understanding of science, building international research relationships and alerting the government to scientific threats and opportunities.

The Swedish Education Minister is in principle advised on research policy by a committee, mostly comprising senior academics, called *Forskningsberedningen*. This was largely ineffective in the 1990s and has been dormant in recent years but was revived in 2009. It is not yet clear whether it will now become influential. Sweden has no council that advises on policy based on an integrated view of research and innovation.

The UK Council for Science and Technology, comprising senior academics and one successful academic entrepreneur, advises the government ad hoc on issues relevant to science and technology policy but does not consider research or innovation policy as a whole. One of its co-chairs is the Chief Scientific Advisor to the government, who also heads the Government Office for Science. This is responsible for providing scientific advice, as opposed to science policy advice, to government and for using foresight to

try to make sure scientific aspects of policy are forward-looking. The Chief Scientific Advisor runs a network of other scientific advisors – one in each Department of State – with the aim of ensuring that all policy is scientifically informed.

Recent work on advisory councils for the OECD[2] found that there appear to be three kinds of council models operating internationally

- A joint planning model (Japan), where the government uses the Council as a virtual "horizontal ministry of innovation", much as engineering companies build project teams by bringing together people across different disciplines
- A co-ordination model (Chile, Finland, Netherlands Innovation Platform, to some extent Austria), where the intention is that the council should communicate horizontally across ministry responsibilities so as to align policies in support of innovation, without this alignment always being binding
- An advice model (Canada, Denmark, Ireland, Netherlands AWT, Sweden, Switzerland, UK), where the government is happy to be proactively or reactively advised on research and innovation policy but does not want to be restricted by that advice

It appears that the context of these advice councils matters at least as much to their success as their structure. Kuhlmann's work[3] suggests that advice and coordination should not only be concentrated to a single place but that there should be 'distributed strategic intelligence' across the system. This should be especially important in relation to the coordination model. Thus, for example, in Finland both TEKES and the Academy have very capable analysis departments, which produce evidence and reports about various aspects of policy and prioritisation and co-exist with (and inform) the broader type of policy advice provided by the Research and Innovation Council.

2.3 Structure of the Research Performing Sector

All the countries considered have a traditional Western organisation of the research-performing sector, in the sense that the universities integrate teaching and research and there is no academy of sciences running a system of research institutes separately from the universities. Denmark integrated the government laboratories into the universities in 2006, leaving only the GTS system of applied industrial research institutes outside the university sector. Finland continues to support a large research institute system, covering both government and industry needs, while it has moved to rationalise the number of universities. The Netherlands recently transferred €100m from the block grant to the research council, in an effort to increase competition and increase quality in the university sector, while continuing to maintain a large government laboratory and applied research institute sector. About a decade ago, New Zealand abolished core funding for its institutes (the so-called Crown Research Institutes), in order to make their funding fully 'contestable'. As a result, one of the institutes closed and the government back-pedalled by setting up the CRI Capabilities Fund, which replaces the lost core funding. Sweden has traditionally had a small applied research institute sector, which has tended to be ignored in policy. However, the last research act announced an intention to increase core funding and the state has set up a new sector-wide holding company – RISE – which has reorganised the sector. The UK stands out for having privatised many of the government laboratories and withdrawn state funding from the applied research institute sector during the 1980s. Currently there is a project in progress to rebuild an institute sector in the UK, with support from the Fraunhofer Society.

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[2] Erik Arnold and Gernot Hutschenreiter, *Chile's National Innovation Council for Competitiveness: Interim Assessment and Outlook*, Paris: OECD, 2009

[3] Stefan Kuhlmann, 'Future governance of innovation policy in Europe – three scenarios,' *Research Policy*, 30 (6), 2001, 953-976

Figure 1 shows that the proportion of university funding allocated via block research grants and research councils differ substantially. The UK again stands out for distributing the greater part of research funding via research councils rather than through block grants. Across the countries, there is a continuing trend to allocate a growing proportion of university research funding competitively via research councils and other funding bodies. This is reinforced by the growing share of countries that also subject the block grants to competition via some form of Performance Based Research System (PBRS). (This is discussed below.)

Figure 1 Allocation of State Funds among University Block Grants for Research, Research Council and Institute Core Funding

In Euros m	Uni Block Grants	Research Councils	Institutes/Labs
DK	618	365	38
FI	546	348	296
NL	2,006	655	672*
NZ	135	51	29
SE	1,495	635	N/A
UK	2,595	4,371	N/A
Index	**Uni Block Grants**	**Research Councils**	**Institutes/Labs**
DK	1.00	0.59	0.06
FI	1.00	0.70	0.54
NL	1.00	0.33	0.53
NZ	1.00	0.38	0.22
SE	1.00	0.42	N/A
UK	1.00	1.68	N/A

Sources: Subsequent chapters. Figures for 2009 or 2010 except DK 2008. **Note** that the table omits innovation agency funding. It therefore under-counts project funding to the universities

* Total core funding to TNO, GTIs, NWO institutes, KNAW institutes and DLO

2.4 Funds Allocation

Data about how research funds are allocated among different classes of institution and purposes in different countries are not systematically collected except at the very aggregated level defined in OECD statistics. In this section we have therefore to be rather opportunistic in combining data from different sources to create an overall picture.

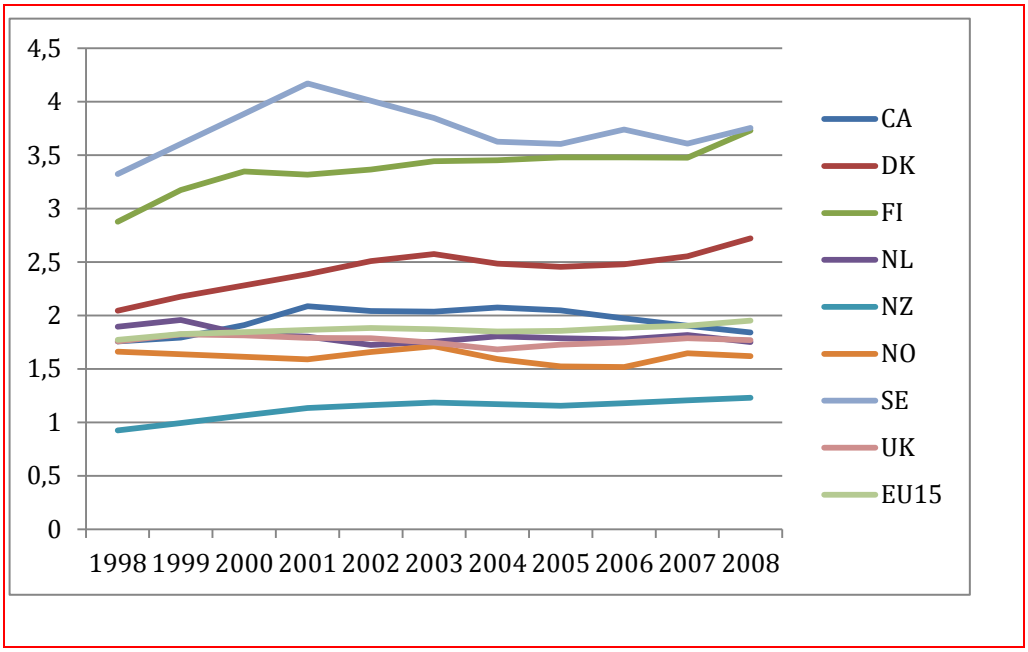
Figure 2 uses the OECD numbers to show the trends in how much of GDP the countries studied have devoted to R&D. Finland, Denmark and New Zealand have increased their investments remarkably over the period. In the other countries, as in the EU-15, spending has stagnated – with the exception that Sweden enjoyed a peak in the early 2000s that coincided with the 'dot.com' bubble and a peak of activity in the telecommunications industry. Norwegian R&D-intensity has fallen slightly over the period.

Figure 3 focuses on government R&D spending, and shows the countries (except Norway) inching slowly towards the 'Barcelona Goal' target of the state spending 1% of GDP on R&D[4]. Figure 4 makes it clear that within this pattern of slow expansion of

[4] The 'Barcelona Goal' of the spending 3% of Europe's GDP on R&D by 2010 (with 1% to come from the state and 2% from business) was set by the EU Council of Ministers in 2000. It has quietly been allowed to slip

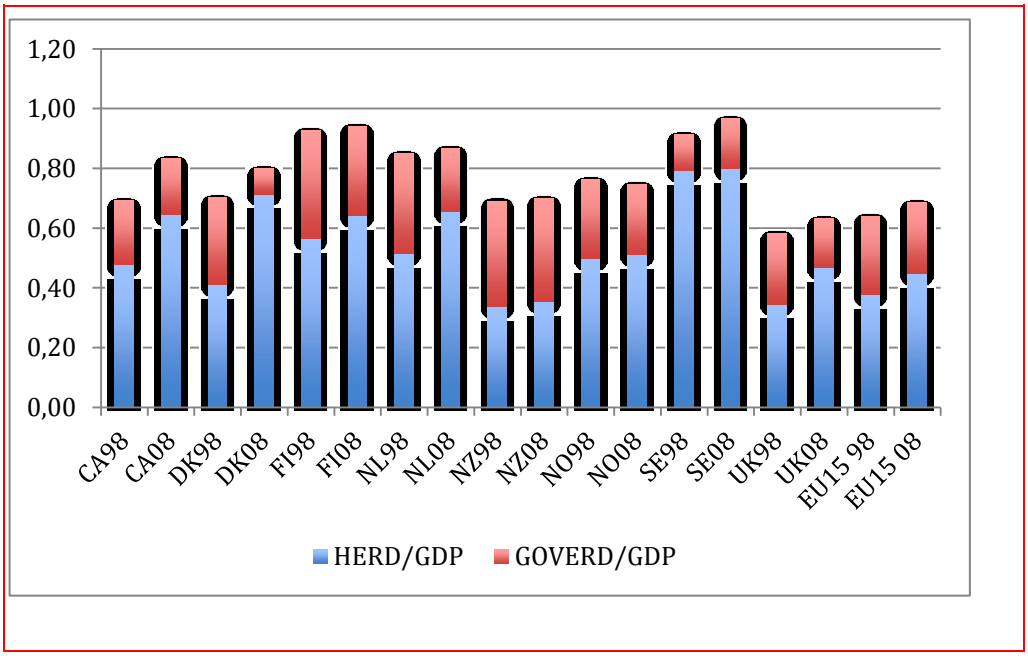
government spending, there is a shift towards spending a greater proportion of the state money via universities, though this shift is much less marked in Norway and New Zealand.

Figure 2 Gross Expenditure on R&D as a Percentage of GDP, 1998-2008



Source: OECD, MSTI; some values are interpolated

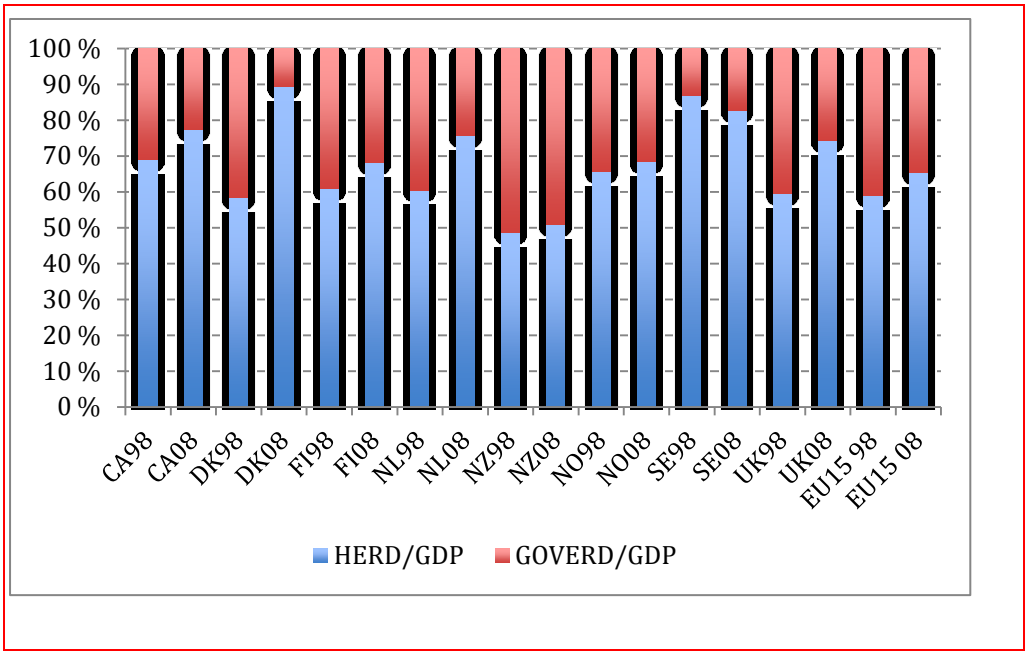
Figure 3 HERD and GOVERD as a Percentage of GDP, 1998 and 2008



into obscurity, since it has for several years been clear that it could not be achieved. However, it has been revived in the new Europe 2020 vision, with the target year moved from 2010 to 2020

Source: OECD, MSTI; some values are interpolated

Figure 4 How Government R&D Spending Splits Between HERD and GOVERD, 1998-2008



Source: OECD, MSTI; some values are interpolated

Figure 5 Proportions of Higher Education and Government Spending on Basic and Applied Research and Experimental Development

Country / Segment	Year	Basic Research	Applied Research	Experimental development
DK Higher Education	1999	63%	28%	9%
	2006*	55%	33%	12%
DK Government	1999	30%	51%	19%
	2006*	15%	63%	22%
NZ Higher Education	1999	68%	32%	0%
	2007	53%	28%	18%
NZ Government	1999	53%	36%	11%
	2007	40%	43%	17%
NO Higher Education	2005	49%	36%	15%
NO Government	2005	17%	61%	22%
UK Government	2002	30%	54%	16%
	2006	32%	53%	15%

Source: OECD, MSTI. * There is a break in the Danish series between 2006 and 2007

Only a minority of OECD members implements the part of the R&D survey that uses the Frascati Manual definitions to classify R&D spending. These definitions focus on the **purpose** of doing the research, producing the slightly odd result that an experiment can appear in any category depending on why the researcher does it. The

data in Figure 5 largely suggest a movement towards a more applied focus in the work of both universities and government. However, if we look at funding allocation it appears that the proportion of research that is researcher-initiated is increasing. In many research policy discussions, 'basic' and 'researcher-initiated' research is discussed as if they were a single category. In reality, it appears that they are not.

If we look at the pattern of funding, the Canadian picture shows a marked shift towards funding through research councils, which accounted for 25% of federal R&D spending in 1999/2000, rising to 31% in 2009/10, with the mission-oriented research funded by government taking a correspondingly smaller share. In current dollars, the budgets of the research councils grew 115% between 1999 and 2009, while the rest of the federal research budget grew only by 54%. Industry Canada's research funding grew a mere 8% in the same period.

Finland has had a similar development. The research council's budget grew 147% from €155.5m in 1999 to €384.4m in 2010. The innovation agency (TEKES) budget grew 49% in the same period, from €411.2m to €610.8m, slightly faster than the core funding budgets of the state research institutes, which do applied research. (They grew 41% from €209.8m to €285.7m).

In the Netherlands, the education ministry's €3bn budget corresponds to two-thirds of all the government's spend on research, with some €2bn of this being the research part of the universities' block grants. Its R&D budget grew by 46% between 2000 and 2009, compared with 27% for the Ministry of Economic Affairs (EZ), which funds innovation. The research council – NWO, which is funded mainly by the education ministry but also by others – experienced a 46% budget increase between 2001 and 2010, from €433m to €634m[5]. Once more, the pattern of the last decade has been towards research council research.

At NZ$650m (€370m), New Zealand's national Research, Science and Technology budget (which excludes institutional funding of the universities) is small, and it is dominated by thematically-prescribed programmes. A third of the money goes to university and institute research to support industry; in total 52% of the budget has industrial aims and a further 16% is environmental research. The main research-council style programmes are the Marsden Fund (in effect the national research council, whose share of the budget has risen from 5% to 6% between 2001 and 2009) and a suite of Health programmes (whose share of the budget has risen from 7% to 10% during the period). Consistent with the principles of the New Public Management, which are strongly embedded in the New Zealand system, the share of research council style funding is therefore small, even if it is slowly rising.

In Sweden, the universities dominate the national research budget. Of the almost SEK 30bn allocated in 2010, the university research block grant took up over 46% and the three research councils (VR, FAS and FORMAS) a further 19.6%. In contrast with Finland, the main research council VR has twice the budget of the innovation agency (VINNOVA). Both agencies' budgets have doubled in the last decade, VR going from SEK 2bn to SEK 4.5bn between 2001 and 2010 and VINNOVA from SEK 1 bn to SEK 2bn in the same period.

The UK has experienced two clear shifts in government research funding over the past 20 years. First, the proportion of government civil research budget spent in the universities rose from 61% in 1989 to 65% in 1999 and 75% in 2009. Second, the proportion of the universities' research income from the research councils rose from 48%to 54% and on to 63% across those same years. In parallel, the Research Assessment Exercise has put competitive pressure on the 'block grant' funding. These two forces may help explain the fact that the proportion of university research that is basic has been rising, at least since the mid-1990s, with a corresponding reduction in

[5] This represents a peak value. The budget is planned to decline to €535m in the period up to 2015

the share of applied research. This is surprising in the context of the relocation of the research councils within the industry ministry – though it is also noteworthy that business expenditure on R&D is in decline in the UK.

UK researchers – especially in medicine and the life sciences – additionally benefit from large amounts of project-based funding from private foundations, of which the best known is the Wellcome Trust.

We can conclude that generally, in the countries studied, the proportion of research council style research is rising but whether basic research is gaining or losing ground compared with applied research seems to be nationally specific and probably depends on nationally specific incentives.

A separate question is the extent to which funding is for 'free research' (sometimes called 'bottom-up'), where the researcher defines the theme, or for research in themes defined by the funder ('top down'). Most countries have more than one research council, or divide an umbrella council into thematically specific sub-councils. On a pedantic definition of 'free research', this would mean that no research is free. In what follows, we treat research as 'free' if the applicant is free to define the subject **within the set of themes tackled by the relevant council**. In the case of Denmark, we therefore regard the Danish Councils for Independent Research and the Danish National Research Foundation as funding 'free' research and the Danish Council for Strategic Research as funding 'top down' research. Figure 6 shows the latest available budgets (usually 2010) of research funders in countries considered and estimates of the proportion that is 'free' in this sense. It is not always easy to draw the line between a research council and an innovation agency that also funds research; but we have tried to exclude the latter. (Essentially, if an organisation funds industry then it in excluded from the Figure.) On this basis, the proportion of 'free' research funding varies enormously – there is no evident pattern.

Figure 6 Proportions of 'Free' Research by Country

Country	Organisation(s)	Total Research Budget Considered	% 'Free' Research
Canada	SSHRC	€511m	60% (2003) 57% (2009)
Denmark	Danish Council for Independent Research (free) National Research Foundation (free) Strategic Research Council (top down)	€360m	58%
Finland	Academy of Finland	€384m	45%
Netherlands	NWO	€327m (project budget)	33%
New Zealand	Marsden Fund (free) Health Research (free) Research for Industry (top down) Environmental Research (top down) New Economy Research Fund (top down)	€277,	20%
Sweden	Science Council (free) FAS (top down) FORMAS (top down)	€661m	78%

Note For Canada we were only able to get data for the Social Sciences and Humanities Research Council; we were unable to obtain usable data for the UK

3. Research and Administration

Surveys of researchers consistently point to frustration at the apparently increasing administrative burdens associated with obtaining research funding, especially at the

European level. However, we have not been able to find data that would support the idea that these burdens are reflected in increases in administrative staffs, workload or the proportion of time academics spend on administration. If anything, the employment and time use data point in the other direction.

We have looked at this question at four levels

- University administration
- The composition of the research workforce
- How academics use their time
- Research funding administration

There are no surveys of university administration that would provide a consistent statistical basis for describing or understanding changes in the importance of administration. We have attempted to dissect annual reports from a sample of universities in the countries studied but have been unable to identify information that would enable reliable quantification of changes in administration as a whole (either in terms of money or numbers of people) or at the level of research, as opposed to education. Primary research would be needed in order to take this issue any further. We know from other sources that universities have over the past 20 years or so been developing their Industry Liaison, Technology Transfer and research management functions, so such research would probably show that trend. But there would also be countervailing trends such as the increasing use of word processing by professionals and the corresponding reduction in the amount of specialised secretarial work needing to be done.

If research were becoming more administration-intensive, we would expect to see the share of support staff in total employment rise over time. Figure 7 shows OECD data for the countries studied. In business, government and higher education, there is a fairly consistent pattern of a falling proportion of support staffs, a slow decline in the proportion of technicians and a corresponding increase in the proportion of researchers.

Figure 7 Shares of Research, Technician and Other Support Personnel in Research Employment, 1985-2005

Country		Canada			Denmark			Finland			Netherlands			New Zealand			Norway			Sweden			United Kingdom		
Year		1985	1995	2005	1985	1995	2005	1985	1995	2005	1985	1995	2005	1985	1995	2005	1985	1995	2005	1985	1995	2005	1985	1995	2005
Business sector																									
% of Total national R&D personnel	Researchers	50	60	59	31	39	62	-	-	-	34	36	47	-	56	60	48	66	67	35	46	65	47	57	64
	Technicians	32	28	28	50	43	27	-	-	-	44	44	41	-	29	25	-	-	-	-	-	-	-	23	17
	Other support staff	17	12	12	19	18	11	-	-	-	21	20	12	-	15	15	-	-	-	-	-	-	-	20	18
Government sector																									
% of Total national R&D personnel	Researchers	38	41	47	49	66	65	-	-	59	41	49	55	-	38	58	48	62	67	51	78	84	36	47	46
	Technicians	28	29	27	-	-	24	-	-	-	31	31	28	-	38	32	-	-	-	-	-	-	15	21	20
	Other support staff	34	30	26	-	-	10	-	-	-	27	20	16	-	24	10	-	-	-	-	-	-	48	32	34
Higher education sector																									
% of Total national R&D personnel	Researchers	60	70	76	65	77	71	-	-	74	47	51	62	-	81	84	60	69	80	65	72	86	48	-	93
	Technicians	21	16	12	-	-	19	-	-	-	-	-	-	-	13	5	-	-	-	-	-	-	17	-	7
	Other support staff	19	14	12	-	-	10	-	-	-	-	-	-	-	6	11	-	-	-	-	-	-	33	-	-

Source OECD, MSTI

The most consistent time series data we can find on use of academics' time are from Norway (Figure 8), but unfortunately they are rather old. They show the proportion of time spent on administration declined between 1981 and 2000. Compared with other country data, the Norwegian numbers are fairly high. Women spent 23% of their time on administration in 1981, declining to 17% in 2000. Men spent 18% on administration in 1981, declining to 17% in 2000.

Figure 8 Women's and Men's Use of Time Among Norwegian Academics

Undersøkelsesår	*1981*		*1991*		*2000*	
	Kvinner	Menn	Kvinner	Menn	Kvinner	Menn
Undervisning	34	32	31	28	33	29
Veiledning	8	10	11	12	13	13
Forskning	27	30	30	32	28	29
Administrasjon	23	18	20	17	17	17
Museum	-	-	2	2	1	1
Utadv. oppgaver	7	7	5	6	6	8
Prof. yrkesutøv.	2	3	2	3	2	3
Sum	100	100	100	100	100	100
(N)	(196)	(1343)	(228)	(1205)	(408)	(1739)
Timer per uke	47,0	49,5	48,8	50,3	47,8	48,5

Source: Hovdhaugen, Elisabeth, Svein Kyvik & Terje Bruen Olsen (2004): *Kvinner og menn – like muligheter? Om kvinners og menns karriereveier i akademia.* Skriftserie 25. Oslo: NIFU STEP.

A survey by Statistic Canada on Canadian academics in 1982 suggested they spent 12% of their time on administration. A study provided by Statistics Finland indicated that in 2005 39% of universities staff time was spent on research (10% for polytechnics staff), while 43% (74% in polytechnics) was spent on teaching and 18% (16% in polytechnics) on "other tasks", including administrative tasks related to research or teaching activities.[6] These figures cover all research staff from professors to assistants.

Considering only researchers, working hours are divided as follows:

- In universities: 77% research, 15% teaching and 8% other tasks
- In polytechnics: 47% research, 29% teaching, and 24% other tasks

Since 1983, the time spent on administrative tasks has remained stable (was 17% in 1983). With the exception of humanities and social sciences, the proportion of research went up in all disciplines over the period.

Dutch data[7] for 1982/3 and 2006/7 show teaching and research taking an increasing proportion of academics' time during the period and consequently that 'Societal Services' and 'Other' activities including administration declined. The amount of change varies by discipline. In Technology, for example, the proportion spent on teaching and research rose from 82% to 88%.

Administrative efficiency at the level of research funders is a minefield. Detailed benchmarking of innovation funding programme design and management[8] shows that different funders count administrative costs in different ways and that their accounting for cost is often incomplete. For example, some benefit from centrally provided infrastructure and services (eg buildings) for which they do not themselves

[6] Time use survey of university and polytechnic staff in the academic year 2004-2005. Statistics Finland, online: http://www.stat.fi (consulted October 2010)

[7] J.M.P. de Kok, J. de Jonge and M. Tom (2007) "Tijdsbesteding universitair wetenschappelijk personeel", policy study nr. 130 in the series "Beleidsgerichte studies Hoger onderwijs en Wetenschappelijk onderzoek, Zoetermeer, 27 September 2007

[8] Erik Arnold and James Stroyan, *Comparative Study on Administrative Burdens and Rules of Procedure between the EU Research Programmes and those of Member States*, IV/98/06, Brussels: European Parliament, STOA, 1999

pay or account. In almost all cases, funders value the time of the research community when acting as reviewers at zero or close to zero. Almost no research funders count or analyse the way they use time, so it is very hard for benchmarking to take account of differences in function among agencies. Budget and Annual Report data therefore need to be treated with a degree of scepticism.

Available exercises suggest that two (rather obvious) drivers affect efficiency: size of organisation; and average grant size. Big organisations can build scale in each of the various processes involved with research funding. Bigger grants do not cost much more to administer than smaller grants.

Figure 9 shows reported administrative costs for a sample of funders in the countries studied. Except in Finland, administrative costs are flat or very slightly declining, as a proportion of budget. Some caution is required with the Swedish numbers, as the organisations were established in 2001 and inherited administration from their predecessors, while their budgets were constrained, tending to inflate the proportion of cost going to administration.

Figure 9 Administrative Costs of Research Funders

Research Council	Share of administrative cost in total expenditure- first year available		Share of administrative cost in total expenditure- most recent year		Data used (annual report)
UK					
EPSRC	2004	4%	2009	3.5%	Operating and Staff costs
MRC	2000	3.6%	2009	3.5%	Total expenditure on administrative running costs
Canada					
CIHR	2003	5.95%	2009	5.98%	Total Operations and Administration
SSHRC	2003	5%	2009	3.32%	2003: Operations 2009: Internal Services
Sweden					
Vinnova	2001	14.8%	2009	13.3%	Administrative Cost
VR	2001	12.5%	2009	9%	Operating Expenditure
Netherlands					
NWO	2004	6.9%	2009	6.2%	Administrative Cost
Denmark					
Danish National Advanced Technology Foundation	2005	2.45%	2008	4.8%	2005: All Secretariat costs 2008: Staff and running expenses
Danish Research Science Foundation	2000	5.3%	2009	4.4%	All costs besides direct costs to research funding.
New Zealand					
FRST	2003	15.4%	2009	9.8%	Administrative Cost
HRC	2006	4.7%	2009	4.9%	Other Operating Expenditure
Finland					
Tekes	2001	3%	2008	8%	2001: an estimate of administrative costs is given by the share of State budget that is not used in the allocation of funding for research 2008: Operation costs

Source: Annual Reports

4. Research Training

4.1 General trend

In principle, research education, or research training, is understood and conducted in a similar way in all the compared countries.

Admission is on merit-basis, the period of training is 3-4 years, and after having produced a thesis based on individual research, and often conducted an oral presentation as well, a doctoral degree is awarded.

A general trend is that the number of doctoral students involved in research education has increased over the years, sometimes significantly.

Another common feature is that governments or other state organisations pay increasing attention to research education, often with strengthened regulation. Economic and working conditions are improved for the doctoral students.

Detail arrangements differ however. There is a spectrum, ranging from those countries with a rather unified national structure by way of those countries with research education systems of a slightly more diverse character to those where the national systems which are relatively diffuse and unregulated.

The differences should not be over-emphasised; the pattern above all is that the compared systems are similar, and increasingly so.

4.2 Organisation of the research training

The way research training is organised has undergone changes during recent years.

Increasingly, post-graduate education is delivered in graduate schools, or research schools, rather than by individual departments or centres. There is no single definition in place regarding which term refers to which kind of educational setup. Still, clearly, traditional doctoral education within the frame of a single discipline is losing ground compared to such training in graduate schools, often multi-disciplinary, with organised networking activities, and encompassing a wider set of skills beside specialisation in the given academic topic.

Significant numbers of doctoral students in the Nordic countries and the Netherlands undergo research education in such research schools. The issue of better coherence and structure of 'graduate schools' is currently under discussion in the UK.

4.3 Admission and examination

Recruitment is done by the universities, and always on merit-basis. Admission is separated from funding of the research education; a doctoral student may get funding for none, part or the whole of the training period. There has been a steady increase in many countries of admitted candidates. Sweden stands out with essentially no difference in the figures at all during the past decade; Finland has seen a 7% increase since 2003; in other countries, the increase has been significant, some 30% or above.

At least in the Swedish case, there was a larger increase during the 1990s, which may explain the curve flattening out during the 2000s.

Examination figures typically follow the admittance figures; most countries show an increase during a range of years. Sweden stands out again, with a decrease during the past decade, while Finland presents a 30% increase, far beyond the slight increase of admissions, perhaps to some surprise. Other countries also show a large increase. Possibly, the bulk of Swedish doctoral students from the large earlier intake have already been examined and compared to those years, the country has now moved into a decreasing trend when it comes to doctoral exams, while Finland may be just behind in time and will, due to the relatively low increase of admissions, in a similar way soon witness a much more modest increase of examinations. And, countries like Denmark and Canada can hardly keep up with the recent years' large increase of admissions for

very long and will probably soon move into more of a steady state as well, with an annual increase on par with the Netherlands' 4% per annum, for instance.

4.4 Funding

Funding of the research training is partly covered by tuition fees in Canada and the UK, while it is covered by state grants directly to the universities in the other countries. In the former countries, the PhD candidate needs to find ways of covering tuition (or being freed of it) as well as their private costs, while in the latter countries, they need only to find sources for their own private funding.

There is a growing awareness within EU and in other parts of the world as well that successful doctoral education on mass scale requires good working conditions for the doctoral students, including a decent private economic situation. The doctoral students conduct what in many cases are important parts of the research in their professor's project, and bad conditions will affect the quality of the research. There are several ways in which the doctoral students can be funded during the training period. The points below capture the lion's share of possible solutions.

1. Employee

The doctoral student is an employee at the university. Often, there is a research proposal written by the promoter for which a suitable PhD candidate is sought. The appointment is for the duration of the research project. A large share of the PhD candidates in the Scandinavian countries and the Netherlands fall within this category. The employee–PhD candidates are responsible for a large part of all university research. In addition, they may have teaching tasks. The research training is often organised in (inter-)university research schools or graduate schools.

Funding for the employee can come either from the university as an actual position, or as part of an external research grant, where funds for a doctoral student (or several) are included.

2. Scientific staff member working on a PhD thesis

In scientific areas with a shortage of positions for employee–PhD candidates, universities may choose to make available teaching positions for doctoral students. These can be on a full or part time basis, and can be related to project work as well, but not necessarily the research that the candidate is writing his/her thesis on.

3. Scholarship

In many countries, there exists a vast landscape of available scholarships of various kinds. Some organisations which provide such scholarships are state managed, others are private. They may provide scholarships for the entire training period, or for parts of it, or it may be a lump sum which may last as long as it will. This system is well developed in Canada and the UK.

4. Foreign scholarship PhD student

Foreign PhD students may decide to perform their research (fully or partly) in another country using their scholarships from their home countries.

5. The external PhD candidate

These PhD candidates typically have jobs outside the university and tend to perform their research in their free time.

6. Dual PhD training

Dual PhD training is on the rise. The PhD candidate is partly employed by the university and partly by another organisation (or admitted to a doctoral programme and employed by a company; combinations occur). The target group can be different from the 'normal' PhD candidates (older, more working experience). Denmark has a well developed programme for this type of PhD candidates, who do their research in a private company (recently even extended to a few positions in the public sector) while

following some courses and seminars at the university. Other countries experiment with this type of research training as well, but perhaps not on such a formalised level as in Denmark.

Figure 10 shows which funding modes are in use in the countries studied.

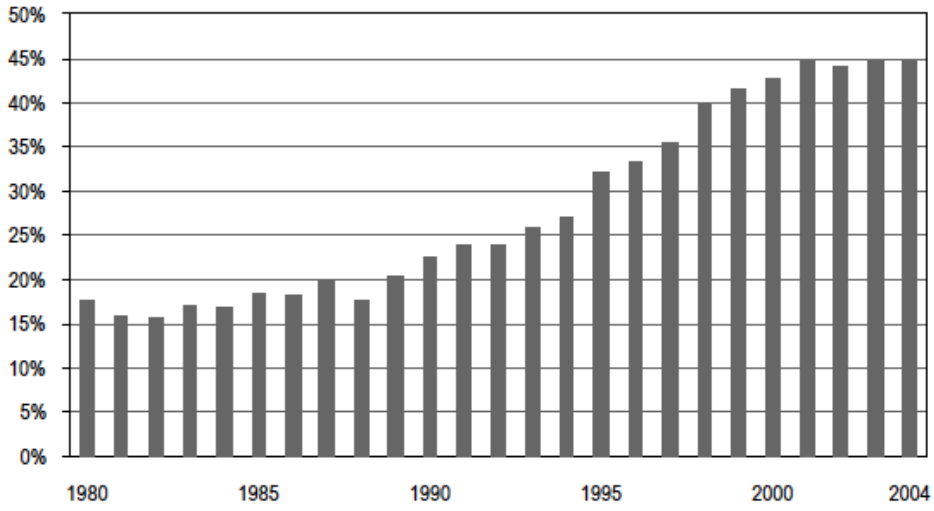
Figure 10 Use of Different PhD Funding Modes

Funding Mode	CA	DK	FI	NL	NZ	SE	UK
As part of a project grant from an external funder, eg Research Council			X		X	X	X
Funded from the university block grant	X	X	X	X	X	X	
Stipends competitively allocated by external funders to university departments	X	X	X	X		X	X
Personal stipend	X		X	X			X
Dual PhD training		X		X		X	X

4.5 Completion Rates

There is an upward trend in PhD completion rates in most countries. Figure 11 provides illustrative data for Sweden.

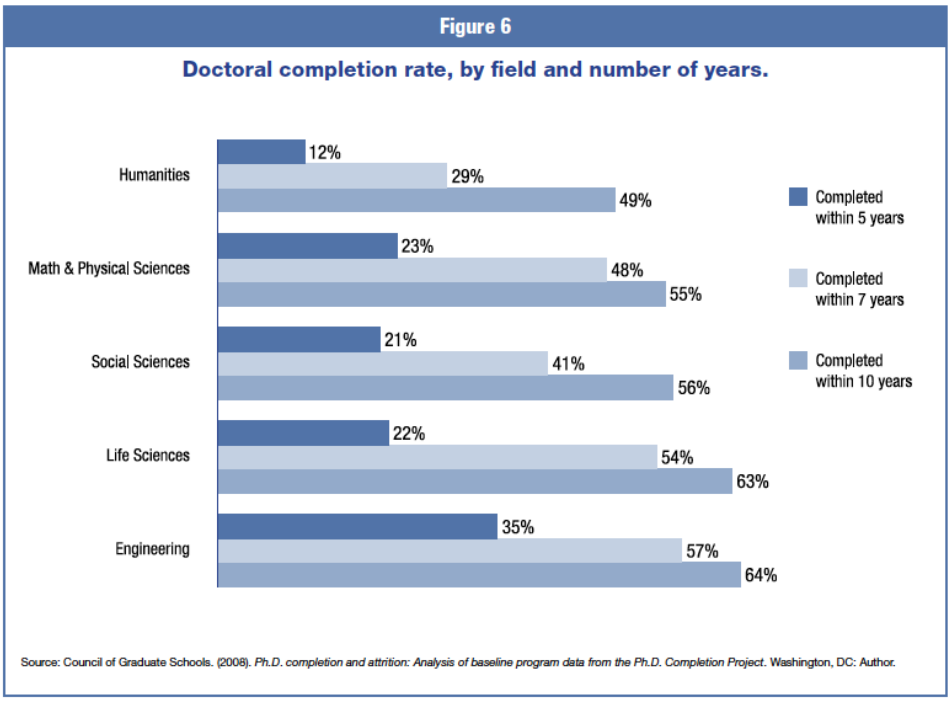
Figure 11 Proportion of Swedish PhD Students Graduating within 5 Years, by Date of Starting



Source: HSV and SCB, *Universitet och högskolor:. Doktorander och examina på forskarnivå, 2009*, UF 21 SM 1001

There is also a consistent pattern that completion rates vary by discipline, with doctorands in the 'hard' sciences taking less time to complete than those in the social sciences, who in turn tend to be faster than those in humanities. Figure 12 shows recent data for the USA but similar patterns are found in other countries.

Figure 12 Doctoral Completion Rates by Field and Number of Years (USA)



There is no standard indicator for completion rates, so different surveys measure the proportion of people examined at different periods of time after starting. The periods used in Figure 13 therefore vary among countries but suggest that Norway, Denmark and England have the best overall completion rates.

Figure 13 PhD Completion Rates

Country	Completion %	Period Since Starting PhD	Source
Norway	80%	?	Fagerberg
England	80%	7 years	HEFCE Web Site, 2011
Canada	45-70% (1984/5 cohort)	Until left university	Elgar[9]
Canada	70% (1996 cohort)	University of Toronto 7 years	UoT performance indicators, 2011
Denmark	80%	6 years	Ministry of Science, Technology and Innovation[10]
Netherlands	65%	7 Years	VSNU, 2010 (University performance indicators)
New Zealand	60%	10 years	Smart[11]
Sweden	71%	8 years	SCB and HSV, UF 21 SM 1001

[9] Frank Elgar, *PhD Completion in Canadian Universities,* Delhousie University, 2003

[10] *A Public Good: PhD Education in Denmark,* Report from an international evaluation panel, Copenhagen: Ministry of Science and Innovation, 2006

[11] Warren Smart. "Persistence in doctoral research: analysing the impact of the PBRF on the retention of doctoral students," 2007. http://www.educationcounts.govt.nz/publications/tertiary_education/16344

4.6 Doctorands' Incomes

To test the idea that Norwegian doctorands are unusually well off in economic terms, we compared the levels of stipend or salaries paid to PhD students in different countries. The results are shown in Figure 14 and clearly confirm that the Norwegian rates are high compared with others. We have not been able to explore tax rates, but it may be that incomes are slightly better in Switzerland than Norway, owing to the low rates of income tax applied.

Figure 14 Current PhD/Stipend Rates

Country	Institution, if Applicable	Annual Pay/Stipend	Tax Status	Source
Norway (2007)	NTNU	€41,656 – €44,640	Pre-tax salary	NTNU web site
UK	Imperial College, London	€17,890	Tax-free stipend	IC web site
UK	Manchester University	€15,549	Tax-free stipend	MU web site
Switzerland	EPFL	€39,360-€43,990	Pre-tax salary (tax is about 10%)	EPFL web site
Canada		€17-19,000	Tax free	McGill and various university web sites
Denmark		€42,650	Pre tax	Utdannelsesgeuiden[12]
Finland		€19230-€26,300	Pre tax	Various faculty web sites
Netherlands		€25,920-€33,151	Pre tax	VSNU, salary table of the CAO
New Zealand		€11,770 - € 15,560	Tax exempt	University web sites
Sweden		€32,380 - €33,830	Before about 30% tax	SULF

4.7 Conclusion

Doctoral studies have gone from being an elite specialisation activity to become a mass research education, with great benefits for the surrounding society including industry. Thus, governments have paid increasing attention to the organisational forms, quality of the training, and outcome of the scientific results.

The doctoral students are nowadays often employed or in some other way fully funded during the whole of the training period. Often they are seen as junior staff. The research education as such is increasingly undertaken in formalised programmes where external perspectives, from other disciplines or from industry, are included in the curricula. Hope is invested in the meeting of different perspectives, with the potential to break into new research frontiers and solving grand challenges in mind. Utilisation and employability are new keywords beside scientific quality.

Examples of new initiatives which may serve as 'good practice' include:

- The Danish programme for professional PhDs (erhvervs-PhD:er), originally proposed in the extensive evaluation of the Danish research education 'A Public Good' from 2006. It has recently been extended to target the public sector as well.

[12] www.ug.dk/uddannelser/universitetsuddannelser/forskeruddannelse_phd.aspx

- The setup of a central support fund in Canada, the tri-council Canada Graduate Scholarships Programme (CGSP), established in 2003 as the first government direct support for research education. It provides scholarships to Canadian students enrolled in master and PhD programmes. The initial programme provided 2 000 scholarships at the PhD level annually. The programme has been expanded further in 2007.
- The Dutch system of research schools and their evaluation cycles, which has resulted in a better quality of postgraduate researcher training. In 2009 there were 81 recognised (accredited) research schools, of which two-thirds are of inter-university type. The quality assurance system in place for the research schools, The Research School Accreditation Committee (ECOS) organises annual assessment rounds. The assessment is based on a protocol established by the Royal Academy KNAW. The accreditation of a research school is valid for six years. After this period an application for re-accreditation needs to be submitted. ECOS also provides advice to research schools on how to further improve their core activities. The main focus is on researcher education and supervision.
- In a tuition-fee based system like the one in UK, the Research Council UK has encouraged other research councils to give a precise grant amount that they are willing to cover in studentship funding. The intention is that the higher education institutes will set their fees accordingly and students are not forced to find funding through other means, nor are higher education institutes forced to waive the difference in tuition and funding.

It should be noted that the re-structuring of the research education in EU-countries and elsewhere has not proceeded without inertia. The incorporation of new norms from other disciplines than the original one that the candidate comes from, or from industry, often stands in conflict with the need for the individual doctoral student to learn the codes of the discipline that s/he belongs to and undergo a socialisation process within that discipline.

Evaluations of research schools have repeatedly shown that this key step has been troublesome, even a failure. The trick is then to find ways of providing research education, which meets society's need for researchers with skills beyond the scientific ones, and academe's need for enhanced in-depth knowledge in a given field. Possibly, the two seemingly inconsistent views could still converge as there is a need for researchers with a broader set of skills even within academia. Thus, research education could continue to transform and include more utilitarian skills, while the requested scientific specialisation necessary for continued academic research increasingly could occur during the subsequent post-doc phase.

5. Research Funding Mechanisms and Criteria

This section focus on national public funding delivered to researchers, research institutions and research teams in the sample of countries, either through public project funding or through public core funding to institutions. Both direct funding and performance-based funding are studied, however, focus is put on good practices and interesting examples of performance-based funding orientated towards targeted goals and achievements.

5.1 Some patterns over time

Overall trends in various countries show that competitive funding is increasing its share over block grant funding in the allocation for research to universities and research institutes. There has been a general search for more accountability since the 1970s/1980, showing that states' research investments are more and more conditioned to the existence of mechanisms determining the value for money and helping the choice of institutions to be granted.[13]

This is part of the general trends analysed within the framework of the New Public Management theory, which has resulted in new practices in terms of management by objectives and accountability for results since the 1980s. Three major shifts are involved

- Public research funders' **strengthening performance-based funding** (based either on competitive funding or on overall quality revision of past performance)
- Public research funders' introducing and strengthening the **selection processes** of research performers for the allocation of performance-based funding
- The introduction of **priority setting and the setting up of goal-oriented research programmes** designed by public decision-makers (as opposed to free projects and grants attributed to individuals and investigators-initiated projects)[14]

Overall, the literature offers conceptual frameworks to explain the changes in the basis for allocation of public funding for research over time. Dietmar Braun has recently analysed the above-mentioned shifts towards the issue of **delegation**. His approach is of particular interest within the analysis of goal-oriented policies since he aims at determining to which extent policy-makers guarantee a large space of manoeuvre to the research performers, while they implement steering and accountability mechanisms.[15]

5.2 Broad overview of the research funding mechanisms and criteria in the selected countries

5.2.1 Mechanisms forming the basis for allocation of public funding of research

5.2.1.1 Overall

As far as **universities** are concerned, a majority of the countries under review has implemented a performance-based mechanism for institutional funding, to improve the international standing of academic research. In 6 of 7 cases, governments allocate a meaningful proportion of total national HE research income, based on performance

[13] *Sverker Sörlin*, Trends and Issues in the Funding of Research, UNESCO ENA Group Meeting Paris 5-6 March 2007 [draft version]

[14] Bianca Potì and Emanuela Reale, Changing allocation models for public research funding: an empirical exploration based on project funding data, Science and Public Policy, 34(6), July 2007, pages 417–430

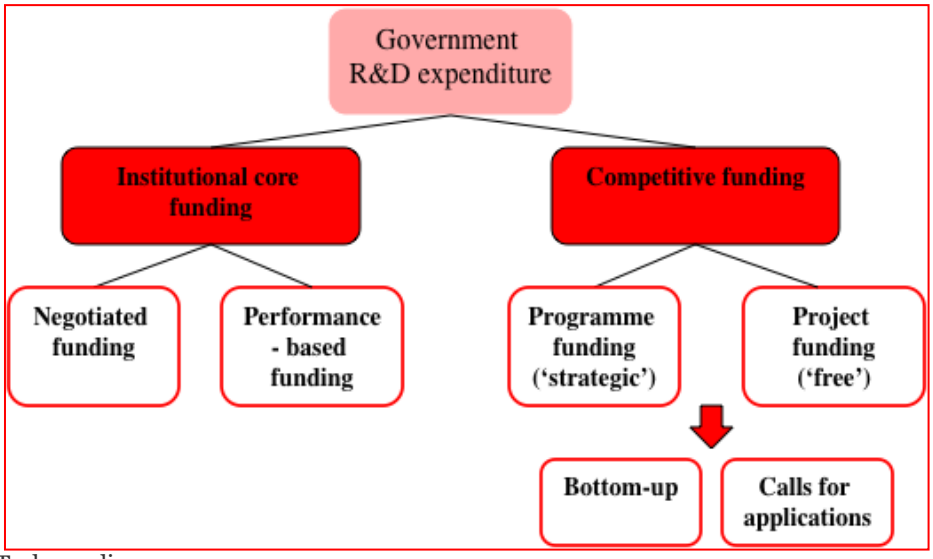
[15] Dietmar Braun, Lasting Tensions in Research Policy-Making – A Delegation Problem, Institut d'Etudes Politiques et Internationales, Université de Lausanne January 2003

- Denmark, Finland, NZ, Sweden and the UK operate binary systems, providing institutional funds through a performance-based mechanism and project awards through competitions
- The federal government of Canada allocates the great majority of its funds for centres or projects, through competitions and provincial government allocate core funding according to performance indicators which vary from one province to the other
- The Netherlands uses direct funding of institutions by ministry of education and science, combined with competitions / calls

As far as **research institutes** are concerned, all countries provide core institutional funding through a negotiated procedure, which is non-competitive but often linked (softly) to performance targets. Core funding is also sometimes delivered through programme funding by relevant Ministries (e.g. the Netherlands, Canada). Moreover, most countries allow institutes to compete for funding within selected national competitions.

For **firms**, in all 7 countries, public research funds are awarded through competitive measures, whether that is programmatic calls for proposals or project-specific ITTs. New-Zealand and Canada also provide venture capital.

Figure 15 Overview of public research funding mechanisms



Technopolis

There appear to be three primary types of performance-based funding in use in the countries studied (Figure 16).

- UK and NZ: PBF represents the main stream of public funding for research to universities (mixed model: indicators + peer review)
- Finland and the Netherlands: PBF is used as part of the formula-based core funding to universities (indicator model)
- Sweden and Denmark: PBF is money redistributed after the allocation of basic funding to universities (indicator model) and is based on a fixed part of basic funding

Figure 16 Overview of public research funding for universities by type of allocation

	Percentage of performance-based funding in total core funding	Type of PBRF	Rule
United Kingdom	All core funding is performance-based PBF represents about 40% of total research funding to universities	For research only Mixed model (peer review and indicators)	The HRCs allocate funds to universities based on a standard formula based on university (past) performance as judged by the Research Assessment Exercise (RAE). The RAE is a large-scale, periodic (every 5 to 7 years) review of the UK's research outputs, involving all UK faculties and departments in a process of self-assessment and peer review.
The Nether-lands	Embedded in the formula-based lump-sum allocated to each research university, no exact percentage	For research and teaching Indicator model	PBRF is part of the funding formula allocated to each university and based on a set of indicators related to volume (student numbers, diplomas), prices (rates per student) and historical considerations. The formula takes into account the relative performance of each university (as compared to the other universities). The teaching component is 42% of the lump sum (excluding the Academic Hospital allocation), and the research component makes up the remaining 58%.
New Zealand	84 % of total university R&D government funding	For research only Mixed model (peer review and indicators)	Under the PBRF, funding is allocated to institutions on the basis of research performance, using a set of indicators complemented by peer review quality assessment. The PBR has three components: assessment through periodic peer evaluations (60%), completions of research degrees (25%) and external research income (15%). It is now administered every 6 years.
Denmark	2 % of the core funding allocated to universities	For research only Indicator model	On a competitive basis, additional university funding is allocated each year through the 45-20-25-10 model: 45% of research allocation is based on the university's education funding; 20% is distributed in accordance with the universities' external research funding, including any European funding; 25% is distributed in accordance with the universities' research publishing ; 10% distributed in accordance with the number of students having completed their PhD thesis. This research funding model is newly implemented (2010) and succeeds an older 50-40-10 model, which did not take into account output – research publishing. Instead the allocation was based on: 50% – education funding, 40% – external research funding, 10%

	Percentage of performance-based funding in total core funding	Type of PBRF	Rule
			– PhDs. A share of the public funding to universities is measured and subsequently allocated through the Bibliometric Research Indicator.
Finland	75% of total core funding for universities is based on extent, quality and effectiveness of activities	For research and teaching Indicator model	PBRF is part of the funding formula allocated to each university and based on a set of indicators. 45 % of PBR is based on research performance, 55% on teaching performance
Canada	PBF is restricted to some provinces.Usually less than 5% of overall funding to universities		Administers in each one of the concerned Provinces
Sweden	From 2011 on, each university put in the same amount they received from the redistribution the year before minus the guarantee sum plus 10 % of the new basic funding, if any.	For research and teaching Indicator model	Funds are distributed each year according to a set of indicators dealing with external funding and bibliometrics.

Technopolis, based on various sources

5.2.1.2 Core funding

Negotiated core funding for research to institutes and universities is mainly determined through volume indicators and there is a high degree of commonality in this matter. Finland has for instance a well-developed practice in the matter.

The Finnish Performance agreements

Since the 1980s Finnish government has developed models goal-oriented steering instead of control models. As a consequence, the Ministry of education provides institutional funding under a performance agreement between University and the Ministry referred to as a 'Management by objectives' practice. Since 1998, a three-year agreement covers the results that the university is expected to achieve and the level of funding. The three-year agreements are modified annually allowing adjustments. The 2009 University act has enhanced universities' autonomy and opened them to new private financing opportunities.

Performance-based institutional funding is standard practice in all the countries of the sample (except for the Netherlands). Although they differ in their implementation, such assessment exercises have the following characteristics.

- They concern universities and universities laboratories and they cover all disciplines

- Funding is provided at university level, but assessment is most of the time made at discipline level or even at staff level (e.g. New Zealand PBRF wherein research staff is encourage to submit Nominated Research outputs under the form of four best pieces of research)
- They are comprehensive exercises, run yearly (e.g. Denmark; Sweden; Finland) or periodically on a 5 – 7 years basis (New Zealand Performance-Based Research Funding, PBRF; UK Research Assessment Exercise, RAE)
- Universities are directly involved in the assessment process, often through the submission of data used as inputs for assessment (e.g. UK RAE, Finland, Denmark)
- Research quality is the dominant criterion (unlike negotiated core funding whose main criterion is research volume)

In all countries, the evaluation process for performance-based funding focuses on one or a combination of the following criteria.

- Quantification of achievements (e.g. esteem and prizes won, or appointments secured)
- Peer review of monographs, journal articles, non-text artefacts etc (e.g. top four articles for each submitted researcher)
- Bibliometric analyses, taking national and international publication and citation data from Thomson Reuters or Elsevier SCOPUS
- Research quality assessed via peer review

In 2 of the 6 countries where performance-based funding operates, the process is built around a combination of data collection and peer reviews (UK RAE and New Zealand PBRF) and is run periodically every five to seven years. In the Canadian process, criteria differ among provinces. The UK RAE launched in 1986 is one of the oldest and most successful examples when it comes to performance-based allocation of public research funding.

The British 2008 RAE:

The institutional funding of HEIs by the four UK Research Councils is determined by the National Research Assessment Exercise (RAE), which is a UK-wide exercise run periodically every 5 to 7 years since 1986. The last RAE was carried out in 2008. It was based on a self-assessment by universities' units of assessment (or disciplines), which submitted information about their research activity in the form of a separate submission to each of 67 units of assessment, followed by a scientific peer review by a panels of experts. 67 sub-panels of experts, one for each UOA, worked under the guidance of 15 main panels. Members of panels were nominated from experts 'college' in each one of the Research Councils by subject associations and other stakeholder organisations, including users of research. Each one of the Research Councils then appointed over 1,000 panel members. Panel members were chosen for their standing in the academic and wider research community, their extensive research experience, and their understanding of the needs of research users and commissioners of research from both the public and commercial sectors. We cannot but notice that a number of Research councils pay a fee or an annual honorarium to college members, plus out-of-the-pocket expenses.

Source: Website of the RAE 2008 : http://www.rae.ac.uk

Unlike the UK, Nordic countries implements less complex processes, focusing on objective data related to the quantification of achievements or to research outputs (bibliometrics). Some of the methods used depend upon the existence of countrywide

database system for the collection of information on each universities. For instance, while data are collected from local research database – which questions their comparability, In Finland performance-based funding is based on an higher education database accessible online to the public. Interesting is however to notice that in two of the three Nordic countries (Sweden and Denmark) performance-based funding have been implemented very recently over the two last years.

The Danish Bibliometric Research Indicator

Performance-based funding allocated to Danish universities from 2010 onwards is based only on a Bibliometric research indicator and the assessment process is carried out yearly. The new allocation model is being implemented gradually between 2010 and 2012. Data for the allocation of funds according to the bibliometric indicator are collected by the Danish Agency for Science, Technology and Innovation from local research databases. No countrywide database system exist so far. At Aalborg University for instance all research activities are registered in the Research Database of Aalborg University (VBN). VBN is the university's research portal, and serves the purpose of rendering research activities and research publications visible. Thus, a research publication can only generate points - and eventually funding - if it is registered in VBN.

The Finland KOTA HE Database:

In Finland, performance-based funding is awarded on a number of indicators and based on central data contained in the KOTA HE database. Like in the United Kingdom, the data are made of reports submitted by universities each year. However, unlike the UK, no qualitative evaluation review has been implemented to complement information provided by the objective data, although some discussions have taken place on the issue.

In principle, performance-based research funding systems have important benefits

- The institutions have stronger incentives to facilitate research for their researchers
- Research is now perceived as a common and institutional responsibility not only as an individual task
- New publications receive attention not only from external peers but also internally from the institution
- Research management improves with the aid of bibliometric information about the research activities[16]

Performance-based research funding systems tend to attract academic opposition. No one likes to be measured, especially if the measurement has consequences. There are nonetheless a number of serious objections to the type of systems that have been put in place in recent years. Figure 17 lists the main advantages and drawbacks of such systems.

[16] Gunnar Sivertsen, "A performance indicator based on complete data for the scientific output at research institutions," *ISSI Newsletter*, 6 (1), March 2010

Figure 17 Advantages and drawbacks of performance-based university research funding

Advantages	Drawbacks
Performance-based – 'meritocratic' in that it links resources to performance, rewarding good research	High cost and labour intensity (whether peer review or indicator-based) for universities and evaluating agencies
Strong incentive to improve individual as well as institutional performance	May cause 'homogenization' of research and universities – i.e., decrease in diversity and experimentation
Competition may lead to increased efficiency – ineffective research identified and cut	May discourage more innovative and risky research
Encourages research to be properly completed and written up for wider dissemination	Encourages 'publication inflation' (e.g., 'salami publishing') and other 'game playing' (e.g., with indicators) – i.e., 'looking good' rather than necessarily doing better
Provides public accountability for government funds invested in research	May encourage traditional 'academic' research at expense of research linked to society's needs
Encourages more explicit/coherent research strategy on part of department or institution	Tends to separate research from teaching, implying lower priority for teaching
Provides mechanism for linking university research to government policy (e.g., to shift priorities)	Rewards past performance not current or future potential
Concentration of resources may enable best departments to compete with world leaders (e.g., in US)	Reinforces research elite/status quo – may cause overconcentration
	May lead to excessive government influence/'interference' in university

Source: Aldo Geuna and Ben Martin, "University research evaluation and funding: An international comparison," *Minerva*, 41, 2003, pp27-304

The novelty of such systems, however, means that there is so far a limited amount of **evidence** about their effects. The UK RAE has clearly increased the quality of UK university research. It has also encouraged the UK universities to take a rigorous approach to developing and implementing their own research strategies. It has also enabled the government to maximise the research return for limited funding[17]. The reason for the RAE's success in these respects is that there was a gap of several years between successive exercises, allowing time for the system to adjust to the expectations of the RAE and for individual researchers to change their behaviour[18].

Performance-based funding can have surprisingly **large effects on collective behaviour**. This is not only a response to potential funding changes but also reflects the role of rankings and grades from performance systems as indicators of esteem. Australia introduced a simple and mechanical system based on publication numbers in 1995. Study of aggregate publication data, complemented by case studies at two universities, indicates that this resulted in an increased number of publications – indeed, Australia's contribution to the Science Citation Index increase by 25% through the 1990s. However, researchers systematically shifted their output towards lower impact factor journals, in order to achieve greater publication numbers, leading to a decline in Australia's relative citation impact in the same period[19].

[17] T Clark, *OECD Thematic Review of Tertiary Education, Country Report United Kingdom*, Paris: OECD, 2006

[18] J Taylor and R Taylor, "Performance indicators in academia: An X-efficiency approach," Australian Journal of Public Administration, 62(2), 71-82; cited from Nicoline Frølich, *The Politics of Steering by Numbers: Debating Performance-Based Funding in Europe*, Report 3/2008, Oslo: NIFUSTEP: 2008

[19] Linda Butler, "Explaining Australia's increased share of ISI publications – the effects of a funding formula based on publication counts," *Research Policy*, 32 (2003), 143-155

Norwegian university researchers have significantly increased the volume and quality of their output since an indicator-based system was introduced, despite the fact that it only affects 2% of total university funding[20]. (Note, also, that publication is only one of four indicators that drive institutional research funding, the others being: PhD production; EU research funding; research funding from the Research Council of Norway.)

5.2.1.3 Competitive funding

All countries provide **project-based funding** to universities, research institutes and business enterprises through research competitions addressing most if not all disciplines, with the aim of maintaining strong disciplines

- Targeted or strategic competitions where relevance (to the target) is given equal weight alongside quality and originality
- Response mode often open calls, where quality and originality are the primary criteria

Countries are extending compliance tests around for example verification of approval by appropriate research ethics / governance committees or the existence of policies relating to environment to diversity.

All countries operate **targeted research programmes** some of which are open to institutes or companies and which have strategic objectives (e.g. industrial competitiveness or grand challenges)

- In these cases, the competitions are almost always closely targeted on issues of strategic importance to the country in question (environment, health, etc)
- Peer review panels often involve research users *as well as* researchers (UK)

The application process is more likely to operate with multiple stages, perhaps beginning with expressions of interest, moving on to short proposals score by administrators and invited full proposals being scored and peer reviewed.

Figure 18 shows recent success rates for major research funders in the countries studied. It shows two important things. First, that there is considerable variation in success rates among countries and funding organisations. A consequence of this is that is hard to identify from the data set **as a whole** whether there is a systematic difference in success rates between 'bottom up' and thematically programmed schemes. It does not help that some organisations publish only aggregate statistics (and others none at all).

However, if we dig deeper into the figures it becomes clear that – within individual organisations and countries – there is such a difference. EPSRC, for example, publishes disaggregated statistics that show that in most but not all fields, success rates in 'targeted' programmes are higher than those in responsive mode. NWO has a significantly higher success rate in its thematic programmes than in responsive mode. The Swedish Science Council's success rate in its regular (bottom-up) programmes is 19%, but in the recent competition for large 'strategic' grants addressing themes identified by the government as priorities, the success rate was as high as 38%.

The contrast is even stronger between bottom up funding and at least the Nordic innovation agencies, where practice has in part been to discuss potential projects with applicants and either to help them improve or encourage them not to submit weak proposals, resulting in a high success rate.

[20] Sivertsen, *Op Cit*

Figure 18 Proposal Success Rates of Research Funders

Country	Organisation	Programme Type	Success Rate	Funding Rate
Canada	NSERC, 2009	Discovery	64%	38%
	SSHRC, 2008	Standard	33%	
	CIHR, 2010	Overall	23%	
Finland	TEKES	General/Programmes	70%	
	Academy of Finland, 2010	Overall	10-15%	
Netherlands	NWO, 2008/9	Bottom up programmes Thematic programmes	25% 42-44%	
New Zealand	Marsden, 2008	Overall	10%	
Sweden	VR, 2010	Overall	19%	
	VINNOVA		?	
UK	EPSRC, 2010	All	30%	32%
	NERC, 2010	Standard Grants	16%	
	BBSRC, 2009/10	Overall	22%	23%
	MRC, 2009/10	Research Grants	17%	
	AHRC, 2008/9	Standard Grants All responsive All strategic	12% 18% 19%	13% 14% 12%
	ESRC, 2010	Standard Small Grants	14% 19%	14% 19%
China	NSFC, 2010	General	18-20%	
EU	ERC	Starting Grants	15%	
USA	NSF	Overall	23%	

Source: Web sites of organisations identified in the Table

The Academy of Finland grants applications processing is carried out either through one-stage or two-stage calls:

1. One-stage calls are standard practice for projects-based and individual grants provided by the academy of Finland. The process is as follows:

- Application submission (online)
- processing of applications and evaluations arrangements
- scientific evaluations of applications by peer review of external experts
- decision preparation in Research Councils
- Funding decision by Research councils

2. A two-stage call is used in most research programmes and Centre of Excellence programmes. Basically, the application process is the same than the one-stage call but in the first round of a two-stage call, applicants draft **letters of intent**, including plans of intent, which are shorter than a normal research plan. On the basis of the letters of intent, the projects/applicants who are requested to submit **full applications** in the second application round are selected.

Source: Academy of Finland website (http://www.aka.fi)

Overall, the allocation of competitive funding is based in all countries on **scientific peer reviews** involving researchers of the targeted field of research ('peers'). The Academy of Finland sometimes based its funding on assessment made by one or two individuals. However, most of the time expert panels comprise four to ten external experts. Peer-review process involve in many cases national but also international esteemed experts of a specific field of research.

As far as competitive funding is concerned, there is a high degree of commonality between the countries of the sample. However goods practices are reported on specific following issues:

- **Good practices in the involvement of applicants**: in the Netherlands for instance, applicants could answer to the first reports on their proposal drafted by the panel before a final assessment. This increase the cost and time of the procedure, but improve the panel's comprehension and the quality of the assessment.
- **Good practices in the recruitment of experts**: The question of the cost of peer-review is tightly linked to the question of academics and other experts' incentives in participating to reviews. Not only is peer-reviewing often based on volunteering, but also the activity is time-consuming for researchers and could overlap their regular tasks. This issue is discussed in the British Research councils, were various systems have been put in place, as follows:

– Experts are appointed by Councils among each Council's peer-review 'college'

– In some research councils experts are paid;

– The EPSCR leads a Reviewers' Incentive Scheme for academics, whereby points are allocated based on the number and timelines of reviews that can be converted into research funds;

– The EPSRC also limits the number of reviews (up to 12 a year)

- **Simplification and rationalisation of procedures**: The UK is currently implementing mechanisms across Research Councils in order to harmonise and streamline existing procedures and processes. It is aiming to reduce the costs of peer review by £30M over several years. The abundance of R&D councils, funding mechanisms, assessment processes and criteria is indeed seen as an important limit to the readability of funding for research performers and can generate high costs. Among others, simplification process involves:
  - The greater use of online tools for reviewers;
  - The rationalisation of procedures among national research councils.

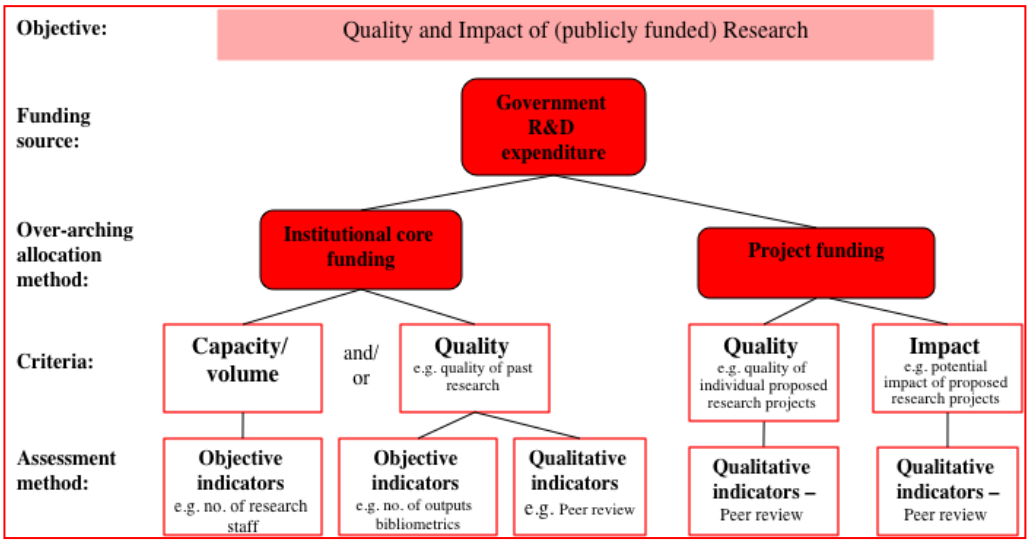
5.2.2 Criteria forming the basis for allocation of public funding of research

5.2.2.1 Overall

Criteria for the basis allocation of public research funding implemented in the seven countries of the sample cover one or a combination of the following indicators (Figure 19):

- Objective indicators related to the capacity and the volume of research (e.g. number of research staff, external funding for research, etc);
- Qualitative and objective indicators related to the quality of research (e.g. bibliometrics, outputs, etc);
- Qualitative indicators related to the impact of research carried out.

Figure 19 Type of indicators used in the allocation of public funding for research



Technopolis

5.2.2.2 Core funding

Negotiated core funding for research in universities is mainly determined through volume indicators related to teaching (e.g. number of master students) and research (e.g. number of doctoral students).

Performance-based funding is a formula that usually includes volume measures as well as performance measures. Usually it provides a non-linear distribution, wherein the best research groups and institutions might be awarded a multiple of the funding awarded to those groups rated just one scale lower. It is based on one or more of the following criteria.

- Research quality (e.g. adjudged excellence, citation rate normalised against average for field internationally)
- Contribution to social and economic benefits (e.g. external research income)
- Efficiency / productivity (e.g. degree completions)

Here one could underline three different approaches, as follows:

3. An 'objective' approach: for instance Denmark has implemented a metrics-based approach based on the Bibliometric research indicator. The Swedish system implemented since 2009 is close to the Danish one, since bibliometrics and external funding determine the basis for the allocation of extra grants to universities
4. A hybrid approach as in NZ where peer review determines 60% of the marks and metrics the rest or in Finland where indicators are put in perspective with a university-specific assessment of whether the targets set in performance agreements have been met;
5. A moderated approach whereby metrics are provided to peer review panels to inform judgements (UK RAE).

Objective approach: criteria to met in order to obtain points according to the Danish bibliometric research indicator in the University of Aalborg:

Denmark has chosen a metrics-based approach in part to minimise the costs of the new procedure. However, the approach is contingent on a national research cataloguing project to permit the national agency to award 'bibliometric' points to universities.

The following type of publications is included in the indicator: Peer reviewed articles; Peer reviewed conference articles; Book/anthology/dissertation/report; Contribution to book/anthology/report; Letter; Report; Contribution to report; Patent; Review; Ph.d. thesis/dissertation; Doctoral thesis/dissertation.

Only research and counselling/commissioned work categories count (i.e. communication and education categories do not generate points, even though the record is linked to a key journal or publisher)

- The publication must have "Published" status in the research data system
- The publication must be publicly available
- The record must be connected to a key journal or publisher
- The record must contain ISBN or ISSN
- There has to be at least one author from the University
- Book contributions must be connected to the main title of the work
- It does not count to be the editor of a record – only the author

Source: Aalborg University, VBN editorial office (http://www.vbnredaktionen.aau.dk)

Hybrid approach: Criteria used in the New-Zealand Performance-based Research Fund (PBRF)

Subject-specific peer-review panels rate the quality of past research carried out in all universities and colleges and allocation of funding depend on the following criteria:

- 60% peer review
- 25% completion rate for doctoral degrees
- 15% external research income

Moderate approach: criteria of the British 2008 RAE and the future REF (Research Excellence Framework):

For the RAE 2008, HEI first submitted data about research activity undertaken from 2001 to 2007, including research active staff and their published research outputs, the research environment in which they operated and indicators of esteem conferred on those staff as individuals or groups. A panel of subject experts for each UOA assessed submissions and awarded a quality profile to each unit. This profiled the proportions of research activity in the submission that was judged by the panel to meet each of five quality levels from unclassified, through to world-leading. The Higher Education Funding Council for England (HEFCE) collected the data in the published submissions on behalf of the four UK funding bodies. The data can be viewed online or downloaded.

The 2008 RAE used the same main principles of peer assessment as previous RAEs. However a few significant changes were introduced:

- The results were published as a graded quality profile rather than a fixed seven-point scale. This was intended to allow the funding bodies to identify pockets of excellence wherever these might be found and reduced the 'cliff edge' effect where fine judgements at the grade boundaries could have significant funding impacts
- Explicit criteria in each subject to enable the proper assessment of applied, practice-based and interdisciplinary research.

The UK Research Assessment Exercise is to be replaced by a Research Excellence Framework (REF) in 2014. The REF is still under development and will be based on quantitative bibliometrics, peer reviews, together with a qualitative assessment of research impacts. The intention of the British government is namely to move to a more metrics based system. While the RAE is strongly correlated to allocations and research income from other sources (Research Councils, charities, private sector etc.), the REF will focus on research excellence.

Source: Website of the RAE 2008 : http://www.rae.ac.uk

The quality of the different processes and new departures or refinements have been piloted and documented in some countries that implement performance-based funding since a while. For instance, the RAE has been assessed successful by a review conducted after the RAE 2001 to consider how to assess research. The review was followed by a widespread consultation on its findings. Some changes were made to the process. However there was very strong endorsement for the 2008 RAE to be based upon expert review by discipline-based panels. As a result, a 2002 report from the House of Commons Science and Technology Select Committee concluded that: *'The RAE has had positive effects: it has stimulated universities into managing their research and has ensured that funds have been targeted at areas of research excellence'.*

5.2.2.3 Competitive funding

As far as **programme funding** is concerned, the evaluation process typically involves proposals being scored and judged by peer review panels, using a longer list of criteria than one might find in academic competitions and highly related to utility and relevance criteria. Relevance, coherence and economy are scored alongside originality and methodological quality that are the main criteria for **project-based funding**.

Good practices are reported on specific following issues:

- **Good practices in the publicity of process and selection criteria**: in the Academy of Finland, proposal evaluation forms and criteria for selection are available online, often in English language.
- **Good practices related to guidance offered to members of the panel in assessing the proposals submitted**: Guides for reviewers in the Academy of Finland and in United Kingdom Research councils.
- **Good practices in terms of new criteria**: panel members involved in the review of the Academy of Finland grants for instance assess proposal towards the ethical question - '*Are ethical issues involved and if so, how are they taken into account?*

5.3 Challenges and further developments of research funding mechanisms and criteria

By way of a conclusion, we would like to emphasise some of the **trends highlighted in the sample of countries**.

- An increasingly proportion of HERD is driven by a performance-based approach and new countries move towards such way of funding research institutions
- Metrics are increasingly used as a way to assess performance - especially in Nordic countries who have recently start new performance-based system from scratch – sometimes in combination with peer review and more qualitative indicators
- Simplification/efficiency projects are under development in some countries
- The participation of peer-reviewers is a major issue and some countries have developed further incentives to researchers to take part in peer review processes (e.g. UK EPSRC)
- New criteria are used in the assessment of performance or in the assessment of projects (e.g. ethical issues in project-based funding; UK is proposing to allocate up to 25% of future institutional funding against adjudged performance on research impact – e.g. breadth and depth of non-academic inputs as demonstrated by case study

For the time being **evaluation of funding mechanisms and criteria are limited to a few countries only** (e.g. United Kingdom, and New Zealand to some extent). Competitions however tend to be evaluated indirectly, as part of broader reviews:

- International disciplinary reviews, wherein international peer review panels will be invited to judge the quality of a country's scientific endeavour against their view of the international state of the art (which can include consideration of the effectiveness of instruments). This is seen in Finland, Sweden and the UK
- Programme evaluations, wherein an external, independent review will typically be required to look at both effectiveness and efficiency. The latter is likely to include a test – with 'users' and against international benchmarks – of the transparency, fairness and efficacy of the operational arrangements

All in all, UK academic papers show improving share of all research output being rated as internationally outstanding. However, OECD citation statistics don't show a strong positive trend. Norway and Finland for instance have registered much stronger improvement in previous 20 years, without research assessment exercises.

Based on international experience of **indicator**-based funding systems, it is easy to agree with van Raan's observation[21] that "Ranking of research institutions by bibliometric methods is an improper tool for research performance evaluation, even at the level of large institutions." He explains that the methods are not good enough and laments policymakers' tendency to try to buy 'cheap and dirty' solutions that are way behind the state of the art and produce misleading results. There is a clear need for indicator-based allocation systems to be 'damped' *through the use of indicators other than research output*.

Key lessons from international experience therefore include

- Move slowly enough to let the system respond to the changed incentives
- Take small steps – moving small amounts of money has big effects on behaviour
- Explicitly tackle field differences
- Do not use solely indicator-based approaches but combine these with other allocation principles

[21] Anthony FJ van Raan, "Fatal attraction: Conceptual and methodological problems in the ranking of universities by bibliometric methods," *Scientometrics*, 62 (1), 2005, 133-143

6. Monitoring the Achievement of Targets

6.1 Policy and governance

The spread of the New Public Management brings with it the use of 'performance contracts' or 'service level agreements'. These are conceptually simple to implement in areas of the public service that provide end-user services, such as public transport or hospitals. They are harder to use in areas like research where the output of the activity is not so important as the societal outcomes and impacts. The contract designer is caught between, on the one hand, using indicators of outputs that in themselves do not matter much but can easily be counted and, on the other hand, using indicators of effects at the societal level that can only partly be influenced by the activities performed under the contract. For example, Finland's BERD has been used as an indicator of Tekes' performance, despite the fact that Tekes' performance can only be one (small) influence among many others over that indicator.

There is no standardised set of institutional indicators in use. Growing use is being made of logic diagram techniques, such as logical framework analysis, to design interventions and the associated indicators. Canada has tended to lead the way in this. Without seeing the relevant logic diagram and the associated analysis it can be hard to understand why particular indicators are chosen, and the diagrams are rarely published. Examples of indicators from the countries studied are shown here. Figure 20 shows the indicators used for the NRC, Canada's major research institute, which focus strongly on outputs and outcomes but not on wider societal effects.

Figure 20 Indicators used for the performance analysis of NRC Canada R&D activities and examples of performance results for 2009/2010

Expected Results	Performance Indicators	Targets	Performance Status	Performance Summary
Excellence and leadership in research that benefits Canadians	Publications in refereed journals / proceedings and technical reports	3,500 publications by March 2010	Exceeded	NRC researchers produced a total of 8174 articles: 1344 in refereed journals, 799 in conference proceedings, and 6031 technical reports.
	Technology licences issued	85 licences in high impact and emerging industry sectors by March 2011	Exceeded	Issued licenses increased by 22% to 135. In addition, NRC introduced 85 unique product and process innovations to industry.

The Danish universities have entered into development contracts (*Udviklingskontrakter*) with the University and Property Agency (or predecessors) since the 1990s. The current agreement spans 2008-2010 and includes indicators/activities in the areas of:

- Research (research production, internationalisation of research, attraction of external non-governmental funds, PhD activity)
- Education (new enrolments, drop-outs, completion time, degree programme relevance to society, entrepreneurship, internationalisation and quality assurance of degree programmes)
- Dissemination of knowledge (collaboration with the business community)
- Research-based public sector services.

Figure 21 gives an example of indicators used for an agency, in this case the Dutch innovation agency. These focus strongly on process.

Figure 21 Performance indicators of EZ for NL Agency

	Core indicators	Explanatory / context variables
Input indicators	Direct/indirect personnel in fte's	Personnel costs per fte; Total fte's; Cost hiring external staff
Output indicators	Tariffs per hour; Number of declarable hours per fte and total; Number of workable and gross/net available hours	Operating result/turnover
Quality indicators	Customer satisfaction; Throughput time primary processes; Accepted notices of objection; Number of complaints; Employee satisfaction	Sickness absence

EZ Budget 2011.

The annual report of the Dutch research council NWO includes performance indicators, which were agreed with the education ministry OCW in a covenant in 2003.[22] This covenant contains the elaboration of the accountability information to OCW that originates in the policy lines and objectives of NWO and the multi-annual strategy of NWO. The results and effects of NWO have been expressed as quantitatively as possible. The covenant aims to improve transparency and includes data on

- Productivity and output (publications, press and media coverage)
- The process of subsidy allocation (applications, awarded applications)
- Specific programmes (thematic and individual-oriented programmes, internationalisation and investments in research infrastructure
- Volume of support and the number of funded research positions divided by subsidy receiver
- Management/administrative cost and data on the NWO office.

OCW is responsible for a careful treatment of the information and can only use it to possible consequences. The information plays a role in the annual deliberations between OCW and NWO and is part of the annual planning and control cycle of NWO but has no automatic link to funding.

As an early adopter of the New Public Management, New Zealand has taken the idea of performance contracts with associated indicators further than most. (There are even performance contracts between the Prime Minister and the other ministers and between the individual ministers and their ministries.) As Figure 22 shows, these indicators focus on process rather than quality or impacts.

Figure 22 Performance Measures for MoRST's budget

Fund	Performance Measures (2009)
Research for Industry	• Number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard in alignment with content guidelines specified in the contract. • At least 50% of contracts reporting co-funding greater than 5% of each contract's

[22] "Convenant Rekenschap met indicatoren op maat", agreed by OCW and NWO on 29 April 2003.

	value. • Research Consortia is used to leverage private sector investment: – At least 50% planned cash co-funding contributed to consortia by the private sector. – At least 50% reported co-funding accumulated over the life of the contract.
Environmental Research	• Number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract. Envirolink: • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract. • 100% of information will be reported as per the Information Sharing Agreement between MoRST and the Foundation.
New Economy Research Fund	• Number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract.
Health Research	• Number and total dollar value of new and active contracts reported in six monthly reports. • 100% of contracts are awarded in line with the process and criteria set out for each output in the contract between the Minister of RST and the Health Research Council (HRC). • Provision of data for RST Scorecard supplied to MoRST by 30 September 2010 and in alignment with content guidelines specified in the Output Agreement.
Technology New Zealand	• At least 15% of participants have not previously had assistance from Technology New Zealand schemes. • The FIA reports quarterly on the number and value of grants made under the grant schemes, identifying their individual purpose and application. • Capability grants. Number and total value disbursed of new and active contracts is reported in all quarterly reports for 2009/10. • Capacity grants. Number and total value disbursed of new and active contracts is reported in all quarterly reports for 2009/10. • The Foundation will ensure that on average the value of targeted grants is not more than 50% of the proposed cost of research and development projects. • 100% of information as required will be reported as per the Information Sharing Agreement between MoRST and the Foundation.
CRI Capability Fund	• Each CRI reports shows adequate reporting of the application of funding • A quarterly exception report to CCMAU from each CRI recipient of a grant identifies changes in the use and application of the grant received
Marsden Fund	• Number and total dollar value of existing contracts reported in six monthly reports. • 100% of contracts will be awarded on the basis of research excellence. • Provision of data for RST Scorecard supplied to MoRST by 30 September 2010 and in alignment with content guidelines specified in the contract between the Minister of RST and the Royal Society of NZ (RSNZ).
Supporting Promising Individuals	• Number and total dollar value of new and active contracts or number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports or six-monthly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract. • Science and Technology Post-Doctoral Fellowships: At least 80 active fellowships. • Health Research Council awards: 50-70 active fellowships and scholarships. • Science, Mathematics and Technology Teacher Fellowships: Number of active contracts as set out in the relevant contract.,

	• Etc (List of scholarships)
International Investment Opportunities Fund	• Number of active and new contracts and total dollar value or number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly or six- monthly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract.
Pre-Seed Accelerator Fund	• Number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract. • At least 75% of contracts produce investor-ready milestones
Social Research	• Number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and align with content guidelines specified in the contract.
Maori Knowledge and Development Research	• Number of active and new contracts and dollars disbursed during the financial year will be reported in quarterly reports. • 100% of contracts meet the criteria set out in the funding agreement and any Ministerial Direction. • Provision of data for the RST Scorecard supplied by 30 September 2010 and in alignment with content guidelines specified in the contract.
Australian Synchrotron	• The agreed contribution is paid in full and on time, as the Crown's contribution to ensure New Zealand access to the Australian Synchrotron.

Source: New Zealand Cabinet. "State Sector Management Bill 193-1" Government Bill – New Zealand Legislation, 2010
http://www.legislation.govt.nz/bill/government/2010/0193/latest/whole.html?search=ts_bill_state+sector_resel&p=1#DLM3166958.

Perhaps more important than the specific indicators used is the connection between performance and budget. In most performance contracts this is unspecified and in practice poor performance tends to have few consequences. Canada has instigated a system of review intended to take resources away from the poorest-performing institutions and programmes. This raises the question of how to deal with institutions or programmes that are doing the right thing but doing it badly. In the past, the USA has tackled the same problem, which arose in connection with the PART Programme Assessment and Rating Tool, introduced to try to make the implementation of the Government Performance and Results Act (GPRA) more effective.

A General Audit Office report[23] on GPRA and PART implementation identified lack of use of the indicators as a de-motivating factor for many agencies. There is no clear relationship between PART scores and funding, since funding is driven by politics and policy objectives. Aggregate PART scores mix up ratings of the **purposes** of initiatives, how well they are **managed** and whether they get **results**. They do not help much in thinking through whether an important programme that is failing to achieve good results should be given less money because it is doing badly or should be given more money so that it can be improved. According to the GAO, mechanistic application of OMB review and PART to everything meant that unimportant priorities were analysed and scarce analytic resources therefore were misused. Programmes

[23] GAO, *Performance Budgeting: Observations on the use of OMB's Program Assessment Rating Tool for the Fiscal Year 2004 Budget*, GAO-04-174

analysed using PART were often disconnected from the higher level strategies set out under the GPRA process. Half of the 234 programmes assessed using PART in 2004 were rated "results not demonstrated", raising the question whether the programmes or the PART process were flawed. GAO concluded, "Many [agency officials] view PART's programme-by-programme focus and the substitution of programme measures as detrimental to their GPRA planning and reporting processes."

The main conclusion to draw from this discussion of the use of indicators and performance contracts as a way to steer research performers and agencies is that these vary greatly in their quality and appear generally to be tied into a bigger process of dialogue-based 'soft' steering. As with university funding, a mechanistic link from indicator values to funding and other decisions is not advisable.

6.2 How are research grants monitored?

Monitoring is the systematic collection and analysis of information as a research grant progresses. It may be conducted through any combination of applications, questionnaires, interviews, and presentations. Aimed at improving the efficiency and effectiveness of the grant, monitoring is often based on targets set and activities planned during the inception phases of the fund. These targets and activities are then further specified in the full proposal submitted by the applicant. It helps to keep the research on track and lets the stakeholders know when things are going different from plan. If done properly, it is an invaluable tool for good management and it provides a useful base for evaluation. It enables one to determine whether the resources you have available are sufficient and are being well used, whether the capacity you have is sufficient and appropriate, and whether you are doing what you planned to do.

Research grants are monitored in somewhat similar ways in each of the seven countries. Details about monitoring are often dependant upon the specific nature of the grant and usually cannot be ascertained without access to the web portal that manages grant conditions. Many researchers are reminded of and advised on the grant monitoring process by an administrative liaison at the research council.

6.2.1 Eligibility

The first step in monitoring a grant is checking for eligibility. Eligibility definitions for research grants depend on the type of funding. Some grants stipulated precise criteria such as educational background of the researcher or status of institute to which a given researcher is connected; while others are very brief and willing to fund any researcher as long as they are part of the country whose research organisation was offering the grant. The former type usually request bibliometric data or other such validity measure in order to rank the researcher/research team. Still others encouraged international linkages and are goal-oriented, thereby limiting applicants to those that propose research in the targeted theme. A final criterion that is commonly assessed for eligibility is the nature of the research, specifically whether it was basic or applied.

Most of the research grants used a process of peer review to rank the proposals and determine the grantees. Often this is a two-part process. First proposals are ranked for eligibility and a process of elimination ensues in which proposals that are unfit for funding are removed. For some countries, at this stage, only an outline is submitted. If the outline progress to the second round, researchers are requested to put together a full proposal or a second, more comprehensive application. A board is then elected to choose the winning proposals and disseminate the funds accordingly. This board may consist of higher-ranking officials in the research council or external peer reviewers.

6.2.2 Peer Review

Peer review is accepted as the most effective means of ranking proposals. Nevertheless, within that process there are variations such as internal or external reviewers, how proposals are ranked, and how IT services affect the process.

Canada's SSHRC has been successful in continuously improving its peer review process.

In 2008, SSHRC commissioned a panel of high-profile internationally respected experts in peer review to assess the quality of the organization's peer review practices. The panel's final report, *Promoting Excellence in Research—An International Blue Ribbon Panel Assessment of Peer Review Practices at the Social Sciences and Humanities Research Council of Canada,* concluded that SSHRC's peer review system is "up to the best practices and highest international standards." Within the same document there was also a series of recommendations to enhance Canada's peer review system. Recommendations included retaining and rewarding excellent external assessors, to standardize electronic tools used in assessment, and to make public successful grants and proposals by placing them up on the website.

Assessment criteria in order to receive funding are largely determined by the ideology of the funding organisation. The common criteria include: feasibility of the research project, collaboration between different national or international organisations, and transferability of research outcomes. Not explicitly stated in many of the criteria was whether the project had to provide research that was useful specifically for the grantee country.

6.2.3 Forms and Letters

Letter Conditions were not given in the general Terms and Conditions for grants. There is variation between the proposals and in most applications the researcher must state their own objectives and outcomes. They even state their own deliverables including those back to the research council taking into account the amount of time research is expected to reach fruition. Often the contracts are performance-based but at the same time are quite flexible in their requirements. Most important in the grant letter is the breakdown of financial expenditure and the people involved. There are also details of public outreach such as funding for public brochures or public interest media. Furthering this outreach, every grant states that all public research is expected to give recognition to the grant that funds the research. Finally, if applicable, commercialisation or knowledge transfer strategies are incorporated. It is important to note that for most grants the Letter Conditions are given through a web portal and not through the web page. Therefore, specific details as to letter conditions were not found. However, general details about what financial expenditure is and is not covered are easily found. This includes, for example, whether research infrastructure is provided by the grantor or by the institution hosting the researcher. Next, the letter states how much of the grant is being allocated to start. Finally, it dictates the next step of the monitoring process by stating what deliverable is due.

Following the letter granting the funding there are a series of status reports most common of which is the annual report. The annual report requests information on a number of key indicators, including, among others, publications, dissemination of research, outreach activities, educational activities, external relations, and organizational development. Besides annual reports the number and organisation of status reports depends on the specific research grant. These can be very short formalities to inform the agency of any changes to proposed research plan or longer processes including an interview, presentation, and a showcase of the research conducted so far. They may just require one to list relevant publications or they may require that relevant research be provided in full including items such as copies of presentations at conferences. The Research Council reserves the right to call for periodic information on progress or to visit the grantee. The grantee is also asked to attend meetings to exchange information and ideas with others undertaking research in the same or similar fields.

The importance of project management varies in the research grants. For some grants the ability to properly manage the project is of the highest concern whereas for others it is barely alluded too-the flexibility of the grant allowing the principle investigator to dictate specifics.

The **Danish Advanced Technology Foundation** provides a handbook on project management, which is meant to compile successful strategies from over 100 completed projects. This guide is suggested to aid the researcher in filling in the application for funding which asks questions about project management. The guidebook provides, amongst other items: advice on the writing of meeting minutes, tasks and responsibilities for different actors taking part in the process of funding research and communication principles.

Incentives and penalties for following the monitoring process were not found. Often they are given in the status report form, which is accessible using a username and password in the web portal. The use of web portals was a common means of data collection. It serves a few purposes. First it ensures that forms are filled out in their entirety in a homogenous manner. Second, it allows the application to be processed by a review board in a fair manner. For example when there is a two stage peer review, the web portal ensures that the application with low rankings (not those that were eliminated) are given the same consideration in the second part of the process as those that are ranked higher.

The last part of the monitoring process consists of either an End of Grant report or a follow-up report. This report can be identical in form to the status reports though they are most comprehensive. It requests a record of the intellectual property that resulted from the grant, research conducted, and the potential for the research outcomes. The potential for the research may then be aligned with the expected outcomes of the research fund. As with the status report, it may be a long report with many sections and surveys collected electronically within a given timeframe. This timeframe may be anywhere between 3 and 18months after the completion of the grant. Longer time frames usually take into account the time for filing intellectual property. Further, the End of Grant Report will state such important items as publications that recognized the grant so that the organisation may justify the grant for future purposes. In addition, this report provides a section to apply for further funding or to propose a project. The penalty for not filing the report means that the last 10 to 20 percent of the research grant funding won't be released. Even if there isn't a financial penalty the grantor will not consider any further research proposals by the investigator if a report from a previous grant is outstanding or where a final report has been submitted but not accepted (for example, if the form is incomplete). Follow-up surveys are more common for research that is expected to reach commercialisation. For example, **TechNZ** a fund from FRST in New Zealand sends surveys every 18 to 36 months after the project has been completed.

The monitoring of publically financed research will have multi purposes and priorities, which are not necessarily directly tied to articulated policy objectives, but are more concerned with, for example, accountability of the use of public funds, or with the quality of research conducted. Monitoring may need to be adjusted to take into account basic and applied research (outcomes). Further, monitoring can be short-term (during or post project funding) or take a more long-term approach (addressing broader areas of scientific research fields in a given country).

The following section takes an overall view of the main findings from the seven country reports.

6.2.4 Examples

Looking across the seven countries, one could draw out a number of observations on the types and methods of monitoring (including evaluation) of public research funding.

Across the selected system, types of governance and the relationship – e.g. the degree of autonomy of HEIs from policymaking – vary across the different systems, but in terms of the reasoning and rationale behind monitoring and evaluations, these tend to correlate with the size of the projects or programmes in question; with the

responsibility of enquiry falling on the supporting agency, that is, the research councils or equivalent. Of course, this is not in itself a surprising statement.

However, some countries do not generally monitor single projects or programmes: the three research councils – VR[24], Formas and FAS, have no monitoring or follow-up of single granted projects and their achievement of results. Those who do – most remaining sample countries – emphasise different objectives.

These range from, and are nuances of:

- Monitoring the use of funds for accountability or value for public money
- Collecting information and data to feedback into the grant application and selection process
- Collecting information and data which may influence the steering of future funding pots

The Canadian research councils' (in particular CIHR and SSHRC) monitoring process emphasise the importance of making (validated) data and results available to appropriate audiences – through publications etc. Along similar lines, Sweden is keen to improve on the utilisation of academic research results, although more leaning towards the commercialisation of academic research through the support of innovation offices in universities with suitable research profiles (e.g. medicine and technology).

The Netherlands' NWO has a monitoring system implemented, but equally emphasises the selection of research proposals – there is a balance between the selection of applications (more likely stressing policy related criteria) and the subsequent monitoring of research after support has been rewarded. Once funded, project leaders are obliged to submit regular progress reports, including measures of outputs etc. The final report will prompt the delivery of the last instalment of the grant (equalling 25 per cent of the funding).

The NL Agency monitoring has different objectives – related to innovation – and mainly uses performance indicators to measure progress, however these vary with the programmes evaluated. For larger programmes, there is usually a whole evaluation and monitoring cycle in place (this is true for the NWO as well).

In the UK, the Research Councils select grant applications using an extensive peer review system, that is, the academic community constitute a self-regulatory system in itself. Externally to this there is a monitoring system in place, which is part of the Public Service Agreements signed between each ministerial department and the HM Treasury, and which also filters down to their delivery agencies. In the case of the science budget, this is operationalised as annual reports from each council to the UK Department for Business, Innovation and Skills, and final reports from grant holders to their funding council.

The UK Research Councils are further obliged to develop an annual reporting structure that provides data to demonstrate their contribution to the Public Service Agreement (PSA) targets. Although these data are delivered within the same regulatory framework, each council has developed its own reporting system. These record data such as: research expenditure and administration costs; framework conditions; public engagement; and knowledge exchange. Data is collected from a range of sources – the councils' management information systems, external data sources, contracted data collection and from grant holders' reports. From a researcher

[24] The prevailing type of evaluation carried out at VR has hitherto been directed towards the academic quality in research areas, often directed at projects financed by VR. Evaluations are normally based on collegial assessments in the form of panels of assessors (peer reviews), and often carried out by foreign experts.

perspective, UK grant monitoring is lighter; all grant holders are required to submit a final report once their research within three months of project completion.

From a higher level perspective, reasoning behind monitoring and evaluation often revolve around issues such as

- Focusing on outcomes (and although not specifically emphasised in the individual country reports, impacts) rather than actual outputs resulting from the research project or programme
- Monitoring, or perhaps more precisely evaluating larger research fields, e.g. a specific analysis of the national research quality in this particular area
- Maintaining a relationship between the policy maker, that is, the ministry / executive agency and the HEIs.

Apart from meeting legal requirements, in New Zealand, the monitoring of all research funding aims to i) centre on results which are likely to benefit New Zealand, ii) focus in research outcomes, iii) demonstrate best practice research management, iv) seek to collaborate with both other government agencies and with science users, v) formulate future strategies by determining the capability needed by existing sectors and industries in order to support and retain them. Monitoring involves all levels of government relevant to research, with departments leading and coordinating evaluation and reporting processes (of research funds, purchase agent activities, and outcomes). Research organisations report to purchase agents, and to relevant ministries. The monitoring of research grants usually takes the form of a technical review.

As previously mentioned, the Swedish research councils may not monitor research on a project level, but they do undertake evaluations of larger scientific areas, sometimes upon request from the government, and sometimes on their own initiative. Examples of these include 'Working life research in Sweden 2008 – the current position' and 'Evaluation of Marine Environmental Research in Sweden 2003-2008'. These are also instances where the three councils cooperate when conducting evaluations.

In some countries, most notably the UK, public block grants to the HEIs are allocated based on past research performances using the extensive RAE system. Denmark and its universities are to an extent moving towards this, although its equivalent of an RAE score will influence, but not fully decide, the allocation of block grants.

In Denmark, the directions and content of evaluations are decided by the overall framework of the Globalisation strategy from 2006, which (in relation to public research) aims to create a basis for qualifying future priority areas, and assessing the results of actual research investments. As the implementation of the Globalisation strategy meant increased funds for research, its framework – drawn up by the Danish Ministry of Science, Technology and Innovation – also requires the establishment of more extensive follow-up and evaluation activities than previously. The main objectives are to document the quality of Danish research, to create a basis for qualifying future prioritisations and to assess the results of Danish research investments. To encourage transparency, the Danish Agency for Science, Technology and Innovation has drawn up guidelines with detailed descriptions of the evaluation process, which includes an overview of when the different stakeholders are involved.

In other countries, monitoring is largely part of the relationship between the research ministry (ministries) and the HEIs. For example, the Canadian Science and Technology Strategy from 2007 articulated clear objectives that aimed at increased accountability vis-à-vis the federal government. In Finland, monitoring is well established, both on agency and on government level, and monitoring has also increased on HEI level post the country's university reform, although some procedures relating to university performance were already routine; since 1999 the University of Helsinki has conducted internal RAE like assessments every six years. All HEIs themselves are assessed too, and are assisted in their evaluations by the Higher Education Evaluation Council (FINHEEC). The evolution in the monitoring ways is a

sign of the growing independence of universities, which has somewhat increased demand for accountability. In addition, there are discussions in Finland of mergers between universities and polytechnics, with the aim of increasing research quality and forging new R&D alliances.

Although already relatively autonomous, next year (2011) Sweden's HEI will see further reforms, in the shape of simplified regulation, increase their independence, although there are not yet any indications how this would affect their monitoring and evaluation systems, either internally, or with government agencies and ministries.

6.2.5 Key messages

As this particular section has tried to demonstrate with a descriptive overview of the seven countries sampled, monitoring takes place for a range of reasons, and can involve several layers of governance, and other stakeholders, including peers from the scientific community, and international experts.

The country reports tend to indicate that the burden of administration is mainly on the research agencies – and the HEIs – rather than on individual researchers or research teams.

Monitoring and evaluations is more closely linked to policy when done at higher level (see specifically New Zealand), and at least two countries – the UK and to a lesser extent Denmark – are examples where research direction and quality is a deciding factor for the allocation of block grants to HEIs. The increased autonomy of the Finnish universities has also seen adjustments made in the approach of HEI monitoring. A similar development seems be occurring in Canada – where accountability of federal funds is gaining in importance.

At a quicker glance, two countries, Denmark and Sweden tend to concentrate on more longer-term policy related strategies – in Denmark the Globalisation strategy pervades a large part of the strategic direction – and Sweden seems to put notable efforts into evaluations of whole and specific research and science fields.

7. Cataloguing Research Outputs

In the absence of Performance Based Research Funding systems, it is not clear to us that a useful function is served by cataloguing research outputs. Some of the Canadian research councils maintain public databases of their grantees' outputs but it is not obvious that these are more useful to future researchers than the existing publications, patents and 'grey' literatures. There is no national system in place.

A key problem for the assessment component of PBRF systems is language, since the bibliometric indexes have a bias towards English. Such systems need also to handle the fact that many scholars, especially outside the 'hard' sciences, use communication channels such as books and monographs that are invisible to journal-based bibliometrics. Both Denmark and Norway have addressed these problems by identifying a list of 'quality' publications, in which publications 'count' for the purpose of the PBRF. In the Danish case, these include

- Scientific monographs, that is, monographs with a scientific aim and that have an ISBN number and are published by scientific publishers that meet the requirement of peer review
- Scientific articles in journals (periodicals or series), that is, articles with a scientific aim, published by a scientific publisher that has procedures for peer review, and have an ISSN number
- Scientific articles in anthologies, that is, articles that form part of a larger scientific work that have an ISBN and are published by a publishing channel that meets the requirement of peer review
- Patents, that is publications on patented inventions, that are issued and registered on recognised patent databases
- PhDs and doctoral dissertations, based on individual university rules for defence of theses[25].

The Finnish education ministry has maintained the KOTA database for this purpose since 1981. In the Netherlands there are two research results databases – NARCIS, run by the KNAW academy of sciences and arts, and METIS, which is runs by some of the universities. Neither is used in connection with institutional funding allocation. Neither New Zealand nor Sweden uses a dedicated database for its PBRF research assessment exercise. They rely instead on the commercial bibliometrics databases. Similarly, the UK has no dedicated database. It uses a combination of ISI data with universities' own efforts to catalogue the research outputs of those staff whom they decide to put into the research assessment system.

The need to catalogue national research outputs seems mainly driven by language and the need to cover the social sciences and humanities in PBRFs that contain a mechanism that counts quality-assured outputs. We argue elsewhere that mechanical allocation of funds based on outputs is a poor method and that peer judgement is needed. In that case, it is also possible to design PBRFs that do not de pend upon maintaining a database, though there are also arguments for combining the database and peer approaches.

[25] Research Barometer 2009, Ministry of Science, Technology and Innovation

8. Comparison of the selected countries experience providing successful goal oriented governance in research policy

8.1 What is a successful goal oriented governance in research policy?

A public policy could be described as a bundle of public actions, which are designed to address one or several specific problems and are set on the political agenda as a clear objective.

Goal-oriented public governance is part of the performance management tradition introduced with the New Public Management in the 1980s. Armstrong and Baron define performance management as 'a process which contributes to the effective management of individuals and teams in order to achieve high levels of organisational performance. As such, it establishes shared understanding about what is to be achieved and an approach to leading and developing people which will ensure that it is achieved'.[26] Goal oriented public governance refers therefore in our sense to

1. A public policy with clear objectives and priorities
2. A public policy whom implementation strategy is oriented towards goal achievements
3. A public policy monitored with assessment systems and regular performance reviews

In this respect, goal oriented governance in research policy could be described as a bundle of policy-making methods, management tools and monitoring/reporting practices to ensure that research public policies are both relevant to social needs and that their implementation is oriented towards the achievement of their dedicated objectives. Crucially, the objectives defined and monitored need to be the socio-economic goals of intervention, not only the outputs.

As far as governance is concerned, policy-making methods is a core principle in the new design of public policy in general and research policy in particular. The public policy literature spoints to the growing use of public dialogue and public debate in new policy-making processes. According to Michel Callon, Pierre Lascoumes and Yannick Barthe, there is a shift from the traditional vertical decision-making process, wherein one legitimate political body commonly took a decision, towards a new decision-making process based on a succession of discussions and decisions involving a wider range of actors. For the authors, this is all the more the case in some specific public policies, including fields in which decision are marked by a high degree of uncertainty, as for research and technology to some extent.[27]

8.2 Experiences in the Sample of Countries

In research and innovation policy, as in many social spheres, there is no such thing as 'best practice'. Successful intervention is crucially dependent upon the context in which it is made. What works in one context may not work in another. The following examples are therefore interesting in so far as they suggest interesting approaches. Making use of them in a Norwegian context requires thinking about them in that context and probably doing some adaptation.

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[26] M Armstrong and A Baron, *Managing performance: performance management in action*. London: Chartered Institute of Personnel and Development, 2004

[27] Michel Callon, Pierre Lascoumes and Yannick Barthe, Agir dans un monde incertain. Essai sur la démocratie technique, Paris : edition du seuil, 2001.

8.2.1 Canada

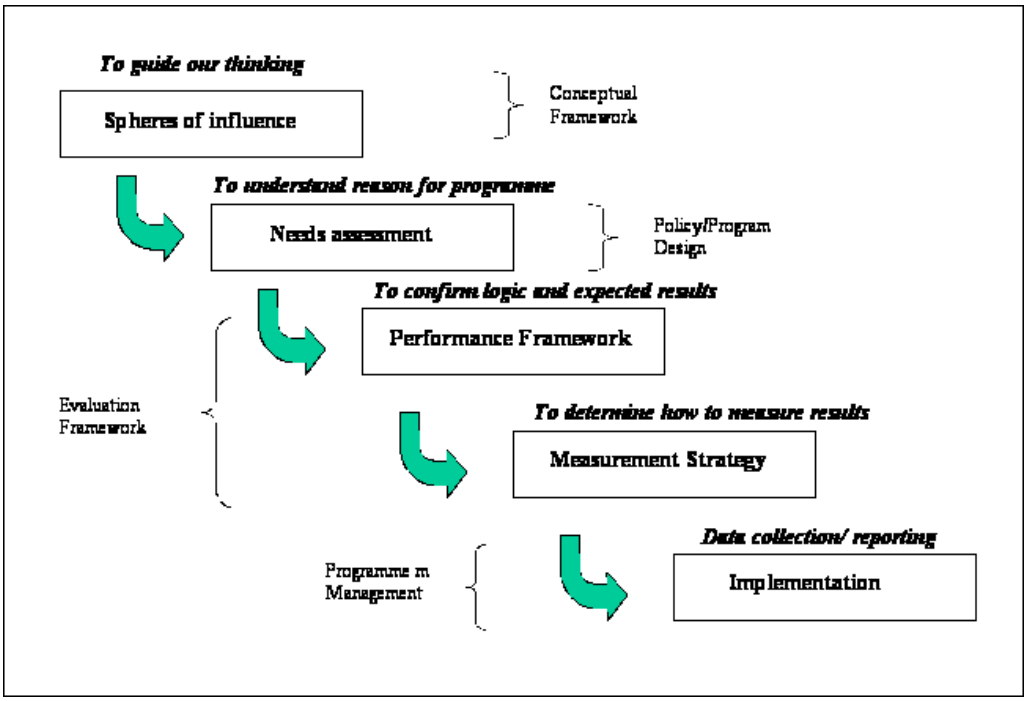
In the light of the strong 'sector principle' that tends to fragment Norwegian research and innovation governance, Canada's science strategy – *Mobilising Science and technology to Canada's Advantage* – launched in 2007, is an important example of interesting practice. Building on the new government's *Advantage Canada* economic plan of 2006, the strategy is produced under the authority of the Prime Minister, Industry Minister, Finance Minister and the Minister of State for Science and Technology. It links science to other policies, notably industry, taxation, education, environment and training policies. Since the strategy was launched, other ministries – notably Health and Environment – have launched their own science strategies that are coordinated and consistent with the overall science strategy.

Before 2007, Canada had several scientific advisory councils but these were rationalised into a single Science, Technology and Innovation Council that year. For key ministers to present a united front appears also to be an important act of de-fragmentation. Science budgets continue to be help at the level of individual ministries, but the common strategic effort has made it possible to achieve a significant increase in the total spend on science.

The strategy is couched in sufficiently concrete terms to set broad thematic priorities (Environment, Natural resources, Health and ICT) as well as making the normal bland commitments to knowledge and excellence. However, it is sufficiently abstract to leave considerable room for initiative, stakeholder consultation and strategising at the level of individual ministries and agencies. Thus the detailing of the strategy is done by those who understand the details, rather than centrally. The strategy is accompanied by a benchmarking report – State of the Nation 2008: Canada's Science, Technology and Innovation System – which is intended periodically to monitor progress at the systems level. Canada has a strong tradition of mapping the logic of individual programmes (normally using Logical Framework Analysis) and devising individual, programme-level performance indicators. Evaluation has been a mandatory part of programming since 1977, and ministries tend to operate with a consistent logic for designing programmes (Figure 23). However, there is **not** a process for 'adding up' the results of programme level evaluation and monitoring to the portfolio level. This is regarded as impractical.

Perhaps the most interesting lesson for Norway is that – given commitment from a handful of key ministers – it is possible to overcome inter-sectoral differences and create a workable strategy, to which others can contribute and commit.

Figure 23 Steps in the Canadian Policy Planning Process



Source: Industry Canada, cited from *An international review of methods to measure relative effectiveness of technology policy instruments*, report to EZ, Technopolis: Amsterdam, 2001

8.2.2 Denmark

Danish governance practice has included the use of 'performance contracts' certainly since the 1990s. These define the interface between a principal and its agent – typically between a ministry and a research performer.

Thus, the GTS institutes obtain core funding through 3-yearly performance contracts with the Ministry. In principle, the core funding pays for the acquisition and development of knowledge and other capabilities needed to provide technological service but some of the performance contracts also specify the delivery of specific services. The contracts are very specific about how the money is to be spent: unlike in some other institute groupings, the core funding cannot be spent at the whim of the director or be used as blanket subsidy for all activities. The Ministry's intention is that core funding should not be used to subsidise service delivery, which should be cost based, and that the institutes should not develop services available in either the private or the university sector.

The ministry's innovation networks are similarly engaged through performance contracts. These have the benefit that it is possible to negotiate about what performance is expected in return for state funding. Denmark does not yet manage its universities in this way, tough other countries (eg Austria) have begin to do so and Finland has a long established practice of using performance contracts to manage the relation between the universities and the education ministry. In the light of the persistent difficulty of clarifying the 'vertical' division of labour between Norwegian principals and their agencies, performance contracts offer an attractive alternative to the extensive practice of 'earmarking' funds.

Two main practical criticisms can, however, be made of performance contracts. The first is that they have to be monitored in the relatively short term. As a result, the performance indicators used tend to focus on fairly immediate outputs, rather than the longer-term outcomes and impacts of intervention, which are the primary reason why the interventions are undertaken. The second criticism is that it is often hard to

decide what the consequences of non-performance should be, since the agents tend effectively to be monopolists. As a result, performance contracts tend to lack 'teeth'.

8.2.3 Finland

While Finland has no formal research assessment exercise at national level, the University of Helsinki implemented research assessment exercises in 1999 and 2005, and the practice has been extended since then to other universities. This is an important move that gives the university the understanding of its own quality and capabilities needed to develop and implement strategy. The University of Helsinki Research Assessment Exercise 2005 combined an external assessment with an internal self-assessment exercise. The evaluators were chosen from suggestions obtained from the Research Council of the University of Helsinki, the four Research Councils of the Academy of Finland, Rectors of the League of European Research Universities[5], as well as from external high-profile scientists.

Data used in the assessment were based only on publications registered in the university's official publication database, JULKI. The results of the external evaluation of the quality of research had an effect on the funds within the University. Following the 2005 RAE, the University of Helsinki spent a total of 15 M€ of its own funds over 2007-2012 to reward the units that were most successful in the evaluation through extra-funding

These practices are of particular interest since they move away from those in other countries where performance based research assessment exercise are implemented at governmental and national level. On the contrary, in Finland, Universities lead research assessment exercises, which are seen as a way to improve their own research strategy and to enhance their research profile on the international scene.

8.2.4 The Netherlands

The Netherlands has introduced a very significant change to the way the major research institute, TNO, is steered. In the past, TNO had itself largely decided how to spend its core funding, in discussion with the OCW ministry.

According to the Dutch government, programming of demand means that, based on consultations with several stakeholders, an inventory is made of the needs of all involved parties at TNO, which are departments, enterprises but also societal organisations. As a result, long-term research programmes are introduced, with a duration ranging from four to ten years. Within these long-term programmes, procedures for interim evaluations and adjustments are included. In this way, it is possible to intervene and adjust the programme whenever necessary. Programming of demand also results in strategic planning for TNO for a period of four years.[28] To some degree, this new arrangement means TNO is more steered towards societal (as opposed to industrial) goals than before.

The funding for TNO is based on twelve themes, each of which is related to economic and social knowledge issues faced by the customers. The themes are also related to the Dutch government's strategic policy and Europe's scientific and technological policies. Each theme has an active network of organisations and companies operating, with one department directing operations, see Table 1.

[28]Ministry of Economic Affairs: *Science, Technology and Innovation in the Netherlands. Policies, facts and figures 2006,* 2006; www.minocw.nl/documenten/ Science-Technology-Innovation-brochure-2006.pdf

Table 1 Source: "United in Innovation", TNO strategy 2007–2010.

Theme		Coordinating ministry
1.	Public safety	Ministry of Interior and Kingdom Relations
2.	Defence	Ministry of Defence
3.	Healthy living	Ministry of Health, Welfare and Sport
4.	Food	Ministry of Agriculture, Nature and Food Quality
5.	Dealing with a changing society	Ministry of Justice
6.	Work participation and ageing	Ministry of Social Affairs and Employment
7.	Attainability	Ministry of Transport, Public Works and Water Management
8.	Construction and spatial development	Ministry of Housing, Spatial Planning and Environment
9.	Living with water	Ministry of Transport, Public Works and Water Management
10.	Energy (management)	Ministry of Economic Affairs
11.	Natural and built environment	Ministry of Housing, Spatial Planning and Environment
12.	High-tech systems, processes and materials	Ministry of Economic Affairs

After input from TNO, the Dutch government defines themes for the organisation. A theme consists of one or more programmes, where each programme is the unit of financing and has a programme agreement. Next to that, there is a knowledge development programme crossing the theme boundaries. In 2007, almost all funding by the Dutch ministries was tied to specific themes. Only 26 out of €196.4 million in public funding was for knowledge development crossing theme boundaries.

Another part of the planning framework is regular audits. In 2007, four business units within two core areas were audited, as well as the technology position of another core area. In general, the audits resulted in "good" to "very good" scores. The general recommendation of the audits was that TNO should benchmark itself more internationally against comparable institutes.

8.2.5 New Zealand

New Zealand was one of the first countries to champion the New Public Management. In the early stages, over-enthusiasm for 'contestability' in research funding caused some damage in the Crown Research Institute sector and led governments to take a 'softer' approach – mixing target-setting and results measurement with investment in building and maintaining capacity. Establishing the CRI Capabilities Fund amounted to a reversal of the previous policy of only relying on outputs and competition, which we read as a symptom of taking a more measured approach to the New Public Management. Similarly, the 2011 reorganisation that brings the main research funding agency into the science ministry is a pragmatic response to the need to reduce fragmentation that ignores one of the key principles of the New Public Management – use of agency.

As the Appendix shows in more detail, government sets RS&T objectives at a high level, covering both functional and broad thematic goals. Their implementation is allocated across a range of programmatic interventions, which are designed at the lower level by the operating agencies. This brings the intelligence available at the lower levels to bear on the design process but also helps ensure the individual interventions can be 'added up' to meet the overall goals.

The PBRF methodology used involves a careful mixture of a minority of quantitative output indicators and a majority of peer review – avoiding the extremes of mechanistic funds allocation on the one side and entirely judgment-based allocation on the other. The PBRF implementation shows a careful use of evaluation and monitoring that aims

to understand whether the incentives created by the PBRF are having the desired effect and whether the intervention needs 'tuning'. Thus, the PBRF was evaluated after the first round and modified as a result. Quality Evaluations have subsequently mapped improvements in quality and a Ministry of Education sponsored evaluation of research quality using bibliometric methods has linked the quality improvements to the PBRF. Key lessons from New Zealand are therefore the use of distributed policymaking, taking advantage of the intelligence built into the innovation system, a pragmatic, increasingly non-ideological approach to the implementation of the New Public Management and use of feedback to understand and improve implementation.

8.2.6 Sweden

Swedish funding for research involves a high – and, in recent years increasing – proportion of the money being allocated through research councils with little or no thematic prioritisation, especially in areas of rather fundamental research. This involves a risk that (through the operation of the Matthew principle) the pattern of thematic specialisation within the research community is slow to change or even becomes locked in. A long-established principle in the division of funding labour in Sweden is that the innovation agency (originally STU, more recently NUTEK Teknik and since 2001 VINNOVA) plays the role of **change agent**, encouraging the development of new themes and both signalling and funding areas where increased effort is needed. Thus, for example, the innovation agencies were instrumental in identifying and building up research capacity in research and education relevant to telecommunications, thereby effectively underpinning the growth and development of Ericsson from being a minor player in the 1980s to being a world leading supplier of mobile telecommunications equipment today[29].

A flaw in this arrangement is that, while the innovation agency can encourage capacity building in areas of economic opportunity, it is more difficult to build capacity in areas of wider societal need – some of which are being discussed internationally as 'grand challenges' today. Nor does it fully address the need, in the light of the development of the European Research Area where research units will need to be much larger in order to be competitive, for Sweden to focus its large-scale research efforts on a manageable number of areas. In the absence of en effective national-level coordination council, the government itself therefore set twenty priority areas in the 2008 Research Act and allocated SEK 1.8 billion to fund additional research in these areas. Ten of the areas are funded through the Swedish Science Council and ten through other agencies. The government chose the areas based on societal need, the presence of world-class research in Sweden and of R&D-Swedish companies able to benefit. We would argue that there are probably too many 'strategic' areas. Nonetheless, the nationally coordinated approach is likely to produce a more coherent pattern of investment than a decentralised one and makes it possible to tackle priorities and aspects of fundamental research that are important but do not necessarily have a close relationship to the economy.

8.2.7 UK

The RAE has developed over many years from its first use in 1986, with refinements being made after each RAE deployment. From the outset it was designed a tool to, not only to assess and identify high quality research, but to allocate research funding on a more selective basis based on that quality assessment - in fact its initial title was the *Research Selectivity Exercise*.

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[29] Erik Arnold, Barbara Good and Henrik Segerpalm, *Effects of Research on Swedish Mobile Telephone Developments: The GSM Story*, VA 2008:04, Stockholm, VINNOVA, 2008

Although the first application of the RAE made limited changes to the distribution of research funding across UK universities, later deployments have resulted in an increasing concentration of block grants in research departments rated as high quality by the RAE process and therefore, by extension, a concentration of funds in universities with large numbers of highly rated departments. Over time, RAE results have been used to justify the progressive withdrawal of funds from lower-rated departments. In 1989 only 33% of the HFC research funding was allocated by RES (as it was called at the time) scores. By 1992 this had risen to 90%. From 1996 onwards the differentials in the proportion of HFC funding allocated to high and low scoring departments has increased, with the lowest scores receiving no funding via this mechanism, so much so that low rated departments are often not submitted to RAE at all. The most recent RAE in 2008 devised a new scoring method that created a profile of departmental research quality across the quality categories rather than a single score. This led to a slightly flatter distribution of funds as it enabled 'pockets' of excellence within departments to be indentified and funded.

In terms of a tool to concentrate funding on high quality research, the RAE has been reasonably successful, within the limits of its ability to objectively measure quality. However the process has been progressively refined and has resulted in a system that many stakeholders are comfortable with.

The RAE was not explicitly designed to directly improve research quality, but over time, the proportion of staff in 5-rated departments has increased from 23% in 1992 to 31% (in 5 and 5* departments) in 1996 and to 55% in 2001.[30] One interpretation of these figures is that the very process of research quality assessment, i.e. the RAE, has been a major driver of a significant improvement research quality. However, this increase in high scoring departments is also seen to be an effect of universities learning to play the RAE 'game' more effectively (e.g. who and what to submit, and how best to present their submissions).[31]

There is also concern among universities, mainly the traditional research-intensive universities, that the RAE and its successor the Research Excellence Framework (REF) are not simply tools to assess research quality, but is also a policy implementation tool. The government would be unlikely to disagree; the REF for example will, in line with government requirements for research to stimulate economic growth and improve quality of life, include measures to assess the impact of research (in the widest sense). This leads to the criticism that the RAE increases the influence of government, via the HFCs, on the universities.

[30] The UK Research Assessment Exercise: A Case of Regulatory Capture? Ben R Martin and Richard Whitley (to be published)

[31] Ibid.

8.3 A Concluding Unscientific Postscript

This report responds to a list of partially unconnected questions from the Fagerberg Committee, which do not all lend themselves to generating conclusions outside the context of the committee's deliberations. So in this postscript, we do not comment on everything. Equally, it is not really possible to make a systematic link between many of the issues discussed here and performance. It is, however, possible on the basis of the material collected here and a wider experience of governance and organisation of the research and innovation system to suggest some principles that may be helpful. All the countries studied have research and innovation systems that function at least moderately well.

The purpose of the research system is to generate new knowledge, building absorptive capacity to ensure that it can identify and make use of new knowledge generated by others and constructing human capital in order to meet social, cultural and economic needs.

We can think of research policymaking at the overall level as having three dimensions

- Development of a robust and dynamic research system comprising institutions able to produce knowledge and human capital of high quality and capability
- Identifying and breaking bottlenecks to the functioning of that system
- Enabling change, seizing new opportunities as these appear

This requires a combination of 'strategic intelligence' about the research system itself and prospective analysis that explores future possibilities. No one believes any longer that one person or one committee can somehow capture and analyse all the knowledge needed to do this, let alone shape the actions of the large number of organisations and stakeholders whose activities and performance make up the research system without the active involvement of those institutions and stakeholders in intelligence gathering and in execution. A central issue in governance is therefore how to find devices that help the various parts of the system act in concert.

The complexity and autonomy of the various parts of the research and innovation system invite the use of goals as mechanisms for creating coherence while using the intelligence and strategy deployment capacities at different levels of the system to fill in the details and to create feed-back about changes needed to the strategy. A further function of the national 'arena' therefore needs to be the capacity for receiving feedback, normally through evaluation.

A general observation is that while there is convergence in some areas (such as the kind of criteria used in funding decisions) there is a wide diversity of practice in many of the areas explored here, so it is unlikely that there are simple behaviour-performance linkages in these cases. Rather, there are alternative ways of doing things.

Most of the countries studied here have opted to decentralise responsibility for research policy to a range of sector ministries. We believe this is better than the alternative of having a science ministry because centralising responsibility for research and innovation distances decision-making from society and reduces the amount and quality of strategic intelligence available for making policy. It is unreasonable to expect all the knowledge and analysis needed for research and innovation policymaking to be collected at one place in the system.

Decentralisation, however, implies a need for coordination. Our discussion of research and innovation councils suggests that these can be good ways in which to coordinate. Such a council can provide an arena in which to discuss and analyse present and future policies. It has to consist of high-status people who themselves are seen as legitimate participants in a discussion about research and innovation policy – otherwise nobody will take the advice of the council seriously. Equally, the council and its members must be seen as non-partisan – as not having a personal or

institutional interest in the advice the council provides. This can be more easily achieved if the role of the council is advice and coordination rather than to decide about budgets. Transparency is important because it enables interested parties to make inputs and builds the trust needed to encourage others to accept the advice of the council.

Getting the details of policy right and mastering its implementation requires cooperation across a number of levels. Consciously making use, and promoting the development, of distributed strategic intelligence in the research and innovation system is likely to lead to better policy and better implementation than in centralised systems. It follows that in general the advice of the policy council should be rather high-level, leaving the details to others. That has the additional advantage of building consensus and commitment through the process of detailed design and implementation.

Few countries have an explicit strategy for research or research and innovation. A rare exception is Chile, whose National Council for Innovation for Competitiveness (CNIC) – which comprises key government ministers and stakeholders from the main institutions of the research and innovation system – has developed such an explicit strategy[32] and continues to monitor its progress and to evolve the strategy year by year. The strategy is quite detailed, covering human capital, knowledge development and innovation policy measures yet it serves only as the top layer that suggests a series of objectives and actions for others to implement. In many countries, such a strategy is at best implicit and at worst – because no one writes it down – full of unseen contradictions. A national 'arena' like the CNIC can provide a useful way to increase the coherence of strategy by playing a role in setting directions or goals.

A broad national research and innovation strategy is a useful instrument for coordination. It communicates the directions of change needed, allows stakeholders to locate their own activities in the larger scheme of things and provides a framework against which to monitor and evaluate progress.

This year's decision in New Zealand to merge the FRST into its parent ministry reflects a wider unhappiness about overly doctrinaire implementation of the new public management. A zeal for using performance indicators in many systems has led to a focus on process and short-term output indicators, as opposed to indicators that actually inform about the effects of policies and programmes. In our view, there is scope to improve the relevance of indicators in many innovation systems. Equally, the New Zealand experience with its Crown research Institutes illustrates that there are limits to 'contestability'. The need to establish and maintain institutions for research and innovation means that the relationship with at least some funders in the system must involve negotiation and not only competition.

The need to build capacity also implies that institutional evaluation systems must have prospective as well as retrospective components otherwise the shape of the research system becomes wholly path dependent. Correspondingly, there is a need for at least one funder in the system to function as a change agent – deliberately guiding funding towards points of actual and needed change. The opportunities for change agency are primarily in competitive project-based funding (or in large-scale versions of this, such as centres of excellence funding).

Many countries are introducing PBRFs alongside their existing competitive, project-based funding systems. The reasons for doing so are not always clearly specified. Logically, the PBRF should be trying to achieve something that competitive funding does not. In the UK, the RAE is clearly about focusing research in a smaller number of high-performance universities. In some other countries, the objectives appear more

[32] Consejo Nacional de Innovación (2008), *Hacia una Estrategía Nacional de Innovación para la Competitividad*, Santiago de Chile

broadly to be to strengthen incentives for quality, while reallocating relatively few resources.

The balance between institutional block funding for research and external research council funding varies considerably among the countries studied. Equally, the proportion of innovation agency funding for university and institute research varies among countries. Thus, while New Zealand's ratio of research council funding to block grants is low compared with other countries much of the gap is closed by funds with more industrial purposes. Similarly there is more diversity in the extent to which research council funding is 'free' or 'top down' than we would expect if there were such a thing as a 'right' balance. The discussion in some policy circles about the balance between innovation agency and research council funding of academic and institute research seems also not to have 'right answer' in international practice. We can only conclude that the 'right answer' is to be found in the co-evolution of the funding, research and innovation systems and that the important policy question is not 'Do we have the right balance?" but "Does the balance that we have actually work?' This underscores the importance of distributed intelligence for strategy and implementation.

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