March 2015

R&D Evaluation Methodology and Funding Principles

Background report 6: R&D governance and institutional funding in international practice

evropský sociální fond v ČR

EVROPSKÁ UNIE

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

OP Vzdělávání pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

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Background report 6: R&D governance and institutional funding in international practice

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Oliver Cassagneau-Francis, Kristine Farla, Malin Jondell Assbring, Peter Kolarz, Bea Mahieu, Göran Melin, Anke Nooijen, Martijn Poel, Caspar Roelofs, Tammy-Ann Sharp, Brigitte Tiefenthaler, Frank Zuijdam - Technopolis Group

Kyrre Lekve - NIFU

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1. Introduction

This report constitutes a background report to the Final report 2 – *The Institutional Funding Principles*. It collects the outcomes of the analyses related to the R&D governance and funding systems in international practice. It sets the context for the study team's reflections on the strength and weaknesses of the current institutional funding system in the Czech republic and especially for the proposed revision of the funding principles.

We focused on the five 'comparator' countries that were identified for this study, i.e. Austria, the Netherlands, Norway, Sweden and the UK.

Norway, Sweden and the UK are three countries where performance-based research funding systems (PRFS) are implemented for the distribution of institutional funding for research. The analysis of the systems in these countries gives a view in particular on the different criteria and approaches to the PRFS.

In Austria and the Netherlands, instead, the allocation of institutional funding is determined through block grants and formulas, and performance agreements play a major role.

We complemented the analyses of the 5 'comparator' countries with an analysis of the funding system in Belgium and Finland. The latter is the country that is most cited in international practice for its long-term use of performance contracts; the former is interesting for its use of a specific fund for basic research, allocated on the basis of a PRFS.

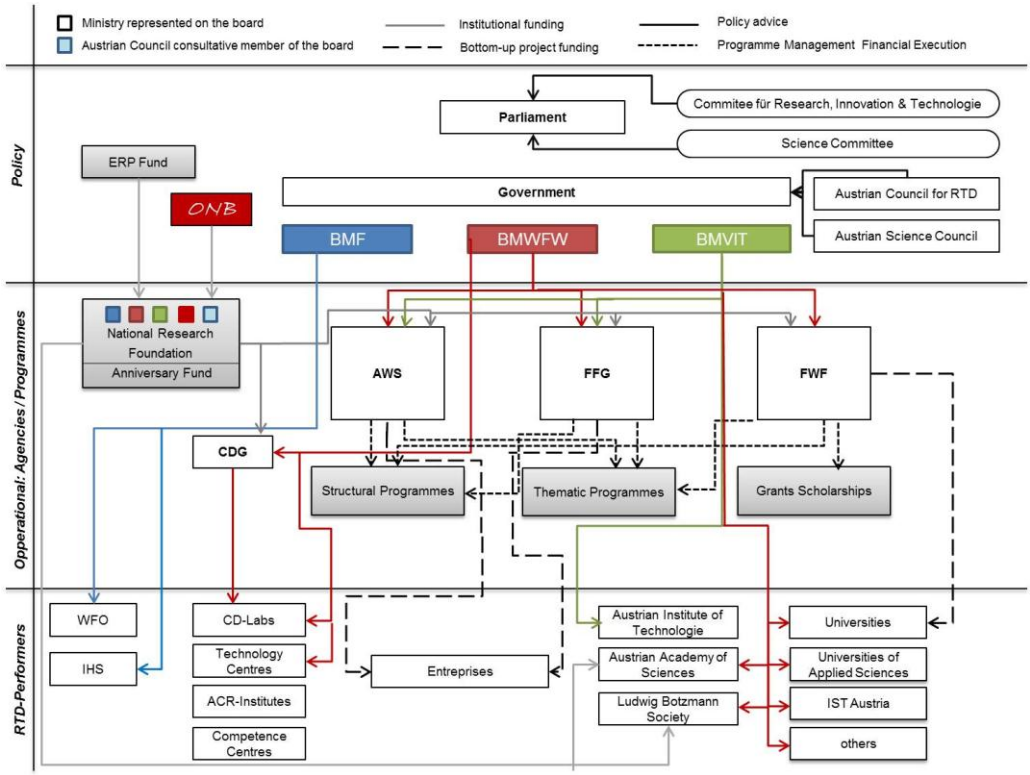
The comparative analysis of the R&D governance and funding systems collected in this background report, completed with international statistical data, constitutes the first chapter of the Final report 2 – *The Institutional Funding Principles*.

2. Austria

2.1 The R&D governance system[1]

2.1.1 General oversight

Figure 1 Austria: The R&D governance structure



Source: ERAWATCH Country Page Austria

The Austrian **Parliament** wields legislative power. Two committees deal with research related matters: the Committee on Science and the Committee on Research, Technology and Innovation, which was established in 2007. In practice, the policy debate and the development of new policy measures in S&T takes place outside the parliament to a large extent, mainly driven by the ministries in charge.

At the federal level responsibility for research and technology policy has changed in the wake of the 2013 elections and is now borne by two (formerly three) **ministries**: the Ministry of Transport, Innovation and Technology (BMVIT) and the Ministry of Science, Research and Economy (BMWFW). There is no **formal** mechanism of co-ordination between ministries. In more detail, these are the main RTDI related roles responsibilities of the different ministries:

[1] The following information is partly based on the description published on the Erawatch Country Page for Austria.

- Ministry of Science, Research and Economy (BMWFW): The former Ministry of Science and Research was merged with the Ministry of Economy to the new BMWFW. Internally, the departmental structure and responsibilities related to science, research and innovation have so far remained unchanged. Main responsibilities related to science, research and innovation are:
  - Responsibility for tertiary education and basic research
  - Representing Austria at the European level on issues of international mobility and the European Framework Programme for RTD
  - Institutional funding and governance of public universities, the Academy of Science, and the Institute of Science and Technology Austria; competitive funding mainly of basic research and human resources related measures, which are implemented through agencies
  - Responsibility and provision of budgets for several funding agencies, i.e. the Austrian Science Fund FWF, the Austrian Research Promotion Agency FFG together with the Ministry of Transport, Innovation and Technology, the Christian Doppler Society CDG, the Ludwig Boltzmann Society LBG, the Academy of Science (which also manages some competitive programmes), the Austrian Agency for International Mobility and Cooperation in Education, Science and Research OEAD, and aws Austria Wirtschaftsservice.
  - Promotion of science-industry collaboration, innovation, entrepreneurship
  - Priorities: general institutional and targeted funding across all disciplines; science-industry relations, innovation, start-ups, HR and gender issues, citizen science, targeted measures in selected priorities (e.g. sustainability, research at museums, start-ups, cooperation etc.)
  - Institutional funding is handled within the Ministry while targeted measures (i.e. competitive programmes) addressing the priorities are mainly implemented through the agencies.
- Ministry of Transport, Innovation and Technology. Main responsibilities related to science, research and innovation are:
  - Institutional funding and governance of the Austrian Institute of Technology AIT (BMVIT holds 50.46% of the shares), institutional funding of several other research organisations
  - Responsibility and provision of budgets for the Austrian Research Promotion Agency FFG and AWS Austria Wirtschaftsservice (together with the BMWFW);
  - Funding of applied research
  - Thematic foci: technologies, especially ICT, transport & mobility, production, energy, sustainable building and housing, space, aeronautics; science-industry relations, HR issues;
  - Institutional funding is handled within the Ministry while targeted measures addressing the priorities are implemented through the agencies, mainly the Austrian Research Promotion Agency FFG
- Ministry of Finance (BMF) governs the allocation of financial resources and sets, at least implicitly, standards for the design, implementation, evaluation and monitoring of programmes. Thus it plays an important role within the research policy system even though it is not directly responsible for the Austrian R&D policy. Moreover, the national funding for some research institutions is directly

allocated by the Ministry of Finance, e.g. for the Institute of Advanced Studies HIS and the Austrian Institute of Economic Research WIFO.

- Several sectoral ministries (e.g. for agriculture, health etc.) also govern and fund research activities within their field of responsibilities but they rarely participate in R&D policy debates. Their share in total government R&D expenditures is small. To illustrate this: The largest sectoral R&D budget (€77m in 2011) is handled by the Federal Ministry for Agriculture, Forestry, Environment and Water Management, which was not more than approx. 1% of the total federal R&D expenditure in 2011. The sectoral ministries allocate most of their research budget to subordinate research institutions that support the sectoral ministries in the fulfilment of their responsibilities.

There are two major **advisory bodies**: the Austrian Council for Research and Technology Development (Austrian Council), established in 2000, advises the government on all matters related to research, technology and innovation. The Austrian Science Board is the main advisory body for all university-related matters. It advises the BMWFW and also the parliament and the universities.

There is a number of intermediary agencies for the implementation of R&D policy measures, mainly for competitive ("targeted") funding programmes addressing a variety of policy objectives in research, technology development and innovation. The majority of these measures are managed by three major agencies[2] on behalf of the ministries:

- The Austrian Science Fund (FWF), established in 1968, is Austria's main body for the promotion of basic research in all fields of science. FWF funds individual scientists and research teams. The BMWFW is responsible for FWF and its budget. FWF is mainly governed by elected representatives of the scientific community. FWF funding is predominantly absorbed by researchers from the universities and from the Austrian Academy of Sciences. Most of the budget is spent through thematically open bottom-up project applications. In addition, FWF manages a few more targeted programmes, e.g. the START-programme to support excellent young researchers, the Wittgenstein award to support outstanding individual researchers, the doctoral programmes scheme etc.
- The Austrian Research Promotion Agency (FFG) is the largest organisation for the promotion of applied research and innovation in Austria. Its main task is the support of business R&D and cooperative research in bottom-up programmes as well as in defined thematic priority programmes, mainly addressing companies and their scientific partners. Moreover, it provides information services with respect to European cooperation, and it hosts the Austrian Aeronautics and Space Agency. FFG was established in 2004. Two ministries are responsible for FFG, the BMVIT and the BMWFW. FFG autonomously manages the thematically open programme "Basisprogramm" for industrial R&D projects and is commissioned (mainly by BMVIT and BMWFW) to implement a large number of mission-oriented programmes, which are either thematically (ICT, genome research, transport technologies, energy) or structurally (science-industry-collaboration, gender issues) defined.
- The Austria Wirtschaftsservice Gesellschaft (AWS) was established in 2002 as state owned banking institution. It is 100% owned by the Republic of Austria,

[2] There are some other organisations which act as agencies, i.e. they manage competitive funds financed by a ministry, but they are comparatively small and will not be described in more detail. The most important small agencies comprise the Austrian Academy of Science in its role as an agency, the Ludwig Boltzmann Society, the Christian Doppler Society, and the OEAD.

represented by the BMWFW and the BMVIT. Its main tasks are the funding of innovation projects in companies as well as seed financing and supporting start-ups. With respect to research, AWS hosts the secretariat of the National Foundation for Research, Technology and Development, established in 2004, and endowed by the Austrian National Bank (ONB) and the ERP-Funds, which acts as a "funder of funders" as it finances R&D policy measures implemented by one of the agencies at the federal level (e.g. FWF or FFG).

See chapter 1.1.3. for more information about FWF and FFG.

The following types of research organisations are active in Austria. The examples name the biggest players in each category; the list is not complete in terms of numbers but it covers approx. 90% of public institutional research funding. However, not all organisations listed receive public institutional research funding

- Higher education institutes (HEI)
  - 22 Public universities
  - The Austrian Academy of Science and its research institutes
  - Universities of Applied Sciences
  - Private Universities (not eligible for public institutional funding)
- Public research institutes:
  - IST Austria
  - Austrian Institute of Technology AIT
  - Regional research centres, e.g. Joanneum Research, Upper Austrian Research, Salzburg research
  - Institute of Advanced Studies HIS
  - Austrian Institute of Economic Research
  - Sectoral research institutes
- Private research institutes and private research organisations (do not receive public institutional funding), e.g.
  - Members of Austrian Cooperative Research (small centres, thematically specialised, providing R&D services for companies, measurement & testing, applied research)
  - Institute of Molecular Pathology
  - AVL
- Public agencies, e.g.
  - National Library
  - Federal Museums
- Hospitals: mainly the University Hospitals linked to the three Medical Universities

Research Infrastructures in Austria are normally integrated into research organisations and not established as independent entities.

There is also a substantial number of 'Centres of Excellence' and 'Centres of Competence' in Austria. They are funded through a variety of targeted programmes

and therefore, the public funding they receive through these programmes is not considered institutional funding.

2.1.2 National strategies & priorities for research

Overview of the research strategies

In March 2011, the Austrian Government published its national "Strategy for research, technology and innovation" (RTI strategy)[3]. The new coalition government which took office in autumn 2013 names this RDI Strategy as a key guideline in its governmental programme. The Federal Government's RTI Strategy has been the result of an unprecedented multi-layer process, starting with a nationwide stakeholder consultation (Austrian Research Dialogue), followed by a thorough evaluation of the research funding system (Systems Evaluation), and a final drafting process involving government experts from six ministries.

The overall objective remains to become one of Europe's innovation leaders by 2020. The quantitative goals are to invest 3.76% of GDP for R&D in the year 2020 (with a public/private split of 1:2), 2% of GDP for the tertiary sector and 1% of GDP for basic research. The RTI strategy addresses measures to strengthen national research structures with a focus on excellence, to foster the innovative capacity of companies, allow for thematic priority setting, raise the efficiency of governance, and linking research, technology and innovation to the education system. The strategy should also help to mobilize research, technology and innovation for the grand challenges of society and the economy.

Government budget appropriations or outlays for R&D (GBAORD) is around € 2.5bn in 2013. The highest shares of GBAORD in 2013 by socio-economic objectives can be found in the categories promotion of the general advancement of knowledge (30.4%), promotion of industrial production and industry (27.6 %), and promotion of health (20.8 %). Around two thirds of targeted (i.e. competitive) public funding is distributed via bottom-up programmes which are not pre-assigned to any thematic priority. A multitude of thematic and systemic programmes shares the rest.

Thematically targeted R&D priority funding still remains relatively small in Austria. The programmes are launched by the ministries responsible for RTDI and not by sectoral ministries, apart from the Ministry of agriculture and environment. Generally speaking, thematic programmes support application-oriented research and technology development in collaborative projects (making science-industry cooperation a non-thematic priority in many thematic programmes) or industrial research projects in a moderately pre-defined thematic field, and they are normally complemented by a set of specific additional measures (e.g. networking, feasibility studies etc.). The typical target groups are universities, research institutes and companies. Projects can normally be submitted during limited calls for proposals and they are selected for funding in a standard selection procedure, generally involving assessment by national and international experts.

Most thematic R&D programmes are managed by FFG, which spent around 25% (2011: 27%) of its funds in 2012 on thematic programmes on behalf of the ministry in charge. According to the FFG statistics for 2012, a total of €107m (2011: €126m) were provided to thematic programmes by the responsible ministries. For comparison: FFG managed a total funding budget (incl. guarantees) of approx. €462m in 2012 (2011: €473m). The budget was allocated to thematic priorities as follows (2012 data):

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[3] English version: http://era.gv.at/object/document/462;
German version http://www.bka.gv.at/DocView.axd?CobId=42655

- technologies for sustainable development incl. energy technologies (€39m)
- ICT (€19m)
- transport technologies (incl. aeronautics) (€30.6m)
- genome research (€2.8m)
- security research (€8.6m)
- future manufacturing.

Likewise, the Austrian Science Fund FWF mainly runs thematically open programmes to support basic research and (young) scientists. FWF also manages two thematic programmes funded by the Ministry of Science; these programmes account for no more than 2.7% of the total funding granted by FWF in 2012 (€196.4m):

- Clinical Research (€3.3m)
- Arts-based Research (€ 2.0m)

Among systemic priorities, the key priority for more than two decades now has been to improve the links between science and industry. Analyses show that the culture of R&D cooperation in Austria has improved significantly and that the formerly missing link between science and industry is no longer a first order problem, however, still an issue in Austria's R&D policy. A variety and a large number of policy measures in support of collaboration, networking and clustering have been designed and implemented, most of which are still running. One of the largest R&D policy priorities has been the reform of the public university system with the University Act 2002. Examples of other systemic priorities set out in the RTI strategy are:

- to stimulate firms which do not perform R&D yet to get involved in R&D activities (e.g. through a low-key voucher programme and indirect funding, i.e. tax credit or bonus for R&D)
- to support academic spin-offs
- to improve research infrastructure
- to strive for gender equality in RTI
- to improve the governance of the Austrian R&D system
- to foster international cooperation

At the strategic level, the Federal Government has installed the „Task Force RTI“ in the context of the National RTI strategy. Its tasks are to coordinate and combine the different efforts and policies of the various federal ministries in the field of RTI. In particular, the task force is an inter-ministerial body responsible for (i) supporting, substantiating and coordinating the implementation of the RTI strategy, (ii) the strategic and system-oriented articulation and coordination of individual ministries' activities, and (iii) dealing with the recommendations of the Council for Research and Technology Development. The Task Force RTI is presided by the Federal Chancellery. Eight working parties have been installed in order to deal with specific issues, e.g. human resources, research infrastructure, internationalisation etc.

The main players in the implementation of Austrian RTI policies are the two ministries, BMWFW and BMVIT. They both use a mix of policy measures. In terms of volume, institutional funding clearly dominates (see funding part of this case study), but targeted funding seems to be attracting more attention among R&D policy makers and public administrators who seem to consider it their "free leg".

A large share of targeted funding addresses thematic or systemic priorities and is organised in programmes which – in principle – last for a limited period of time.

However, so far not only most of these priorities but also the very programmes have turned out to be long-living, with some programmes in operation for more than ten or fifteen years.

Institutional funding itself has been an RTI priority, especially the reform of the public university system. Other RTI priorities can have an influence on institutional funding if they are relevant for a research organisation. They can influence some content of the performance contracts (e.g. projects towards research excellence or the development of human resources), and the formula-funding for public universities uses indicators that represent high-priority policy targets (at present and with regard to research: knowledge transfer, measured by third-party funding). As a very special case, an entirely new research organisation was founded in in order to reach research excellence in Austria: the IST Austria.

2.1.3 Level of autonomy of the public research funding bodies

We focus on the two agencies most relevant for funding research, i.e. the Austrian Science Fund FWF and the Austrian Research Promotion Agency FFG.

Their legal basis for the **Austrian Science Fund FWF** is the "Forschungs- und Technologieförderungsgesetz (FTFG)" (Research and Technology Promotion Act). The FWF has to develop a multiannual programme for the implementation of its tasks, taking the priorities of the Austrian R&D policy into account, and to operationalize this programme in annual work programmes. The programmes have to be approved by the ministry in charge and they have to be published. The act specifies in detail which other issues have to be approved by the ministry in charge. According to the FTFG, FWF's operational and funding budget is financed through the Federal Budget "depending on the funds available for the purposes "of FWF and based on the multiannual programme. In recent years, not all funding programmes and activities suggested by FWF have been funded, according to the ministry in charge due to budgetary constraints.

FWF has to report annually (and upon request) to the ministry about its activities and the situation of basic research in Austria and to provide the required monitoring data. The FWF's Supervisory Board approves the FWF's annual accounts as well as its annual budget estimates, long-term plans and annual work plans. The Assembly of Delegates is charge of approving the FWF's annual report.

The Austrian Research Promotion Agency FFG has been established in 2004 with the "Forschungsförderungsgesellschaft Errichtungsgesetz FFGG" („Research Promotion Agency Establishment Act") as a fusion of four predecessor agencies. FFG is structured and organised different than FWF, but FFG's planning and reporting requirements towards the ministries in charge are basically the same as those of the FWF.

The most recent institutional evaluation of FWF and of FFG's predecessor agency FFF, contracted by the ministry in charge, was performed in 2004. In addition, most programmes and activities managed by these agencies have been evaluated, either upon initiative of the ministry in charge or the agency.

Each research council and innovation agency, not only in Austria, typically has a clear goal to influence the research organisations they fund: they want research organisations to perform research of higher quality, or to cooperate with partners from "the other side" (science or industry, or partners from abroad), or to enter into or to enforce activities in certain thematic fields, to name just some of the most popular research policy priorities.

In Austria, the agencies mainly operate through a large number of competitive funding programmes, i.e. they provide financial incentives to their target groups. With respect to international cooperation, information and support services are provided to potential participants in international cooperation, especially in the European Framework Programmes for Research.

2.2 The R&D system

2.2.1 Characteristics of the publicly funded research organisations

In Austria, the biggest research performers in terms of volume are the business enterprise sector and the higher education sector. 68.8%[4] of gross domestic R&D expenditure in R&D (GERD) in 2011 was spent on research in companies, and 25.6% in the higher education sector. The public sector covered 5.1% of GERD and the private non-profit sector accounted for only 0.5% of GERD.

Of all public institutional research funding in 2011, 79.4% (1,388.546 Mill. Euro)[5] went to public universities. 7.3% went to the three largest non-university research institutes together, i.e. Austrian Academy of Science, the IST Austria and the Austrian Institute of Technology AIT. 1.6% were granted to museums and the National Library. The large number of other organisations that receive public institutional research funding share less than 13% of the total spent in 2011, i.e. they are comparatively small and public institutional research funding often contributes just small percentages of their total available budget. Private universities and private research organisations do not receive public institutional funding in Austria (by definition of private).

Higher education institutes (HEI)

Within the higher education sector (HES) the 22 public universities (including the university hospitals) play by far the largest role as research performers, consuming 89% of the sector's total R&D budget in 2011 (all sources of funding); another 5.5% went to the Austrian Academy of Sciences and 3.7% to the 'Fachhochschulen' (Universities of Applied Sciences). The rest of the R&D expenditures within the HES was spent at private universities and other institutions. Not all of these institutions receive public institutional funding.

These are the major recipients of public institutional funding in the HES

- 22 public universities
  - 21 universities offering the full range of tertiary education. Their traditional missions are teaching and research. The public universities are the backbone of post-secondary education and of basic research in Austria and also perform applied research. They are very different in age, size and specialisation.
  - 1 university of further education, offering only post-graduate courses and playing only a minor role as a research performer
- The Austrian Academy of Science: The Academy is a learned society and the largest non-university performer of basic research in Austria, mainly in fields complementary to the public universities' activities.
- The Institute of Science and Technology Austria (IST Austria): Newly founded by law in 2006, established as a greenfield investment, it is dedicated to internationally competitive basic interdisciplinary research and graduate education in natural and mathematical science.

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[4] Statistik Austria: Research and experimental development in Austria by sectors of performance 2011

[5] Source: Statistik Austria, published in Österreichischer Forschungs- und Technologiebericht 2014, Tableenanhang, Tablee 9

Public research institutes

According to the last available full census in 2011, there are 252 public research organisations in Austria, which comprise a number of very different institutions. Their tasks range from basic research to providing R&D services for industry. As R&D performers they play a small role compared to the business sector and the university sector; together they perform approx. 5% of R&D in Austria (measured as a percentage of GERD)[6].

- Austrian Institute of Technology AIT: is the largest non-university research institute in Austria performing applied research. AIT covers the entire spectrum from taking up emerging technologies, first proof of concepts, applied research to transferring these emerging technologies into specific applications up to demonstrators and prototyping.
- Regional research centres, e.g. Joanneum Research, Upper Austrian Research, Salzburg research: relatively small research centres, funded and (co-)owned by provincial authorities, mainly performing applied research and development in various thematic fields
- Sectoral research institutes perform R&D in support of a sectoral ministry's work e.g. in the fields of environment, agriculture, forestry, water management, education etc. Some of them also provide knowledge for the specific clientele or to the public. The latter holds e.g. for the Austrian Meteorological and Geophysical Office (ZAMG).

Public agencies

This group of institutions includes as the largest players the National Library and the Federal Museums (e.g. the Museum of Natural History, the Kunsthistorisches Museum Wien (Museum of Fine Arts), the Technical Museum etc.). They perform research related to their collections and according to census data spend approx. 18% of their budget on research.

Special Case: Universities of Applied Sciences

Starting in 1993, 20 Universities of Applied Sciences have been established (status quo 2014) in order to diversify tertiary education in Austria and to meet the demands of the labour market. Their main task is tertiary, practice-oriented education. They receive institutional public funding – but not for research. Nevertheless, some of them have established R&D facilities and these efforts have been supported through targeted programmes (COIN, Josef Ressel Centres) financed by BMVIT and BMWFW respectively. The Universities of Applied Science focus on applied research and technology transfer, mainly addressing regional companies and complementing the activities of universities.

For information about the funding of Centres of Excellence and Centres of Competence, see chapter 2.2.3

[6] There is no non-ambiguous typology for research performing organisations. For example in the Austrian case, official census data count the Austrian Academy of Science and its research institutes in the HES; a number of other organisations are identified as ‚cooperative sector' within the business enterprise sector. All of these could also be labelled ‚public research institutes' for one reason or another. If they were added to this sector in the statistics, it would grow and all together perform approx. 13% of R&D in Austria.

2.2.2 Level of autonomy of the publicly funded research organisations

The largest recipients of public institutional funding (public universities, Academy of Science, AIT, IST Austria) have different legal basis and governance systems, but some facts hold for all of them:

- They do have the right for autonomous decision-making on their strategy
- They do have the right for decision-making on internal fund distribution
- They all have to report regularly to their funding ministries (written reports at least once a year, depending on the type of organisation; monitoring meetings with their ministry)
- Performance contracts are the most important (or the only) governance instrument between these organisations and their ministry (in the case of IST Austria, a performance agreement is currently negotiated)

This already summarizes the major developments and trends of institutional governance in Austria during the past decade. However, the systems are not unchangeable, and several reform steps have already been implemented or are currently under preparation (see for example the financing of public universities as described in the funding part of the Austrian case study).

2.2.3 Research infrastructures and Centres of excellence/Competence centres

Research infrastructures are normally financed through the institutional funding or through limited competitive funding (mainly for the public universities, see funding part of the case study). Institutional funding in Austria is normally granted as a block funding and the recipients decide about the use of the funds internally.

Austria is a member in a number of international research infrastructures (e.g. CERN, Elettra, EMBL, EMBC, ESO, ESRF, IARC, ILL, IODP/ICDP) and actively participates in several ESFRI projects. These memberships are normally long-term commitments which are contractually agreed. The particular funding conditions depend on the rules for participation set by each infrastructure. Participating in or joining an international research infrastructure is decided case by case. The precondition for joining any international research infrastructure is a sufficiently large research community that would benefit and make use of the infrastructure.

The Austrian equivalent to a **'Centres of Excellence'** is a 'Spezialforschungsbereich (SFB)' funded under the 'Special Research Programmes' run by the Austrian Science Fund. The goals of this programme are to establish research networks based on international standards through autonomous research concentration at a single university location and to build up highly productive, tightly interconnected research establishments for long-term and interdisciplinary work on complex research topics. The programme addresses Austrian universities and non-profit research organisations. Funding is granted for up to 8 years, with a stop-or-go decision after a mid-term evaluation. SFB are not established as independent legal entities, therefore this funding is not institutional but targeted funding.

'Centres of Competence' in Austria are established and publicly funded through competitive programmes for a limited period of time (7 – 10 years, depending on the programme). They are intended to strengthen the links between research institutions and the users of their results (industry in most programmes). The main types of 'Centres of Competence' are: Ludwig-Boltzmann-Institutes, Christian Doppler Institutes, COMET centres ('K1' and 'K2'), Laura Bassi Centres, Josef Ressel Centres. Generally – and especially by the funding ministries and their implementing agencies – the Centres are not considered 'research organisations' but 'projects'. Although in some programmes, in particularly the largest, COMET, the Centres have to be established as legal entities, the public money they receive is not considered

institutional, but targeted funding. From our perspective, this is a hybrid type of financing which could be labelled 'temporary institutional funding'.

2.3 The funding system

2.3.1 Flows of public research funding

Table 1 Austria: Institutional and targeted funding in Austria (2011)[7]

GDP: Gross domestic product at market prices	299,240.4	Mill. Euro
GERD: Total intramural R&D expenditure	8,276.335	Mill. Euro
GBOARD: Total Government R&D appropriation	2,428.143	Mill. Euro
GBAORD - institutional funding	1,748.326	Mill. Euro
GBAORD - project funding	679.817	Mill. Euro
Institutional funding as a share of total GBOARD	72	%
Institutional funding as a share of GDP	0.58	%
Institutional funding as a share of GERD	21.12	%
Project funding as a share of total GBOARD	28	%
Project funding as a share of GDP	0.23	%
Project funding as a share of GERD	8.21	%
Institutional funding: project funding	2.57:1	-

Source: Eurostat

In Austria, no comprehensive data are available regarding the level of institutional funding and its share of overall income for different (types of) research organisations. However, it is still possible to draw a rough picture of the situation, again showing the importance and towering size of public universities among the publicly funded research organisations in Austria: In 2011, 79.4% (1,388.546 Mill. Euro)[8] of all institutional research funding went to public universities. On average, this public funding accounts for 81.6% of a public university's total budget[9], i.e. 18.4% are income from competitive sources (grants and contracts). 7.3% went to the three largest non-university research institutes together, i.e. Austrian Academy of Science, the Institute of Science and Technology Austria (IST Austria) and the Austrian Institute of Technology AIT. 1.6% were granted to museums and the National Library. The large number of other organisations that receive public institutional research funding share less than 12% of the total spent in 2011, i.e. they are comparatively small and public institutional research funding often contributes just small percentages of their total available budget (see Table 2).

[7] Source: Eurostat

[8] Source: Statistik Austria, published in Österreichischer Forschungs- und Technologiebericht 2014, Tableenanhang, Tablee 9

[9] Source: Federal Ministry of Science and Research: „Universitätsbericht 2011"

Table 2 Austria: Distribution of institutional funding among publicly funded research organisations (2011)

Institutions	Institutional research funding (Mill. Euro)	Share of GBOARD institutional funding
Public universities	1.388,546	79.4%
Large non-university research institutes: Austrian Academy of Science, IST Austria, AIT	127,848	7.3%
Museums and National Library	27,515	1.6%
Others	204,417	11.7%

Source: Statistik Austria, published in Österreichischer Forschungs- und Technologiebericht 2014, Tableenanhang, Tablee 9

2.3.2 The institutional funding system

2.3.2.1 *Criteria used for decision-making on sources allocation*

Funding model

In Austria, there is no single mechanism for allocating institutional research funding to research organisations. There are different systems in place for different research organisations or types of research organisations. The funding systems for those research organisations that, taken together, receive the lion's share of public institutional research funding have been reformed during the past decade and in some cases they are still changing, most notably for the public universities. Before the new governance of funding, the budgets were based on history and negotiation skills. The transitions to the new governance of funding (e.g. through the University Act 2002) typically had no short term implications on the size of the budgets; on the contrary, for the public universities the University Act 2002 limits the annual changes in public institutional funding in order not to cause instabilities.

The following four (types of) research organisations together account for nearly 87% of public institutional research funding (see table 2). All other organisations taken together receive approx. 13% of all public institutional research funding, which accounts for very different shares of their total institutional budget. Public institutional funding is normally granted as block funding with no "earmarks" for research in the cases of organisations that fulfil also other tasks than research (i.e. research organisations may use the funding as they like as long as they use it to fulfil their tasks). In other words, it is within the research organisations autonomy to decide upon the allocation of the funding to its different tasks (teaching, research, administration etc.). Therefore, the following explanations refer to total institutional funding.

Public universities

Global University Fund = formula funding + performance contract + competitive institutional funding (specific projects selected in informed peer review)

At present, these funds (apart from the competitive share) are not earmarked for research, teaching or any other purpose. See Table 3, below.

Table 3 Austria: Components of the institutional funding for public universities (total) in the funding period 2013 to 2015

Mechanism	**%**
"Hochschulraumstrukturmittel": **Formula-based funding + competitive institutional funding**	**20%**
Formula-based funding	
Indicator 1: Exams *Number of exams operated in Bachelor, Diploma and Master studies, weighted by subject.*	*60%*
Indicator 2: Graduates *Number of graduates in Bachelor, Diploma and Master studies, weighted by subject. For inter-universities degrees, the graduate counts as 0,5 for each university involved.*	*10%*
Indicator 3: Transfer of knowledge *External funds for R&D projects collected from privates, companies, foundations and others, both nationally and internationally (grants and contracts).*	*14%*
Indicator 4: Private donations *External funds collected as donations from privates, companies, foundations and others, both nationally and internationally*	*2%*
Indicator 5: Cooperation *Competitive institutional funding (projects selected in informed peer review)*	*14%*
Performance contracts	**80%**
TOTAL INSTITUTIONAL FUNDING = Block grant (no earmarks for specific tasks)	**100%**

Source: Federal Law Gazette for the Republic of Austria, 2012, Hochschulraum-Strukturmittelverordnung (Higher Education structural funds regulation), 3 September 2012 Part II

The shares in the table above refer to the total budget available at the Federal Ministry of Science for the institutional funding of public universities in the funding period 2013 to 2015[10].

The budget appropriations for the indicators 1 to 4 are calculated as follows on an annual basis: The public universities report the data for all indicators annually. For the indicators 1 and 2, values are calculated on the basis of the subject weights. Values for all universities are added to a total indicator value. For each indicator, each university receives the percentage of the available budget, which equals the university's share of the total indicator value.

The funding based on indicator 5 was allocated for the entire funding period (2013 – 2015) based on a competitive call for proposals for all public universities. The funding is granted for projects that establish new cooperation between public universities as well as with external partners. Approx. three quarters of the available budget were dedicated to cooperation in teaching and research, one quarter funds cooperation in administration.

The University Act 2002 limits the maximum amount of budget cuts to the public universities in order to safeguard stability and planning security: a university's block grant for a given three-years funding period must not be less than 96% of the block grant in the preceding period. Maximum budget cuts for the annual appropriations are restricted, too. A cut of 4% over three years might seem small at first sight but it can account for a large share of the 'disposable' budget a rector can use, given the large share used to cover more or less fixed 'running costs'. Hence, even this seemingly small cut certainly sends out a strong signal.

Despite the recent changes, the university funding system in Austria is going to be reformed again. The major change to be expected is a funding system partly based on the number of university places, which would imply a change of paradigm in the Austrian university system with its (largely) free admission policy.

Austrian Academy of Science

The Austrian Academy of Science receives its institutional funding through a performance contract covering the entire institutional funding from the Federal Ministry of Science. The first contract was signed for the period 2012 to 2014. A follow up contract is currently under negotiation.

The Academy of Sciences also fulfils additional tasks on behalf of the Ministry of Science, e.g. the management of several scholarship programmes. These are contracted separately.

[10] The formula-based funding used before used more indicators and a more complicated formula. It is described in E. Arnold et al: "The Quality of Research, Institutional Funding and Research Evaluation in the Czech Republic and abroad", Final Report, part 3 of the „International Audit of Research, Development & Innovation in the Czech Republic"

Austrian Institute of Technology (AIT)

AIT receives its institutional funding through a performance contract with the Ministry of Transport, Innovation and Technology covering the entire public institutional funding. BMVIT is also the major shareholder of AIT.

IST Austria

IST Austria was founded by law in 2006 and established as a greenfield investment. Funding is granted through long-term funding agreements lasting until 2026. There are two providers of institutional funding: the Province of Lower Austria finances the infrastructure (construction and maintenance), and the Federal Government represented by the Ministry of Science for all other cost. This part of the funding is partly conditional and indicator based: A maximum amount of money has been set aside for a period of 10 years (2007 – 2016), broken down into annual appropriations. Two thirds of each annual appropriation are paid unconditionally. The size of the remaining share equals the amount of third party funding (grants, donations) IST Austria has received in the year before (up to the maximum amount specified, i.e. one third of the annual appropriation).

A performance contract for the Federal money is in negotiation.

Table 4 Austria: Components of the institutional funding for IST Austria

Mechanism	%
Infrastructure (Construction and maintenance)	
Long-term funding agreement with the Province of Lower Austria	100% (upper limit specified in the agreement)
Operation	
Long-term funding agreement with the Federal Ministry of Science*	Max. 100% (upper limit specified in the agreement)
Annual block grant	*66.6%*
Performance-based funding (PBF) *Indicator: External funds received the year before (grants and donations, no contracts)* *Formula: PBF = external funds received in the year before (up to a maximum of 1/3 of the annual block grant)*	*Max. 33.3%*
TOTAL INSTITUTIONAL FUNDING	Max. 100%

* A performance contract is currently under negotiation to replace this agreement. It will most probably also contain a formula funding.

2.3.2.2 *Performance contracts & processes*

The first performance contracts as a tool of institutional funding in Austria were signed between the Ministry of Science and the public universities in 2006. They are concluded for periods of three years. The basic elements of the performance contracts are laid down in the University Act 2002.

The basic steps of the procedure are as follows:

- Universities formulate (or update) their multiannual development plan ("Entwicklungsplan"). This is their basis for the negotiations.
- The Ministry of Science provides the universities with guidelines on the structure of the performance contract and the procedures. Moreover, in a letter to each rector, the ministry specifies expectations, normally a list of items that have to be addressed during the negotiations.
- Each university prepares a draft performance contract and submits it to the ministry.
- Delegations of the Ministry and each university meet several times to discuss the draft performance contract, which is signed, once agreement has been achieved.

Reporting is standardised and specified in an ordinance. Annual reports comprise a narrative part, which is basically a description of activities and achievement along the structure of the performance contract, an overview of progress made towards the goals specified in the contract, and a large number of monitoring and performance data.

Representatives from the ministry and each university meet twice a year for a monitoring meeting ("Begleitgespräche") to exchange information and discuss the progress made. There are no sanctions if a university fails to reach one or several goals specified in the contract. Any deviations are addressed in the monitoring meetings.

2.3.2.3 *Processes for funding system implementation*

There are rules that govern the relationship between the public funders and the existing recipients of institutional funding in general and, for the largest share of the funds allocated, in particular (e.g. the University Act 2002, the performance contracts etc.). However, there are no regulations on how someone could set up a research organisation in Austria and then apply for institutional research funding[11].

The status quo is contingent: it is the way it is. The largest share of public institutional research funding goes to "logical" recipients, i.e. organisations that traditionally have received public funding in many European countries because their societal relevance is largely undisputed: the public universities. For most other research organisations that receive public funding, public bodies (ministries, governments, even emperors) have played an important or even decisive role in their establishment: the Academy of Science, AIT, the regional research centres, the sectoral research centres, the Federal Museums, the National Library etc. – and most recently, the IST Austria. IST Austria was established as a basic research institute and graduate school by law in 2006. It had been proposed and initiated by eminent Austrian scientists and is jointly funded by the Federal Government and the Province of Lower Austria. In other words, the establishment of the IST Austria and its public funding was a political decision.

[11] There are rules for founding Universities of Applied Sciences and for private universities but they do not receive institutional research funding (UAS) or no public funing at all (PU).

There are also examples of research organisations loosing institutional research funding: Beyond the lion's share of institutional research funding, which goes to the big players, there is a large number of mainly small organisations that used to receive institutional funding, mainly from the Ministry of Science on a historical basis. Very often, their founders had received some start-up funding from the Ministry without formal procedures and some institutional support thereafter on a historical basis. In 2010, as a response to the budget consolidation crisis the Austrian Ministry of Science and Research has terminated institutional funding for 70 smaller non-profit organisations, which are organised on private law basis as associations or limited companies. Again, it was through a political decision that public funding of research organisations was stopped.

Most research infrastructures in Austria are placed at, managed and used within research organisations. e.g. at the public universities, the research centres etc.. It is mainly financed through institutional and competitive funding. The Ministry of Science considers the financing and management of research infrastructures a key challenge.

Centres of Excellence and Competence Centres are funded through competitive funding programmes. They are set up temporarily and the money they receive is considered project ("targeted") and not institutional funding. See the R&D system part of this case study for more information.

Public institutional funding of Austrian public universities is granted as a block funding without any preconditions on how to spend it, and the public universities are autonomous in their decisions about the use of their funding as long as they use it to fulfil their tasks as specified in the University Act 2002. In essence, this also holds for other recipients of public institutional funding.

2.3.2.4 *Governance of the funding system*

Several ministries grant institutional research funding in Austria: The Ministry of Science, Research and Economy and the Ministry of Transport, Innovation and Technology together account for approx. 85% of all public institutional research funding granted. The remaining 15% are mainly financed by the Ministry of Agriculture, Forestry, Environment and Water Management, the Ministry of Education and Women's Affairs, the Ministry of Finance, and the Ministry of Health (in descending order of research budgets).

Present responsibilities for institutional funding are basically the result of history. The ministry that first granted institutional funding to a particular organisation is responsible for this organisation as long as it grants funding.

In Austria, there is neither an obligatory coordination mechanism among research funders nor a concept of 'adequate field coverage'. Indeed, the questions is, how would one know that the disciplines are adequately represented?

In Austria, what disciplines are covered lies mainly within the responsibility of the public universities, which since the University Act 2002 have been autonomous, and the other research performers. However, the Ministry of Science could influence the disciplinary mix a university offers in the performance contract negotiations.

In the past decades, national research priorities in Austria have been either thematic (e.g. ICT, nano, energy, life science etc. – the usual suspects) or structural (e.g. science-industry links). These issues are typically addressed through competitive funding programmes. Institutional funding at large is normally not subject to such priorities – not least because the bulk of institutional funding goes to universities. However, some issues are typically brought forward by the ministry in charge and are then addressed e.g. in the performance contracts.

National infrastructure is mainly incorporated into research organisations, i.e. mainly funded through institutional (and to a smaller share competitive) funding without a strong coordination. Participation in international research infrastructures is mainly

driven bottom-up and decided upon on a case-by-case basis (see also the R&D system part of this case study). There are no formal coordination mechanisms but the efficient funding of research infrastructure has been (and remains) on the Ministry of Science's agenda for several years.

At the strategic level, the Federal Government has installed the „Task Force RTI" in the context of the National RTI strategy. The task force is an inter-ministerial body responsible and its tasks are to coordinate and combine the different efforts and policies of the various federal ministries in the field of RTI. Eight working parties have been installed in order to deal with specific issues, one of them for research infrastructure. This working party has published its first strategy paper in February this year, the "Österreichischer Forschungsinfrastruktur-Aktionsplan 2014 – 2020" (Austrian Research Infrastructure Action Plan 2014 – 2020).

2.3.3 Feedback and reflections on the system

In Austria, there is no single funding system in place. Rather funding systems vary depending on the (type of) organisation. Institutional funding is normally granted in the context of long-standing working relationship between the ministry in charge and the research organisation(s). This is one of the advantages of the system as it is flexible and robust. On the downside, it appears intransparent and complex.

The largest recipients of public institutional research funding have had their governance systems changed towards multiannual funding arrangements (mainly performance contracts) and more autonomy to the research organisations (i.e. the largest players in the system as described above). The advantages of this system for the beneficiaries are more autonomy and higher planning security. The performance contracts are concluded for three years, which is a big advantage compared to annual budgeting. The ministries also consider the longer funding periods beneficial, although they seem to fear a loss of control and a lack of information.

In the case of the public universities, the University Act 2002 also implied substantial reorganisation at the universities and the Ministry of Science alike, as many administrative tasks and responsibilities (e.g. human resources) were transferred to the universities or even newly established (e.g. quality management). Moreover, the ministry had to find its new role on a more strategic level; some people still seem somewhat unsettled. There is an ongoing debate within the ministry on how to optimize the new governance system, especially with respect to the performance contracts.

As far as effects are concerned, there is no comprehensive information, and each individual funding arrangement would have to be assessed individually. For the largest recipient group, the public universities, the first funding formula applied for their public institutional funding between 2007 and 2012 has been evaluated. It turned out to be too complicated to have any steering effect. This is an interesting case: The indicators were carefully selected in order not to put certain universities at a disadvantage, e.g. due to size or subject specialisation. The formula was based on a sigmoid function, which theoretically should have created incentives towards defined target values for each indicator. Yet, it was too complex to be effective. Consequently, the new funding formula comprises less indicators and a less complicated formula.

3. The Netherlands

3.1 The R&D governance system

3.1.1 General oversight

At the first policy coordination level, the government takes decisions on R&D policy. The government consists of the parliament and the cabinet, both of which are advised on science and technology policy by the Advisory Council for Science and Technology (AWT) and by the Royal Netherlands Academy of Arts and Sciences (KNAW). The AWT advises on policy in the areas of scientific research, technological development and innovation. The KNAW councils provide advice on matters related to scientific research, with separate councils established for different scientific disciplines.[12]

The main actors and institutions in the Dutch science, research and innovation governance system - the Ministry of Education, Culture and Science (OCW) and the Ministry of Economic Affairs (EZ) – lie at the second level of policy coordination. OCW is concerned with science and basic research, whereas EZ is concerned with technology and innovation. The ministry of OCW has by far the largest budget for research. OCW has responsibility for science policy and for establishing the (four-annual) science budget. The last science budget was in 2011 (*Strategic agenda for higher education, research and science policy*[13]). In this policy document, the Minister of OCW sets out the main policy objectives and the accompanying policy measures. Other ministries (e.g. Agriculture, Nature & Food Quality (LNV), Health, Welfare & Sport (VWS) and Transport, Public Works & Water Management (V&W)) also have their own specific research and innovation policies. The R&D budgets of these ministries are, however, much smaller than the budgets of OCW and EZ.

The main bodies responsible for managing and implementing policies through competitive funding are the Netherlands Organisation for Scientific Research (NWO), the Royal Netherlands Academy of Arts and Sciences (KNAW), and Netherlands Enterprise Agency (RVO, an agency of EZ). KNAW and NWO function also as an umbrella organisation for research institutes that carry out basic and strategic research in various disciplines.[14]

Government funding for scientific research carried out in the Netherlands is provided in four different ways:

a) Provision of a fixed contribution (block grant) to institutions by OCW (institutional funding, or "first flow funding");
b) (Competitive) funding of research via intermediary organisations (such as NWO, KNAW, and RVO) by OCW, EZ and to some extent other ministries;
c) Funding of research via the ministry's own knowledge institutes, for example at the Ministry of Justice and the Ministry of Health, Welfare and Sport;

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[12] Ortega-argiles, *ERAWATCH Country Reports 2012 : The Netherlands*; *Country Report: Social Sciences and Humanities in The Netherlands.*

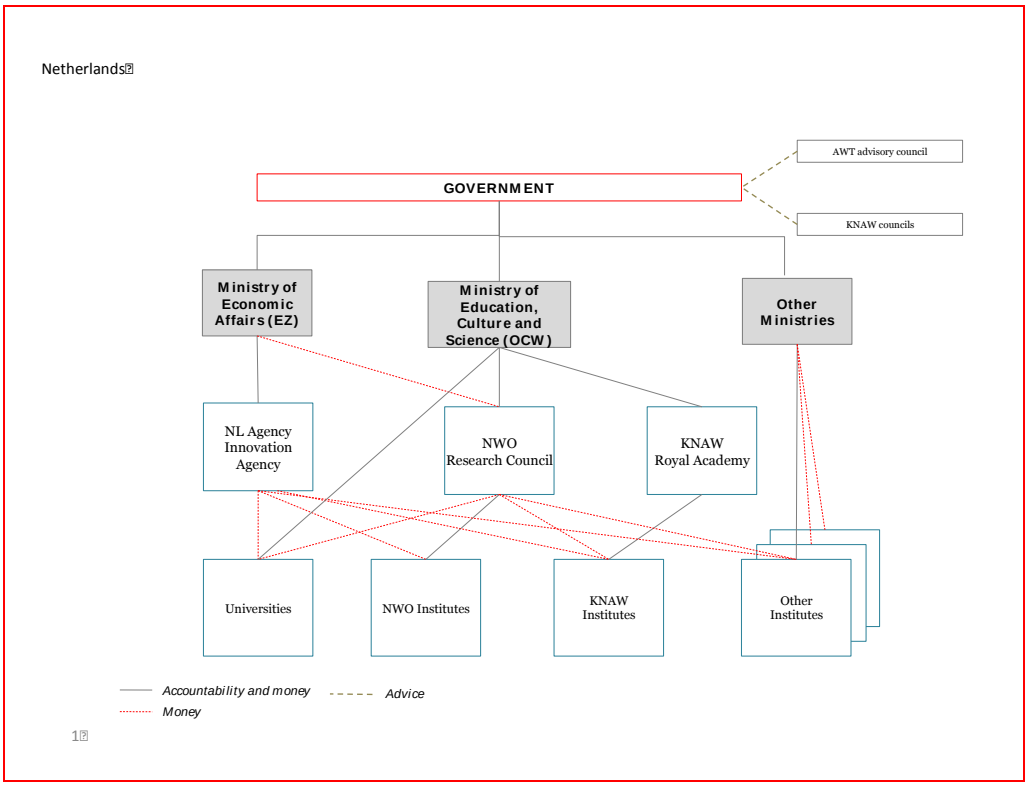
[13] *Kwaliteit in Verscheidenheid: Strategische Agenda Hoger Onderwijs, Onderzoek En Wetenschap.*

[14] *ERAWATCH Country Reports 2012 : The Netherlands.*

d) Direct funding of policy-oriented research.

A large number of organisations conduct research in the Netherlands. Three sectors are generally distinguished: A) higher education institutes (universities, university hospitals and universities of applied sciences); B) research institutes, including private non-profit (PNP) institutes; and C) companies.[15]

Figure 2 Netherlands: The R&D governance structure in the Netherlands



Elaborated from *ERAWATCH Country Reports 2012 : The Netherlands.*

3.1.2 National strategies & priorities for research

Overview of the research strategies

The Dutch research strategy is formulated as part of the Higher Education, Research, and Science strategic agenda of the Ministry of OCW. The aim of the agenda is to create a higher education system that can compete internationally and performs internationally outstanding research, as well as to enforce the international position of Dutch businesses. The strategy has two main pillars: a stronger profiling of the public research system, and the stimulation of valorisation of knowledge through stronger

[15] *The Science System in the Netherlands an Organisational Overview.*

collaboration in the triple helix, i.e. universities, industries and government, and by targeted investments in the top sectors. The Dutch research strategy [16]:

- Aims for a research landscape with a number of internationally recognised and competing research focus areas, well embedded in European alliances and well-able of acquiring European funding. These focus areas are primarily formed on the basis of the criteria scientific quality, and impact. Within these focus areas, there is close collaboration with companies from the nine 'top-sectors' (water, agro food, horticulture, high tech systems and materials, life sciences and health, chemistry, energy, logistics, and the creative industry) and social organisations in order to address the European 'grand societal challenges'. Important is regional collaboration, but also national and international collaboration.
- Aims for stronger and more firmly embedded connections between fundamental research, practice-oriented research, applied research, innovations in companies and social renewal. In addition to the criteria of scientific quality and excellence, economic and societal impact are core values of the science system. It aims for a greater contribution of scientific research to societal challenges, nationally and internationally.

Also relevant is the Topsector policy of the Ministry of Economic Affairs. The Topsector policy is aimed at the economic sectors that are the most important to the international competitive position of the Netherlands, such as the knowledge-intensive and export-oriented sectors. The government has defined the following Topsectors: Agri-food, Chemicals, Creative Industry, Energy. High Tech, Horticulture and propagation material, Life science and health, Logistics and Water. The top sector approach is geared towards providing a solid exchange between businesses, knowledge institutes and the government (the 'golden triangle'). The government does not make its own proposals for the sectors, but invites businesses and scientists to draw up action plans. Research is an important part of these action plans. Each Topsector has formed a "Topconsortium for Knowledge and Innovation" (TKI). The TKIs developed strategic research agenda's. Institutes like the NWO (the Netherlands Organisation for Scientific Research), KNAW (the Royal Netherlands Academy of Arts and Sciences), TNO (Netherlands Organisation for Applied Scientific Research) and the large technology institutes have to adjust their programmes to the top sectors and the strategic research agendas in particular.

Implementation of the research strategies

The first pillar concerning profiling of public research is implemented through performance agreements between the State Secretary and universities for 2013-2017 in three domains:

- Education: improvement of quality and performance and deepened differentiation.
- Profiling and focus areas in research: stimulate local competences and national coordination.
- Strengthening knowledge valorisation.

By 2017, 7% of the institutional funding to universities (ca. M€ 325) is meant to be allocated based on the performance of universities in these three domains.

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[16] *Kwaliteit in Verscheidenheid: Strategische Agenda Hoger Onderwijs, Onderzoek En Wetenschap*; *Effecten van Universitaire Profilering En Topsectorenbeleid Op de Wetenschap in Nederland: Een Eerste Kritische Reflectie*.

Implementation of the second pillar and the Topsector policy is partly done by the Topsectors themselves. Each Topsector has developed a strategic research agenda. For the execution of these agendas 2 B€ is committed by the Government by 2015 and 1.8 B€ committed by industry in 2012.[17] The second pillar and the Topsector policy is also implemented by NWO. The Dutch government decided that NWO must allocate most of their funds for thematic research to the nine economic priority areas selected by the government. From 2015 onwards, NWO will allocate 100 million euros per year to research within the economic priority areas that is realised in cooperation with industry.[18]

3.1.3 Level of autonomy of the research funding bodies

OCW is responsible for the functioning of the national research system as a whole. OCW has the responsibility to define the framework within which the research system should operate, e.g. in terms of internationalisation, emphasis on knowledge valorisation, or focus and mass. Within these broad guidelines, the other actors in the research system, including the research funding bodies and research performing institutes, have their own responsibilities with a large degree of autonomy. Guidance for these organisations is given by the Ministry's Strategic Agenda which is published every four year.

The research funding bodies' policies are partly based on the national research and science policy, and partly based on long term strategic plans. NWO and KNAW are in charge of the evaluation of research conducted at their affiliated research institutes, while the boards of universities are in charge of the evaluation of research conducted at their university.

NWO is responsible for allocating competitive funding ("second flow funding") to universities and to NWO institutes, and to a lesser extent to other institutes. It also provides institutional funding ("primary flow") to a number of NWO research institutes, functioning as an umbrella organisation. Although NWO falls under the responsibility of OCW, it is an independent administrative body. The Ministry do not wants to be involved in the decision making about competitive funding (matter of principle to not mingle the assessment of research quality and politics). It therefore has a high level of autonomy, although the Minister of OCW does approve NWO's budget and responds to its strategic plan. Furthermore the Ministry sometimes commissions specific research programmes, e.g. about young talent, minority groups. These assignments come with additional budget. 85% of the NWO budget comes from OCW, and 4% from EZ.

KNAW duties are defined by law. Briefly, they are: to serve as a learned society representing the full spectrum of scientific and scholarly disciplines; to act as a management body for national research institutes (umbrella organisation); to advise the Dutch Government on matters related to scientific pursuit. It decides on its own budget spending and strategic plan. 62% of its budget comes from OCW.[19]

RVO is part of EZ, and therefore has limited autonomy.

While the research institutes have a very high degree of autonomy, the funding bodies do have influence. Their secondary funding is dependent on the competitive funding

[17] Ibid.

[18] See www.nwo.nl

[19] See www.knaw.nl

calls from funding bodies, and the newly established performance contracts also affect the institutional funding (see section 3.3.2.2).

3.2 The R&D system

3.2.1 Characteristics of the publicly funded research organisations

The Dutch research system includes 14 government-approved research universities (including an Open University), the research institute TNO (contract research), research institutes under the umbrella's of NWO and KNAW (basic research), DLO-institutes (agricultural research), Large Technological Institutes, research institutes of ministries and a range of research institutes for public-private partnerships in strategic research.

3.2.1.1 *Research universities*

Universities have a three-fold mission: teaching, research and utilisation of knowledge (valorisation). There are 14 universities (including an Open University) that spend almost 2.6 billion on R&D (2007), which amounts to 27% of total R&D expenditures in the Netherlands.[20] There are six general research universities, three universities of technology, four specialised research universities and the Open University.

3.2.1.2 *Public research organizations*

Public research institutes are a small player in the Dutch science system. They contribute 10% to total R&D performance and receive 75% of their funds from the government. The research institutes vary in their focus and the type of research they perform. In general, the research institutes can be divided into seven different categories [21]:

1. The research institutes of NWO and KNAW. Both organizations are also intermediary organisations (see section 3.1).
2. Netherlands Organization for Applied Scientific Research (TNO).
3. Large Technological Institutes (GTIs).
4. Research universities of the Wageningen University and Research Centre (WUR).
5. Departmental institutes.
6. Other institutes funded by provinces or other public bodies.

NWO has nine research institutes, focusing mainly on fundamental research in a wide range of research fields. They receive institutional funding to cover personnel and equipment costs, and additional funding is obtained by participation in NWO competitions and attracting other external funds. In 2011, the research institutes received 97 million euros as institutional funding and obtained 57 million euros through NWO competitions[21].

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[20] OCW (2010) Wetenschaps- en Technologieindicatoren 2010.

[21] Dalen et al., "Public Funding of Science : An International Comparison."

The KNAW has 18 research institutes, which are organized around three themes: Humanities and Social Sciences, Life Sciences, and Programming and Social Debate. The budget of KNAW was 150 million euros in 2012. The institutes receive institutional funding which does not depend on past performance. Additional funding can be obtained by applying for (NWO) grants or attracting other external funds[21].

TNO is a non-profit organization that focuses on applied research. Its mission is: *"TNO connects people and knowledge to create innovations that boost the sustainable competitive strength of industry and well-being of society."*[22] TNO focuses on themes that are central the national and European innovation agenda. TNO's consolidated revenue for 2012 was equal to 587 million euros of which a third (192 million euros) was institutional funding from the government. This government funding includes basic funding 40% and demand-driven funding (60%). Besides the institutional funding, the government spend close to 120 million euros on projects performed by TNO[21].

The GTIs receive institutional funding from the government (104 million euros of basic and demand-driven funding in 2012) but the largest part of their budget comes from public (71 million euros) and private (152 million euros) demand driven funding. The research institutes of the WUR focus on agricultural research and are also part of the Foundation DLO (Dienst Landbouwkundig Onderzoek). Furthermore there are some departmental research institutes, like the National Institute for Public Health and Environment (RIVM) or the Netherlands Institute for Social Research (SCP).

3.2.2 Level of autonomy of the publicly funded research organisations

OCW is responsible for the functioning of the national research system as a whole. OCW has the responsibility to define the framework within which the research system should operate, e.g. in terms of internationalisation, emphasis on knowledge valorisation, or focus and mass. Within these broad guidelines, the other actors in the research system, including the research funding bodies and research performing institutes, have their own responsibilities with a large degree of autonomy. This has been the case for many years and there are no significant changes at this point.

3.2.3 Research infrastructures and Centres of excellence/competence centres

Research infrastructures are funded through competitive funding by NWO. The research council has three dedicated schemes for research infrastructures:

- **The National Roadmap Large-Scale Research facilities**: this scheme aims to strengthen the scientific position of the Netherlands by encouraging the development and construction of large-scale research facilities. For this purpose, OCW provides NWO with a structural budget of M€ 40.[23] NWO organises a competition every two-year. The 2013 funding round of the National Roadmap for Large-Scale Research Facilities was solely for projects included in the 2012 Roadmap. The aim of this round was to invest NWO funds for the National Roadmap in the best facilities. These funds are also used for investments in the

[22] www.tno.nl

[23] *Call for Proposals: Nationale Roadmap Voor Grootschalige Onderzoeksfaciliteiten*.

Dutch participation of European infrastructures. Besides that the Ministry of OCW provide targeted funds for the Dutch contribution to international infrastructures such as EMBL, CERN, etc. but also pan European surveys like ESS.

- **Investment Grant NWO Large:** the aim of the programme is to stimulate investments in innovative scientific equipment or data collections of national or international importance. Investment Grant NWO Large is meant for the purchase of equipment and for the setting up, linking and enriching of data collections. The NWO contribution is at least € 1,500,000 for all scientific fields with the exception of the arts, social sciences and humanities for which a lower limit of € 1,000,000 applies.
- **Investment Grant NWO Medium**: this scheme aims to stimulate investments in innovative scientific equipment or data collections of national or international importance. For proposals an upper limit of € 1,000,000 applies for the arts, social sciences and humanities and € 1,500,000 for the natural and life sciences. The lower limit is usually € 250,000, yet for certain research areas this amount may be deviated from.

There are no Centres of Excellence that are financed separately from the aforementioned public research institutes (e.g. TNO and the TTIs). As such, these obtain financing through competitive NWO calls.

3.3 The funding system

3.3.1 Flows of public research funding

In the Netherlands, total R&D expenditures amounted to 2.03% of GDP in 2011, and 2.16% in 2012. The national investment target is 2.5% in 2020 (EU target is 3.0%). Because of the sector structure in the Dutch economy – with a large service sector and a small high-tech sector within a relatively small industry sector – a 2.5% target is argued to be more realistic and appropriate than a 3% target. Government is the second largest funder of overall R&D (35.6%) after the business sector (49.8%). The public funding amounted to 0.72% of GDP in 2011, which is above EU average (0.68% of GDP in 2011). The large majority of research is performed by the Business Enterprise Sector (56.5% in 2012), followed by HEIs (32.4% in 2012). See Table 5 for trends from 2009-2012.

Table 5 Netherlands: Basic Indicators for R&D investments in the Netherlands

	2009	2010	2011	2012	EU27
GDP growth rate	-4.2	1	0.5	-1.6	-0.7 (2012)
GERD as % of GDP	1.82	1.86	2.03 (b)	2.16 (p)	2.08 (2012)
GERD (euro per capita)	631.3	657.1	728.9	772.6(p)	534 (2012)
GBAORD Total R&D appropriations (€ million)	4,851.352	4,857.239	4,975.058	4,664.857	90,351.843 (2012)
R&D funded by Government (% of GDP)	0.74	-	0.72 (35.5%)	-	0.68 (2011)
R&D funded by Business Enterprise Sector (% of GDP)	0.82	-	1.01 (49.8%)	-	1.12 (2011)
R&D performed by HEIs (% of GERD)	40.1	40.3	33.0	32.4 (p)	23.6 (2012)
R&D performed by Government (% of GERD)	12.6	11.8	10.8	10.6 (p)	12.0 (2011)

	2009	2010	2011	2012	EU27
R&D performed by Business Enterprise Sector (% of GERD)	46.7	47.8	56.2	56.5 (p)	63.5 (2012)

Eurostat, Sept 2014. Note: p=Eurostat prevision, b=prevision with break

Table 6 summarises the different flows of public funding (institutional versus competitive funding). Of the public funding, 49% was institutional funding, and 51% was competitive funding. Of the overall R&D expenditures, 17.4% was institutionally publicly funded, and 18.1% was competitively publicly funded. Of the public funding, 22% was allocated to public research organisations (PROs), and 72% was allocated to higher education institutes (HEIs). The public funding constituted 75% of the overall income of PROs, and 70.4% of the overall income of Universities (data for UAS not available). There is no data available on the balance of institutional funding versus competitive funding of PROs. As for HEIs, about 60% of the income is institutional funding, and 15% is competitive funding.

Table 6 Netherlands: Flows of public research funding 2011

	% of Overall Public funding	% of GDP	% of spent on R&D	PROs (% of total income)	HEIs (% of total income)
Institutional	49	0.35	17.4	n.a.	60%
Competitive	51	0.37	18.1	n.a.	15%
Overall public funding	100	0.72	35.5	22 (75)	72 (70.4[1])

(Dalen, Mehmood, Verstraten, & Wiel, 2014)
Note: 1=data for universities only

Table 7 shows the public funds for fundamental and applied research over the years. Historically, the majority of public research funds is spent on fundamental research – mainly conducted at the research universities. Publicly funded applied research is mainly conducted at PROs such as TNO, and at universities of applied sciences. The figure shows a trend of increasing funding for fundamental research and decreasing funding for applied research.

Table 7 Netherlands: Summary of resources for research and innovation

	2009	2010	2011	2012	2013	2014
Fundamental research	3,122	3,183	3,234	3,280	3,282	3,309
Applied research	512	503	488	455	453	407

Kamerstuk 2012

3.3.2 The institutional funding system

Universities are publicly financed via different flows of funds. The research universities receive their public funding via three funding flows.

- The first – the base funding – originates directly from the Ministry of Education, Culture and Science (OCW) and tuition fees paid by students. It is approximately 60% of total university revenue.
- The second flow of funds consists of research council funding and represents 10 - 15%.
- The third flow of funds makes up the remaining 25 - 30%.

As far as the *first stream* of funding is concerned, each research university receives a formula-based lump sum (block grant) for teaching and research. The lump sum allocation is based on measures of volume (student numbers, diplomas), prices (rates per student) and historical considerations. The allocation mechanism is known as the *BAMA model*, named after the BA and MA degrees that were introduced from the year 2002 onwards. The BAMA model is largely formula-based; it distributes a given sum of money (set by Parliament) across the 13 research universities. The formula takes into account the relative performance of each university (as compared to the other universities).

The Netherlands Organisation for Scientific Research (NWO) is responsible for allocating the *second* flow. NWO receives funding from the Education ministry and the Ministry of Economic Affairs (the latter supports the natural/technical sciences). NWO then awards project funds after reviewing the research proposals submitted by researchers. Competition for this type of prestigious funding is high. Only universities can win competitive research council grants. Such grants have become more important over the years but are still not very large.

The *third* flow of funds consists of a heterogeneous mix of revenues from activities such as contract research (approximately half of the third stream), contract teaching, consultancies, research commercialization, endowments and renting out university facilities. Clients are: private businesses, government, non-profit organizations and the European Union, as well as individual students and staff.

The Dutch universities profit of all three funding streams. Another source of funding are tuition fees. Table 8, below, provides an overview of the different sources of income of universities.

Table 8 Netherlands: University funds

	2004	**2011**
Grant Government	61%	57%
Tuition fees	7%	8%
Contract research	22%	26%
Other funding	10%	9%

Source: VSNU

3.3.2.1 *Criteria used for decision-making on sources allocation*

The BAMA allocation consists of a *teaching* component and a *research* component, but this distinction is for calculation purposes only. The teaching component is 45% of the lump sum and the research component makes up the remaining 55%.

The *teaching component* consists of (a) a new entrants allocation; (b) a diploma (BA/MA) based allocation; and (c) a basic allocation. For individual universities, the shares may differ, due to their relative performance. The *basic allocation* consists of fixed amounts per university. These amounts differ also across universities; they have a historical basis. The emphasis on performance increased in 2000, as degrees received a higher weight in the formula.

The *research component* of the BAMA funding model consists of three parts:

A. A basic allocation
B. Allocation for PhDs and designer certificates (in Dutch: *ontwerperscertificaten*);
C. Provision research

Ad A: The first part – the basic allocation – consisted till 2003 of fixed allocations per university. Since 2003 these part is based on the number of Bachelor and Master diploma's.

Ad B: As part of their research budget, Dutch universities receive a premium for each postgraduate degree – i.e. PhD, designer certificate – awarded (based on two-year averages). For PhDs, two funding rates apply. The rates for science PhDs are twice as high compared to social science PhDs.

Ad C: This component consists of different elements. The funding is based on a formula taking into account the type of university (e.g. technical university get extra funding for their research facilities, Labs, etc.) and some specific tasks. Furthermore is contains funding for specific activities (e.g. funding for sector plans, top research, etc). The exact formula for funding is subject to many changes even during the year. These changes are being made by the Ministry of OCW. It is felt that this art of the formula for research funding is not very transparent.

In term of funding part C is the biggest part: about 62% of the total budget. Part B determines around 22% and Part A around 16% of the total research funding.

In 2007, an amount of € 100 million was taken out of "first flow funding" and redistributed according to each university's success in terms of winning research council grants (from NWO) and selected competitive research contracts in the third stream of funding. However, after a new Cabinet took office in 2007, the Smart Mix policy was abandoned and the 100 million was redistributed by the research council for strengthening fundamental research in universities.

Table 9 Netherlands: Components of the institutional funding for research

Mechanism	%
Block grant	0
Formula-based funding	100%
• Indicator 1: # Bachelor and Master Diploma's	16%
• Indicator 2: PhDs and designer certificates	22%
• Indicator 3: distribution based on type and specific tasks activities	62%
TOTAL INSTITUTIONAL FUNDING	100%

* Is additional funding, not part of the institutional research funding for universities.

3.3.2.2 *Performance contracts & processes*

In 2012 the Ministry of Education, Culture and Science (OCW) introduced performance agreements for all colleges and universities. The starting point for the agreement was the ambitions of the colleges and universities in the field of education, research and valorisation. Colleges and universities were asked to indicate their strengths and develop a certain profile based on these strengths. This result in a tailor made performance agreement per college / university. A small part of the funding (7%) is linked to these agreements. This are additional funds, the money is not part of the institutional funding for research. The colleges and universities can get funds if they meet the objectives in the performance agreement.

3.3.2.3 *Processes for funding system implementation*

The research organisations that are entitled to receive public institutional funding are mentioned in the Law on Higher Education and Research (Uitvoeringsbelsuit WHW). The organisation must we accredited by the Accreditation Organisation of the Netherlands and Flanders (NVAO). The NVAO assess the potential quality of higher education provision alongside national authorities appraisal of legal and organisational issues. After accreditation the higher education institute can receive institutional funding. There are no other bodies, e.g. centres of excellence, competence centres that receive institutional funding.

3.3.2.4 *Governance of the funding system*

The institutional funding for research organisation is the responsibility of the Ministry of OCW. The grants for intermediary organisations like NWO and RVO is provided by Ministries (OCW for NWO and Economic Affairs for RVO). In addition all the Ministries has own research institutes, e.g. the Scientific Council for Government Policy (Ministry General Affairs), African Studies Centre (Ministry Foreign Affairs) and the research centres at the Wageningen University.

There are no formal coordination mechanisms between Ministries or research funders to ensure adequate coverage of different scientific fields. The research organisations themselves are responsible. The Executive Boards of the universities and research institutions have a large degree of autonomy for research and are also free to allocate the funding from the first low as they wish (even across teaching and research activities). However, sometimes the Ministry of OCW can intervene with specific support measures for certain disciplines (e.g. mathematics).

The national research priorities do not influence institutional funding allocations as this is formula based. Only 7% of the (teaching) budget is linked to the performance agreements.

Funding of large-scale research infrastructures is coordinated in the National roadmap for infrastructures. This roadmap is updated form time to time. NWO receive 40 million euro per year for the implementation of the National Roadmap.

3.3.3 Feedback and reflections on the funding system

In a study on research funding in the last thirty years the Rathenau Institute comes to a number of conclusions:

- The growth of public research funding in the Netherlands has decreased as % of National GDP and compare to private R&D. The public funding of Research in the Netherlands as a percentage of GDP is equal to the average for the EU, and above the average of the OECD, but lower than in EU countries such as France, Germany, Finland, Sweden and Austria.
- The funding for basic research is relatively stable. Basic funding for university research and fundamental research targeted funding streams has not decreased relative to other streams.
- Within the total core funding for universities and research institutions the proportion of basic funding has declined. Universities and research institutes became more dependent on other funding streams (like competitive funding, EU funding, contract funding).
- The number of programs has increased exponentially, as well as the policy objectives associated with it. More in general there is a wide variety of funding instrument sin the Netherlands for research and innovation. Many of these instruments exist only for a rather short period; there is a lack of continuity.
- The Ministry of Economic Affairs – as the coordinator of innovation policy – has gain more and more influence on the research infrastructure in the Netherlands. Economic relevance of research has become much more important and determine also a (larger) part of the funding for research.[24]

In general research institutions and policy makers are rather satisfied with the funding system in the Netherlands. It provides sufficient means for a broad range of disciplines. Bibliometric studies show that Dutch researchers are relatively productive

[24] Rathenau Instituut, *30 jaar onderzoeksfinanciering* (Den Haag 2012).

and have high citations scores. In general the research in the Netherlands is of a high very high level.

A general complaint is the fact that research organisations faces decreasing budgets and argue for increasing investments in Research and Innovation. Extra funding is needed in order to maintain the high level research in the Netherlands. Also the exact formula for research funding for universities is not very transparent and subject to changes.

There are a number of issues debated when it comes to research funding in the Netherlands:

- The need of matching funds. Universities underline that the increased dependency of 2e and third funding flow requires matching funds within the university. NOW and the EU does not provide full cost funding so the universities has to 'match' these funding streams with own means. There are different views whether matching is a real problem for the universities.
- The autonomy of the institutes: there are many new funding instruments introduced in the Netherlands, e.g. Top institutes, TKI's, funding programmes. The effect is that much more research is carried out in consortia, programmes, temporary) institutes outside the university. The research in these consortia, programmes, etc. is in many cases driven by a specific (economic / societal) agenda. So the level of autonomy for universities/ individual researchers has decreased.
- Efficiency of the funding system. Bibliometric studies show a relatively good performance of the Dutch research, both in terms of productivity and citations. However, the productivity per Euro invested in the research system is rather low. This might indicate a low efficiency of the funding system. Possible reasons are research money that is being used for teaching staff, the expensive PhD system or the cost for intermediary layers.
- Complexity: the increased number of finding arrangement raises the question if there is an effective steering mechanism. Aren't there too many instruments with their own steering (scientific excellence, young talents, societal relevance, etc.). Is there sufficient alignment between these instruments at a system level?

4. Norway

4.1 The R&D governance system

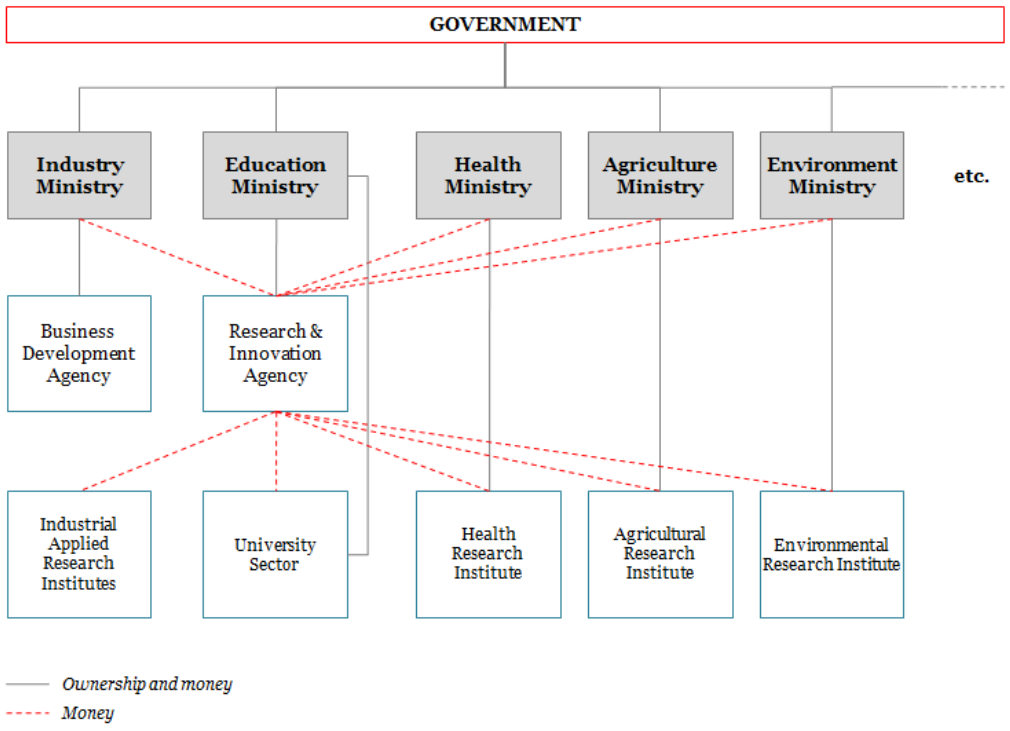
The Norwegian R&D system is first of all characterized by a strong sector principle. All ministries have a long-term responsibility for the research in their sectors – the broad sector responsibility – and a responsibility for research covering the ministries' own knowledge needs for policy development and governance. In short, the sector principle involves:

- An overall responsibility for research in the sector
- Responsibility to monitor the sector's needs for knowledge
- Responsibility to fund research in the sector
- Responsibility for international research collaboration

The Norwegian Ministry of Education and Research (KD) has the coordinating role of the research policy. It is carried out through strategic processes, budgetary coordination and the agency steering of the Research Council of Norway (RCN). The white paper on research ("Forskningsmeldingen") presented every 4-6 year to the Parliament, is the most important strategy document – pointing out the direction for the research policy in the coming years.

4.1.1 General oversight

Figure 3 Norway: The R&D governance structure in Norway



Source: Technopolis

RCN is an agency of KD (the Ministry of Education). Norway differs from many other countries in that it only has one research council. Close to half of RCN's income is provided by two ministries: the Ministry of Education and Research (28% of Ministry funding in 2010) and the Ministry of Industry and Trade (23% in 2010). Other ministries with relatively important shares in RCN's funding are the Ministry of Oil and Energy (~10%) and the Ministries of Fisheries and Coast, Agriculture & Food, and Environment, each accounting ~5% (in 2010). RCN was created in order to combat the tendency of the sector principle to fragment the Norwegian research and innovation system. It channels almost a third of the state's spending on R&D from sixteen ministries. The intention from the outset was to provide it with 'strategic' resources to counter-balance fragmentation. Important challenges are e.g. related to whether research funds are effectively utilized and in the areas where they are most needed; difficulties to realize cross-sectorial research (and that is not necessarily connected to one sector's needs).

- Due to the strong sector principle, all ministries have their responsibilities. Former governments have had a so-called research committee (level 1, "Regjeringens forskningsutvalg"), but the common perception is that this has not been a very active or important committee, and that no one at level 1 has been willing to have a national coordination role. The current government has recently discontinued the research committee. Therefore, the Ministry of Research and Education (KD) (level 2) is the true coordinating unit. The White Paper on research to the Parliament is produced by KD and coordinated with other ministries (most important are health and trade, industry and fisheries, and to some degree petroleum and energy, and climate and environment).

  In analytic terms, KD's coordination of research is 'weak' coordination, where the role of KD is to collect and share information about the research activities of the various sector ministries and bottom-up to prepare the national research budget. FFN provided resources that KD has used to fill gaps and launch new policies. We distinguish this from 'strong' coordination, which would involve imposing priorities or reallocating resources among ministries. KD's leadership of the process of setting national priorities in successive White Papers similarly amounts to 'weak' coordination, where the White Paper proposes directions rather that being strongly coupled to mechanisms that impose them[25].

- All ministries fund research (albeit to various degree) and in principle, all ministries fund competitive research, through channeling funds via RCN. Some ministries, however, have direct funding of institutional research, e.g. primary industry research institutes being funded by the primary industry sector ministries (e.g. agriculture and fish). In general, there is little direct public funding of research outside RCN. The system is characterized either by basic funding or funding through RCN.

- RCN, Innovation Norway and SIVA are the three main players in the national research, development and innovation industry and business support system. The three agencies have different roles, responsibilities, and tasks, but are required to cooperate in areas of common interest where there are risks of overlap. In short, the contrasting roles of the agencies could be described as follows: SIVA's investments are geared towards physical and virtual centre and incubator investments aiding innovation, while RCN's focus is on creating commercial and

[25] Jasper Deuten and Patries Boekholt, *Prioritering in kennis- en innovatiebeleid*, Ervaringen uit Canada, Duitsland, Frankrijk en Noorwegen, Den Haag: Ministerie van Economische Zaken, Landbouw en Innovatie, 2009

social value via research grants. Innovation Norway works largely through loans and is geared towards creating socioeconomic benefits from entrepreneurship, business development and innovation but without having a research funding role. In contrast to SIVA, Innovation Norway and RCN both base their support in individual enterprises and projects, which are in turn encouraged to create networks. SIVA, on the other hand does not support individual undertakings, focusing instead on the development of physical and organisational infrastructure.

- *Research Council of Norway (RCN):* is a subordinate organ to KD. Reports directly to KD. To some degree RCN also acts as an interest organization on behalf of the research community (e.g. writing critical chronicles in newspapers etc.).
- *Innovation Norway (IN*): Is the Norwegian Government's most important instrument for innovation and development of Norwegian enterprises and industry. IN is owned by the Ministry of Trade, Industry and Fishing (51%) and the 19 county governments of Norway (49%). IN's main purpose is to support companies in developing their competitive advantage and to enhance innovation. IN supports industry-related research (more emphasis on development, than on research though).
- *SIVA (The Industrial Development Corporation of Norway):* is a governmental corporation and national instrument founded in 1968, owned by the Norwegian Ministry of Trade and Industry. SIVA aims to develop strong regional and local industrial clusters through ownership in infrastructure, investment and knowledge networks as well as innovation centers.
- *Regional health authorities (RHA):* We also add a fourth type of agency; the regional health authorities (in total four), whose main purpose is to provide specialized health care services to the Norwegian population. In addition to running the public hospitals in Norway, the RHAs have three main responsibilities: research, education and training of patients and their relatives. The RHAs reports to the Ministry of Health and Care Services.

- There are three main types of research organizations in Norway: 1) higher education institutions, 2) hospitals, 3) independent research institutes. The latter is somewhat unique in Norway, because its contribution to the overall R&D in Norway is almost at the same size as that coming from the higher education sector. In addition to this private companies constitute a fourth main type. R&D at the county and municipality level is practically non-existent (so is the contribution from NGOs).

  Like other countries, Norway has chosen to make its research performers increasingly autonomous and to a great extent to steer them using performance-based funding systems to promote quality, and using external project-based funding to steer research in thematic terms.

  The 2002 Quality Reform of the Higher Education Sector introduced significant changes in governance. It granted the HEIs more autonomy (e.g. for the use and internal distribution of their public funding) and tackled quality in teaching and research by introducing a performance-based funding model (PBRF), fully implemented in 2006. A similar model was also implemented for part of the core funding in the research institute sector in 2009. The reform aimed to encourage modernisation and greater ability to respond strategically to contextual changes and pressures. This implied a change in the relationship between the higher education sector and the government. Government maintained its ability to influence research directions, steer the research base to align with policy priorities, and ensure performance through more external competitive funding and shifting the balance of core funding towards more performance-related

funding. More open competition for funding based on quality and relevance was expected to lead to a more 'dynamic' division of labour in the research system. A key objective was to ensure effectiveness and efficiency of the university and institute sectors in fulfilling their roles in the education and research system.

Other interventions such as the 2005 Act on Universities and University Colleges increased the their responsibility for strategic management of research and granted them the right commercially to exploit intellectual property they developed. The Acts also mandated that the universities facilitate research-based innovation through the licensing of technology and spinning off new enterprises. The universities responded by establishing Technology Transfer Offices, in some cases jointly with university colleges and other institutions. (RCN's FORNY commercialisation programme was for a time used to support these start-up operations.) Norway opted not to have a Danish-style forced merger between the government laboratories and the universities, although there has been some merger activity on a voluntary basis, through mergers among the food research institutes and a merger between certain institutes and Oslo University College.

4.1.2 National strategies & priorities for research

Overview of the research strategies

- The national research strategies are primarily defined through three documents: 1) KD's white paper on research – and the follow up in annual state budgets, 2) different strategies from ministries (i.e. sectorial strategies – for example strategy for innovation in the public sector, or strategy for biotechnology research), 3) "21-processes" (a stakeholder-driven national strategy process on behalf of the government or ministries to promote research-based value creation and development in key areas of society for the 21st century). The white paper on research (alt. 1 above) is the main document for research priorities in Norway, and is considered essential to RCN whose follow-up is strong.
- In the white paper to the Parliament *Climate for Research* ("Klima for forskning", St.meld. nr. 30 (2008-2009)), the Government described five thematic and four systemic approaches that should form the baseline of Norwegian research policies were introduced. In the most recent white paper these remained the thematic and systematic approaches.
  - Thematic approaches:
    - 1) Global challenges: solutions to global challenges, particularly within environment, climate, marine, food safety and energy.
    - 2) Improved health and health care services: good health, reduced social inequalities in health, and health care services of good quality.
    - 3) Welfare and research-based professional practice in the welfare services.
    - 4) A knowledge-based business/industry sector in all areas of Norway.
    - 5) Industry-relevant research in strategic areas: industry development in the following areas: food, marine, maritime, tourism, energy, environment, biotechnology, ICT and new materials/nanotechnology.

In order to achieve this, four systematic approaches were identified:

- A well-functioning research system
- Research of high quality
- High degree of internationalisation in the research
- Effective utilization of research resources and results

Implementation of the research strategies

National strategies are implemented by RCN (competitive funding) and through institutional funding (earmarked funds and KD's budget letters ("tildelingsbrev") to the institutions). The growth in national R&D expenditures is concentrated in the prioritized areas. It is not channelled through or reflected in any ways in the PBRF.

4.1.3 Level of autonomy of the public research funding bodies

The risks inherent in sector-based steering of research were clearly identified in the report of the Grøholt committee. The documents that set out RCN's goals and responsibilities include the report of the parliamentary committee for KUF (the predecessor of KD) identified the need for a 'countervailing force' that would balance the fragmenting tendency caused by sector interests with centralising tendency that reflected the collective interest. Amongst other things[26], it says

> *The government will give RCN framework conditions that enable the Council to play an independent strategic role. In this connection, the government will ensure stability in the overall budgets given to RCN as it becomes established, and to ensure that the funding structure allows RCN to act as an independent strategic research agency.*[27]

RCN makes strategies within an overall framework. Strategy development is weak at level 1, strong at level 2, concentrated at level 3, and fragmented at level 4. RCN, Innovation Norway and the RHAs all have strong coordinating roles and strategic action frames in addition to a strong executive role. Within their budget frames they are allowed to make strategic decisions. Technopolis' interviews and review of documents in their 2011-evaluation of RCN suggest that the steering processes between RCN and individual ministries are cordial and based on trust – more so than was the case 10 years ago – and some ministries have increased the proportion of their research expenditure that they channel through RCN as a result. All the ministry representatives that Technopolis interviewed were pleased with the dialogue with RCN. They all found RCN to be expedient and competent and thought that RCN understands their needs. They were also pleased with RCN's reporting, though reporting needs differed considerably among ministries. The ministries of Trade, Industry and Fisheries and Health and Care Services required intensive monitoring and frequent data deliveries, while KD and other ministries were less focused on data inputs.

Technopolis described the dialogue to be more two-way now than before. Allocation letters have overall developed positively and become more instrumental and distinct. The number of guidelines has generally not increased and the ministries say they listen more than before to RCN when drafting allocation letters.

In the health sector, the RHAs are working through annual allocation letters ("styringsdokumenter"), where some general objectives are specified for their research activities: minimum 20 percent of publications to be co-authored with international co-authors and 20 per cent of publications to be published at level 2 in the hospital sector's PBRF. Research strategies and distribution of funds to hospital within each regional health authority is up to the RHA to decide.

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[26] Arnold, E., Mahieu, B., A Good Council? Evaluation of the Research Council of Norway, Technopolis Group, 2012

27 Innst. S. nr. 192 – 1992–93, p 5

- Each ministry have its budget/allocation letter to RCN. Ministry of health and care services has its budget/allocation letter to the RHAs and Ministry of Ministry of Trade, Industry and Fish to Innovation Norway.
- Funding/responsible ministries do this on a regular basis and in their follow-up of the institutions' budgets. Both Innovation Norway and RCN has been the subject of external evaluations. The Office of the Auditor General of Norway also monitors these funding agencies. In the Ministry of Research and Education, talks are continuously held between the ministry and the higher education institutions. A new Management By Objective (MBO) system for RCN was implemented in the steering and reporting process between the funding ministries and RCN in 2010-2011. It represents an attempt to integrate ideas from the New Public Management into that relation, supporting the ministries in the exercise of their sector responsibility with respect to research while at the same time enabling coordination and a streamlined process of instruction and reporting. It also provides an opportunity to review the degree of specificity in ministry instructions and the dialogue with RCN about particular activities and therefore the room RCN has to manoeuvre in trying to optimise its activities at the national level while still making sure that sector needs are met. The MBO system involves three high-level goals, broken down into a total of 13 subgoals. In 2011, most of the ministries adopted the system. It is largely overlaid on previous practice, with letters of allocation providing an indication of which MBO sub-goals ministries want RCN to pursue on their behalf in addition to a traditional set of tasks and guidelines.

Positioning versus the research organisations

- There has been a debate in Norway to what degree the ministries have implemented a hands-off approach towards the research organisations. Both KD and the Ministry of Trade, Industry and Fisheries seem to have implemented this. The smaller primary industry ministries have arguably a stronger and continuous steering through their grant letters.
- RCN has a national responsibility for evaluating research in Norway. This is done either by subject-specific evaluations, institute evaluations or thematic evaluations (in addition to evaluations of various research programmes in RCN). According to Technopolis (2011), the closest thing RCN produces to direct 'advice' to research performers is the results of its field evaluations. As far as we know, neither the regional health authorities, SIVA or Innovation Norway as ever issued any evaluations of the organizations that they have funded.

4.2 The R&D system

4.2.1 Characteristics of the publicly funded research organisations

In essence, Norway has three types of publicly funded research organisations: higher education institutions, public hospitals and the institute sector. The higher education sector counts of 8 universities, 8 specialised university colleges and 36 accredited university colleges. Their missions defined in the "Act relating to universities and university colleges" comprise: a) providing higher education on the basis of the foremost within research, academic and artistic development work and empirical knowledge. b) conducting research and academic and artistic development work. c) efficiently managing resources provided and actively seeking provision of external resources. d) helping to disseminate the results of research and of academic and artistic development work. e) contributing to innovation and value creation on the basis of the results of research and academic and artistic development work. f) making provisions for participation in the public debate by the institution's staff and students. g) helping to ensure that Norwegian higher education and research participates in the front line of international research and development of higher education provision. h) cooperating with other universities, university colleges and corresponding institutions in other countries, local and regional civic and working life, public administration and

international organizations. i) providing continuing and further education in the institution's field of operation.

The overall goal of the research institutes in the latter sector is to provide applied research with high relevance to industry, public sector and society in general in a competitive marked. The institute sector also has a responsibility for knowledge development in national prioritized areas, and a special role in relation to innovation: merging basic and applied research. The institute sector is more than any other sector, the one that effectuates the national prioritized areas (especially the funding in relation to global challenges).

Norwegian R&D can be distributed across four sectors. Their shares of total R&D expenditures in Norway (2011) is as following:

Table 10 Norway: Shares of total R&D expenditures in Norway (2011)

Sector	Percentage
Private sector	44 %
Higher education institutions	26 %
Institute sector	23 %
Hospitals	6 %

Source: Report on Science & Technology Indicators for Norway 2013. Oslo: RCN.

In the institute sector, the R&D expenditures are distributed as following:

Table 11 Norway: Shares of total R&D expenditures in the institute sector in Norway (2011)

Sector	Percentage
Other institutions with R&D	19 %
Research institutes with basic funding from a ministry	16 %
Agricultural and fishery research institutes	11 %
Technological and industrial research institutes	9 %
Environmental research institutes	9 %
Social sciences research institutes	8 %
Regional research institutes	3 %

Source: Report on Science & Technology Indicators for Norway 2013. Oslo: RCN.

Table 12 Norway: Current expenditure on R&D by field of science and sector of performance 1991-2011 (mill NOK, per cent)

	HE*	%	Institute sector	%	Private	Total	%
Humanities	1311,4	9,8 (11,8)	215,9	2,0	-	1527,3	3,6
Social sciences	3057	22,8 (27,5)	1833,4	17,2	-	4890,4	11,5
Mathematics and natural sciences	2380,1	17,8 (21,4)	2006,3	18,8	-	4386,4	10,3
Technology	1819,2	13,6 (16,4)	3626,4	34,0	-	5445,6	12,8
Medicine and health	4590,6 (2323,1)	34,3 (20,9)	1323	12,4	-	5913,6	13,9
Agriculture, fisheries and veterinary medicine	229,3	1,7 (2,1)	1652,3	15,5	-	1881,6	4,4
Unspecified	-		-		18532,5	18532,5	43,5
Total	13387,6 (11120,1)	100	10657,3	100	18532,5	42577,4	100

Source: NIFU/Statistics Norway.*Including university hospitals. Numbers in parentheses when university hospitals are excluded

As shown in Table 12, above, there is a clear division of labour between higher education institutions and the institute sector: Medicine and health is mainly a field in the higher education sector, whereas technology and (particularly) agriculture, fisheries and veterinary medicine are strongholds in the institute sector. Of the 4,59 billion NOK in medicine and health research in HE, the university hospitals accounted for 2,27 billion NOK, so that social sciences is the largest scientific field in Norwegian universities and university colleges. Similar trends are observed across the national thematic research priorities (Table 13).

Table 13 Norway: Thematic areas by sector (2007-2011) in mill NOK (%).

	HE*	%	Institute sector	%	Private	%	Total	%
Global challenges	1946,7	21,1	3609,1	38,1	5332	59,6	10887,8	39,4
Food	436,1	4,7	1177,1	12,4	965,7	10,8	2578,9	9,3
Marine	453,1	4,9	1642,7	17,3	191,8	2,1	2287,6	8,3
Maritime	247,3	2,7	327,1	3,5	906,3	10,1	1480,7	5,4
Health	4580,4	49,7	1898,7	20,1	1545,5	17,3	8024,6	29,1
Welfare	511,5	5,6	623,5	6,6	0	0,0	1135	4,1
Education	975	10,6	121,1	1,3	0	0,0	1096,1	4,0
Tourism	59,7	0,6	69,3	0,7	0	0,0	129	0,5
Total	9209,8	100,0	9468,6	100,0	8941,3	100,0	27619,7	100,0

Source: NIFU/Statistics Norway.*Including university hospitals.

4.2.2 Level of autonomy of the publicly funded research organisations

- Yes, in the HE-sector there is a large degree of autonomous decision-making for the ROs as receivers of basic funding. The institute sector is by large a "free sector". The 2002 Quality Reform of the Higher Education Sector introduced significant changes in governance. It granted the HEIs more autonomy (e.g. for the use and internal distribution of their public funding) and tackled quality in teaching and research by introducing a performance-based funding model (PBRF), fully implemented in 2006. A similar model was also implemented for part of the core funding in the research institute sector in 2009. The reform aimed to encourage modernisation and greater ability to respond strategically to contextual changes and pressures. This implied a change in the relationship between the higher education sector and the government. Government maintained its ability to influence research directions, steer the research base to align with policy priorities, and ensure performance through more external competitive funding and shifting the balance of core funding towards more performance-related funding.
- The internal distributions/processes are formally free, but in reality the universities are bound. The real autonomy is limited due to a large share of the funds being tied up in undergraduate students, phd-students, salaries, etc. This implies a limited strategic window for the units to make their own priorities. In the institute sector, the basic funding is a small proportion of the total income, but may be spent freely at activities aimed at long-term competence building, and promoting scientific quality and international cooperation.
- The HE-institutions report officially every year. The reports are publicly available at the reporting website.[28] An overall analysis is presented every year in a report by KD called "Status in the higher education sector" ("Tilstandsrapport for høyere utdanning"). The institute sector report to RCN, while the hospitals report to the RHAs.
- Following the introduction of PBRF inn all sectors (HE, institute and health care), more of the reporting is done directly through PBRF-indicators**.**

4.2.3 Research infrastructures and Centres of excellence/Competence centres

- National research infrastructures are funded on a competitive basis by RCN who has made a "road-map" (i.e. a priority plan) for infrastructure. The first version of the Norwegian Roadmap for Research Infrastructure was published in 2010. It presented large-scale projects of national importance that had achieved very high ranking in the first funding round under the National Financing Initiative for Research Infrastructure in 2009. The roadmap is to be revised after each major funding announcement for research infrastructure issued by the Research Council. The first revision was published in 2012. The Norwegian Roadmap for Research Infrastructure 2014 has been updated on the basis of the outcome of the assessment review process under the third funding round in 2012.

The Ministry of Education and Research now sets aside an earmarked allocation for research infrastructures, and the Research Council of Norway has established a dedicated funding initiative. A total of over 200 grant applications have been processed, and funding has been awarded to around 40 infrastructure projects.

[28] http://dbh.nsd.uib.no/styringsdata/

Funding decisions have been made in an application review process in which competition based on scientific merit is combined with an integrated assessment of strategic importance. Under the infrastructure initiative, funding may be sought for research infrastructure of national character with investment costs of more than NOK 2 million. The maximum amount of funding that may be sought from the Research Council is NOK 200 million.

In addition to this, some research infrastructure is especially funded through earmarked grants in the state budget, and the HE-institutions do invest in this themselves (either from their basic budgets but also through external funding from e.g. EU)

- There are earmarked funds for this through 1) specific programmes at the RCN, 2) directly from the state budgets (e.g. all research infrastructure at Svalbard is funded in unique posts in the budgets), 3) participation in large European efforts (e.g. International Spatial Centre in Sweden).

In RCN's National Financing Initiative for Research Infrastructure (INFRASTRUKTUR) funding is also provided for Norwegian participation in Nordic, European and other international cooperation on research infrastructure, including Norwegian participation in the implementation phase of projects on the European Strategy Forum on Research Infrastructures' (ESFRI) Roadmap. For distributed international research infrastructures, funding can be provided under this initiative for building-up and operation of the Norwegian contribution of the research infrastructure. Decisions regarding international research infrastructure cooperation involving major, long-term commitments in the form of investments and membership dues are taken at the ministerial level.

- The Centres of Excellence scheme is a national programme under the auspices of the RCN, who provides the basic source of funding for the scheme (10-year funding, the CoE grant is about 1-2 mill Euro per year per centre). Additional funding comes from the institutions themselves: "The funding plan is to be based on the principle that the Research Council of Norway in conjunction with the host institution, or with a SFF consortium consisting of the host institution and its partners, will jointly provide the resources required to perform the centre's activities… Contributions may be provided in the form of own financing, staff placed at the disposal of the centre and/or essential infrastructure. The Research Council of Norway requires that the host institution and any consortium participants cover expenses for the premises, electricity, heating and other infrastructure for the centre, and that a reasonable amount of scientific equipment be placed at the disposal of the centre. Research funding that promotes the centre's activities, e.g. EU funding, project or strategic grants from the Research Council or other sources, may be counted toward the required contribution".
- High scientific quality is the main criterion for the selection of the centres, and are picked by RCN. The competition for status as a Centre of Excellence is fierce; in 2011, 139 research groups submitted applications. Of these, 29 were found to be strong enough to make it to the final decision round. Only 13 passed the final test, after a detailed and time-consuming application process. A new process is soon to begin.

The funding system

Most striking about R&D expenditures in Norway, is that the research institute sector is almost as large as the higher education sector (Table 14).

Table 14 Norway: Total R&D expenditure in Norway by sector of performance/type of institution, 2011.

	Bill NOK	Per cent of total R&D 2011
Industrial sector	20,066	44
Higher education sector	11,989	26
Institute sector	10,610	23
Health trusts	2,776	6
Total Norway	45,440	100

Source: RCN Indicator report, 2013

There is clearly a division of labour between the R&D performing sectors in Norway (Table 15): The industrial sector conducting experimental/developmental R&D, the institute sector conducting applied research and the Higher education sector conducting basic research.

Table 15 Norway: Current expenditure on R&D by type of R&D and sector of performance, 2011. Billion NOK and per cent

Sector of performance		Total	Basic research	Applied research	Experimental development
Industrial sector	Bill NOK	18 532	495	3891	14145
	%	100	3	21	76
Institute sector	Bill NOK	10 657	1400	7260	1996
	%	100	13	68	19
Higher education sector	Bill NOK	13 387	6278	5435	1672
	%	100	47	41	12
4.2.4 Total	Bill NOK	42 577	8175	16588	17814
	%	100	19	39	42

Source: RCN Indicator report, 2013

4.3 The funding system

4.3.1 Flows of public research funding

Total R&D expenditure in Norway in 2011 was 1.65 per cent of GDP (Table 16). 43 per cent of this was from public spending on R&D, of which 31 per cent was in the higher education sector, i.e. R&D expenditure in the Higher Education Sector was 0.5 per cent of GDP.

Table 16 Norway: Key numbers for R&D expenditure in Norway 2005-2011

	2005	2007	2009	2010	2011
R&D Expenditure (total) as percentage of GDP	1,51	1,59	1,76	1,68	1,65
R&D Expenditure funded by Government as percentage of Total R&D Expenditure	45,0	43,0	42,0	-	43,0
R&D Expenditure in the Higher Education Sector as percentage of total R&D expenditure	31,0	32,0	32,0	32,0	31,0

Source: RCN Indicator report, 2013

Like most countries, Norway has a **'binary' research funding system**, where state research performers get general core or 'institutional' funding and supplement this by competing for external project-based funding.

Table 17 indicates that the large universities are more dependent on external funding than the smaller HE-institutions.

Table 17 Norway: Total R&D costs, 2011, by sector, institution and funding source

	Total R&D costs (bill NOK)	Direct state funding (%)	External funding (%)
University of Bergen	1 730,7	64	36
University of Oslo	3 096,8	57	43
University of Tromsø	1 151,7	60	40
Norwegian University of Science and Technology	2 450,6	55	45
Norwegian University of Life Sciences	521,5	63	37
University og Stavanger	368,3	69	31
University of Agder	274,1	82	18
University of Nordland	172,5	69	31
Norwegian School of Economics	148,2	88	12
Norwegian School of Veterinary Science	154,1	59	41
Others[1]	739,4	80	20
SUM UNIVERSITIES AND STATE UNIVERSITY COLLEGES	***10 807,9***	***61***	***39***
Regional university colleges[2]	**1 181,0**	**78**	**22**
University hospitals	**2 270,6**	**83**	**17**
Research Institute Sector	**10 912**	**11**	**89**

1Includes e.g. Norwegian School Of Sport Sciences, Norwegian Academy of Music, Norwegian Business School, The Norwegian Police University College.[2] Includes e.g. Oslo University College, Bergen University College, Lillehammer University College, Molde University College.

Source: RCN Indicator report, 2013

4.3.2 The institutional funding system

In this section we describe the funding system for the three main set of actors in publicly funded R&D in Norway: the Higher Education institutions, the research institutes in the institute sector, and the public hospitals. There are different funding models for each sector.

Criteria used for decision-making on sources allocation

Funding model

The Higher Education Sector: The funding of the institutions consists of three main components: the basic funding, a teaching component and a research component.

- *The basic funding*: equals the total budget of the institutions at the time the PBRF funding model was introduced, minus the current teaching and research components. The basic funding has, however, also been adjusted individually for each institution on the basis of special priorities. For all HE-institutions in Norway, the average share of the block grant is 60 per cent (Table 18).

Table 18 Norway: Share of state funding for Higher Education institutions, 2008

	Basic funding	**Teaching component**	**Research component**
Universities	55 %	22 %	23 %
State university colleges	61 %	22 %	17 %
Regional university colleges	69 %	28 %	3 %
Private academic colleges and colleges	49 %	43 %	8 %
All HE-institutions	60 %	25 %	15 %

- *The teaching component:* is distributed on the basis of produced study credits and incoming and outgoing exchange students. This component has an open budget frame, i.e. it will increase as the number of students and study credits increase. On average this component constitutes 25 per cent of the budgets in the HE-sector.
- *The research component*: is made up of two parts – a strategic grant and a performance-based component. The strategic grant is mainly made up of funds for phd-positions and scientific equipment. The performance based component is based on four indicators (weights and value for money in 2014):
  - 0,30 Doctoral degree candidates (320 108 NOK per candidate = approximately € 38 000)
  - 0,18 Grants from EU's framework program for research (and related EU activities) (1 309 NOK per 1 000 NOK received)
  - 0,22 Funds from the Research Council of Norway and regional research funds (156 NOK per 1 000 NOK)
  - 0,30 Publication points (31 290 NOK (approximately € 3 750) per publication point).

The publication points are calculated using the following weights:

Table 4 Norway: The publication indicator – components (2014)

Scientific publications	Weight level 1	Weight level 2	NOK level 1	NOK level 2
Articles in scientific journals	1	3	31 290 NOK	93 870 NOK
Articles in anthologies	0,7	1	21 903 NOK	31 290 NOK
Monographs	5	8	156 540 NOK	250 321 NOK

Publications are fractionalized by author addresses. Publication channels at level 2 constitute the most prestigious journals/publishers, and the share of publications in these channels represents approximately 20 per cent of all publications.

Unlike the teaching component, the research component has a fixed frame, i.e. how much each institution will get depends both on its own, as well as the production of all other institutions. On average, the research component constitutes 15 per cent of the HE's funding, but with large variations between the four types of institutions in the sector. Universities have by far the highest relative share (23 per cent).

The Regional Health Authorities (RHA): There is no direct funding from the Ministry of Health and Care Services to hospitals (except for some special budget posts related to competence centers, national registries, etc.). Practically, all funds are channeled through the four RHAs who distribute research funds to individual hospitals. Most of R&D funds at hospitals are channeled as basic funding via the RHAs.

In 2014, total budget for the four RHAs were 118,3 billion NOK, of which 1,083 billion was a specific research grant. Of this sum 30 per cent is a core research grant, whereas 70% (453 million NOK) was distributed based on a PBRF-model similar to the publication component in the HE-sector. The major difference lies in how much money one publication point generates. In the hospital sector one publication points was worth three times as much as in the HE-sector (102 501 NOK versus 31 290 NOK). The health care sector has one component in its research indicator that the HE sector has in its teaching component: completed phds. In the health care sector one phd equals three publication points (=307 503 NOK in 2012).

The publications are fractionalized by author addresses. In addition there are two more components in the calculation: publications co-written with international institutions give a weight of 2,5 and publications co-written with hospitals from other RHAs in Norway give a weight of 1,25.

The research institute sector: The research institutes are mainly funded from external incomes. They also receive a core funding, of which a certain proportion is based on a PBRF-model (weight in parentheses):

- Scientific publishing (30 percent) (the publications are fractionalized: if a publication is co-authored with other national or international institutions, a weight of 1.25 is given)
- Completed doctoral degrees (5 percent)
- International funding (20 percent)
- National (competitive) funding (45 percent)

The institutes are distributed across four arenas, based on their scientific portfolios and users. Ministry of Education and Research decides which arena each institute should belong to following advice from RCN. Four ministries have the responsibility for the institutes' basic funding, within their sector:

- Environmental institutes (Ministry of Climate and Environment)
- Primary industry institutes (Ministry of Agriculture and Food, and Ministry of Trade, Industry and Fisheries)
- Social science institutes (Ministry of Education and Research)
- Technical-industrial institutes (Ministry of Trade, Industry and Fisheries)

The responsible arena department suggests a total budget frame for their arenas, as well as how much of the budgets should be distributed based on results (PBRF). In addition to the basic funding, the institutes may also receive a strategic institute grant.

Table 19 Norway: Funding of the institute sector, mill NOK (2013)

Sector	Basic funding (excl. strategic institute grant)	PRFS (%)	Strategic institute grant	% public funding of total funding
Environmental institutes	102,4	5,0	64,7	15,0
Primary industry institutes	267,0	2,5	7,6	16,0
Social science institutes	159,0	10,0	0,0	15,0
Technical-industrial institutes	234,8	10,0	24,8	5,9

The primary industry institutes have by far the lowest share of the basic funding being distributed following performance indicators -just 2.5 per cent.

Performance contracts are not used in Norway, but the dialogue meetings that take place between HE-institutions and the Ministry of Education and Research, do to some extent function as an evaluation of last year's results of the institutions, although no contracts exist where goals are specified. Nevertheless, the Ministry does use statistics, bibliometrics, etc. to monitor the activities of the HE-institutions.

Performance contracts & processes

We do not believe that such negotiations take place. All research institutions in Norway (be it HE-institutions, research institutes or hospitals) are partly funded based on results in the PBRF system, but there are no negotiations connected to this. Everyone obviously aims at increasing their production/improving their results in this system. The Ministry of Health and Care Services specify in their grant letters to the RHAs that all hospitals should strive for a minimum of 20 per cent of their publishing in level 2 journals, and that a minimum of 20 per cent of the hospitals' publications should be co-authored with international contributors, but this is not a matter of negotiations. The only type of contract negotiation we can think of is the annual dialogue meetings between KD and the HE-institutions, where there may be room for negotiations for upcoming budgets.

- Both KD (HE-sector) and RCN (institute sector) make annual status reports for their sectors based on the institutions annual report and results from the PBRF system.

Processes for funding system implementation

Entitlement to institutional funding

HE-sector: Institutions are accredited by an agency called NOKUT (Norwegian Agency for Quality Assurance in Education). In order e.g. to become accredited as university, NOKUT investigates whether the criterions set out by KD are met:

- The institution's main activities should be education, research and scientific or artistic development or procurement. The institution's organization and infrastructure should be adapted to its activities.
- The institution must have stable research and scientific/artistic development activities of high quality related to its scientific areas.
- The institution must have employees in teaching- and research positions in the scientific fields that are relevant to the study programmes.
- The institution must have accreditation for at least five study programs of at least five years duration (in total or as joint study programs), which provides it with an independent right to award higher degrees, as well as lower degrees within several subject fields. The institution must have examined candidates on both lower and higher degrees in most of these areas.
- The institution must have a stable researcher training and an independent right to award doctoral degrees in at least four subject fields. Two of these must be central in relation to regional enterprises' value creation, at the same time as the fields are of national importance. One of the four doctoral degrees can be replaced by scholarship programs for artistic development work which the institution has been accredited for.
- The institution must be affiliated with national and international networks within higher education, research and scientific or artistic development work, and must contribute in the national cooperation for researcher training and any similar artistic scholarship program.
- The institution must have a satisfactory scientific library.

The research institute sector: RCN offers advice of approval to KD, who has made guidelines for national basic funding of research institutes. In these, it is specified that basic funding can only be given to institutions who fulfill the following demands:

- The institute must conduct research and research dissemination in fields that is of interest to Norwegian industry/private sector, public administration or social community.
- The institute must have academic and scientific competence that leads to scientific publications in well-known publication channels.
- The institute must have a sufficient level of research activity, so that there is a real competence build-up taking place in the organization.
- The institute must have several funding sources and participate in an open marked for national and international research funds.
- The institute must take part in a suitable division of labor in the Norwegian research system.

- Neither the institute's funding agency, owners or single companies can be given exclusive rights to research results that have been funded through the basic funding.
- The institute must be run and organized in such a way that no dividend is payed.
- Academic freedom (etc.).

Just recently, RCN added four specific criterions that must be met, in order to receive basic funding:

- Income from national and international commissioned projects must represent at least 25 per cent of total R&D incomes.
- Scientific publishing (i.e. publication points per FTE) must at least be 1/3 of the average in the institute's arena.
- The institute must have at least 20 scientific FTEs.
- The institute's contribution income (e.g. from RCN and EU) must at least equal ten per cent of total R&D incomes.

The regional health authorities (RHA): Included in the RHA's funding system for research, are those hospitals/institutions that the RHAs have an operating agreement with.

- In *the health care sector*, several smaller institutions (especially private non-profit institutions within rehabilitation) have in recent years signed operating contracts with hospitals, and are thus included in the RHAs funding system. In *the HE-system*, some smaller, private colleges have emerged in recent years, and since they have received accreditation from NOKUT, they are entitled to institutional funding. In the *institute sector*, some of the institutes are former foundations established by (and at) universities, who have become independent institutions (although largely still owned by the universities), and fulfils RCN's criterions for institutional funding.
- National research infrastructures are funded on a competitive basis by RCN who has made a "road-map" (i.e. a priority plan) for infrastructure. The first version of the Norwegian Roadmap for Research Infrastructure was published in 2010. It presented large-scale projects of national importance that had achieved very high ranking in the first funding round under the National Financing Initiative for Research Infrastructure in 2009. The roadmap is to be revised after each major funding announcement for research infrastructure issued by the Research Council. The first revision was published in 2012. The Norwegian Roadmap for Research Infrastructure 2014 has been updated on the basis of the outcome of the assessment review process under the third funding round in 2012.

The Ministry of Education and Research now sets aside an earmarked allocation for research infrastructures, and the Research Council of Norway has established a dedicated funding initiative. A total of over 200 grant applications have been processed, and funding has been awarded to around 40 infrastructure projects. Funding decisions have been made in an application review process in which competition based on scientific merit is combined with an integrated assessment of strategic importance. Under the infrastructure initiative, funding may be sought for research infrastructure of national character with investment costs of more than NOK 2 million. The maximum amount of funding that may be sought from the Research Council is NOK 200 million. In addition to this, some research infrastructure is especially funded through earmarked grants in the state budget, and the HE-institutions do invest in this themselves (either from their basic budgets but also through external funding from e.g. EU).

The Centres of Excellence scheme is a national programme under the auspices of the RCN, who provides the basic source of funding for the scheme (10-year funding, the CoE grant is about 1-2 mill Euro per year per centre). Additional funding comes from the institutions themselves: "The funding plan is to be based on the principle that the Research Council of Norway in conjunction with the host institution, or with a SFF consortium consisting of the host institution and its partners, will jointly provide the resources required to perform the centre's activities… Contributions may be provided in the form of own financing, staff placed at the disposal of the centre and/or essential infrastructure. The Research Council of Norway requires that the host institution and any consortium participants cover expenses for the premises, electricity, heating and other infrastructure for the centre, and that a reasonable amount of scientific equipment be placed at the disposal of the centre. Research funding that promotes the centre's activities, e.g. EU funding, project or strategic grants from the Research Council or other sources, may be counted toward the required contribution".

Use and internal decision-making on institutional funding

The universities can do this within certain limits. However, this is not seen as a problem. The universities are encouraged to make these priorities themselves, as they do not have specific budgets for teaching and research. Some institutions get more research funds than other, but the balance internally between teaching and research is up to each institution to decide for itself. Nevertheless, KD may send signals about what they would prefer to institutions to do in the dialogue meetings they have with the higher education institutions.

Governance of the funding system

- All ministries in Norway funds for research, based on the sector principle, i.e. every ministry has a responsibility for the necessary research within its own sector.
- The HE-institutions are free to decide on their portfolios of fields (e.g. they may close down institutes/programs and create new ones). The coordinating mechanism thus seems to be RCN's funding schemes, in which funds are distributed across programs representing different fields.
- RCN is the executive agency of national strategies, but these reflect thematic areas (e.g. climate, environment). The HE-institutions decide themselves on their portfolio of disciplines.
- No, direct funding to institutions is not tied up by scientific strategies. These are up to the institutions themselves to make. External funds have an impact on the total budgets, i.e. they are reflected in externally funded projects, but the institutions decide themselves upon scientific profile and make the priorities themselves. The institutions need to balance external/competitive funding and basic funding, but the level of institutional funding of research in Norway is high.
- There is close contact between RCN and the Ministry of Education and Research. RCN has the mandate to coordinate this through their INFRASTRUKUR programme, which supports national infrastructure as well as international infrastructure and participation.

4.3.3 Feedback and reflections on the system

Advantages & disadvantages of the system

According to the HE-institutions there is little room for strategic priorities, as most of the budgets are tied up in study positions and phd-positions. The sector has large basic funds, but experience little freedom to prioritize. The Ministry of Education and Research does not share this view (arguing that lack of prioritization is a matter of leadership and organizing). The high level of basic funding may be seen as an impetus to changes, i.e. lack of adaptability, but as the HE-institutions are more inclined to generate external funding, this may change.

In the institute sector, the general feeling is that the basic funding is too small, making the institutes too heavily dependent on external/competitive funding, often in small short-term projects, making it difficult to focus in scientific development.

A large share of the funds is channelled through RCN, and there is a belief among beneficiaries that these are too tied up by thematic specifications. Informants (not from RCN) claim that RCN itself feels that the funds are too fragmented because of the sectorial principle, i.e. there is too little coordination from the funding ministries.

Most institutions (both in the HE-sector and the institute sector) are positive to the PBRF, as it contributes to more transparency, making distribution of funds more proportional to the institutions' contributions.

Effects of the funding system

The implementation of PBRF in all sectors initially caused much concern and criticism (i.e. too much focus on publishing, meriting quantity instead of quality, etc.). A recent evaluation of the publication indicator showed, however, that a strong increase in production, as not led to a decline in quality.

The institute sector has expressed concerns that their low basic funding contributes to a fragmented project portfolio of competitive projects. It is argued that this had made it difficult to make long-term strategies and build up competence.

The sectorial principle may be claimed to have some unwanted consequences. It can be argued that priorities are simply the sum of many single decisions – since there are no priorities at the national level except those outlined in the White Paper on Research by the Ministry of Education and Research. So the system can be described as "business as usual" with some additional funding from year to year. Processes follow a one-year cycle making stability over years difficult.

Risks of the funding system

Beneficiaries deal with budgets on a yearly-basis making long-term planning difficult. R&D in Norway is to a small degree characterized by powerful, long-term priorities.

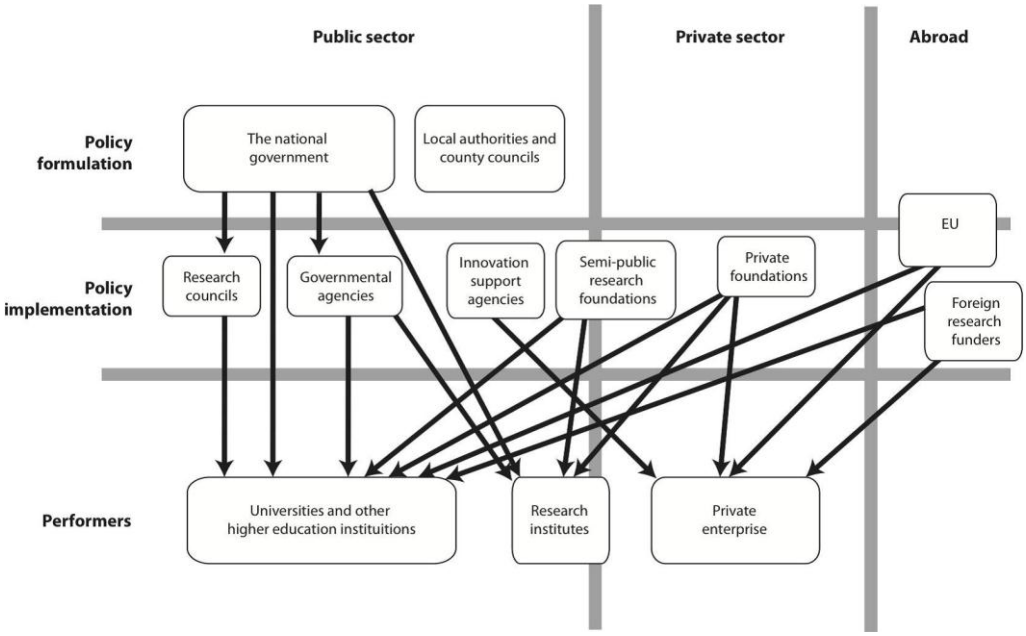
The fact that Norway only has just one research council (and few private sources) may be a problem for those whose applications are rejected by RCN. RCN needs to coordinate many (independent) appropriations from funding ministries, so there is a limit as to how much coordination it is possible for RCN to exercise.

5. Sweden

5.1 The R&D governance system

5.1.1 General oversight

Figure 4 Sweden: The R&D governance structure in Sweden



Source: Erawatch country reports 2012: Sweden

The Government's job is to formulate the overall goals for the different parts of the administration and to distribute the financial means necessary. The Swedish Parliament decides on research policy every four years by signing a research policy bill prepared by the Government and in particular by two major research policy-forming bodies; the Ministry of Education and Research and the Ministry of Enterprise, Energy and Communications.[29]

There is no permanent advisory board at Government level. However, from 2013 through 2011, there was the National Council for Innovation and Quality in the Public Sector, established by the Government to improve the efficiency and quality of public activities at national, regional and local level. The Council's task was to assist the Government in stimulating innovation and change in public services. Council members were from the National Agency for Social Insurance (Försäkringskassan), state owned educational company Lernia, health care business Praktikertjänst, the Administrative Courts of Appeal (Kammarrätten) and The Swedish Association of Local Authorities and Regions.30

[29] Technopolis, 2011

[30] http://www.innovationsradet.se/

Sweden has rather small ministries which essentially only direct the policy and distribute funding. The Ministry of Education and Research has overall responsibility for the coordination of research policy in the Government offices. It initiates and oversees the preparation of the research policy bills submitted during each parliamentary term of office. Because research resources exist within the scope of all ministries, the Ministry of Education and Research drafts its research policy bills in collaboration with other ministries. The Ministry is responsible for R&D in the academic sector and funds institutional research and public competitive funding through the research councils.[31]

The Ministry of Enterprise, Energy and Communication is responsible for innovation policy formulation and also the founder of VINNOVA, which grants competitive funding. The Ministry of Enterprise, Energy and Communication grants strategic competence funds (non-competitive) to Research Institutes of Sweden, RISE.[32]

NOTE: As the institute sector is very small in Sweden, it will only be dealt with briefly in this report.

Policy is implemented at agency level by research councils and sector agencies, which execute their tasks in line with the objectives assigned by the Government. Agencies act and decide relatively independently within the framework of white papers and other regulations issued by the Government.[33]

There are three main research councils:

- The Swedish Research Council (Vetenskapsrådet, VR)
- The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas)
- The Swedish Research Council for Health, Working Life and (Forte)

In addition there is one innovation agency, the Swedish Governmental Agency for Innovation Systems (VINNOVA). The Swedish Energy Agency and the Swedish Space Board also supports targeted research to some extent.

Funding is distributed on a bottom-up principle; it is the researchers themselves who design and propose a research idea, and apply for funding. However, the funding organisations often launch certain themes or other kind of strategic funding channels, with specific requirements for applicants. In this way there is often an in-built top-down principle at work as well. Within such themes or strategic areas, a bottom-up approach is still applied.[34]

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[31] Erawatch country reports 2012: Sweden

[32] Erawatch country reports 2012: Sweden

[33] Erawatch website: Sweden

[34] Technopolis, 2011

HEI are the main research performers in Sweden. All HEIs except three are in the form of national agencies.

The non-academic research performing organisations are very heterogeneous, and it is difficult to provide a general description. There are several Government agencies that receive all or most of their funding directly from the Government on an annual basis. There are also a few NGOs that receive varying levels of Government funding.35

A more homogenous group are the research institutes which receive some base funding from governmental, but the nature of such funding and the ways in which it is disbursed varies significantly depending on the institute's field of responsibility. The Swedish institute sector is small in international comparison. RISE functions as an umbrella organisation for 16 institutes in various industrial areas. Funding comes from the Government, EU-funds and from private firms.36

The business sector R&D is mainly internal to large enterprises, as the majority of the funding of R&D in the private sector remains within the comparatively small number of very large companies. The public and private R&D systems are institutionally separate, i.e. that public sector and private sector finance and perform in their own systems and that there is little interaction between them.

5.1.2 National strategies & priorities for research

Overview of the research strategies

The most important research and innovation policy measure in recent years was the launch of **Strategic Research Areas** in the 2008 research bill (issued every four years), allocating a total of SEK5b over five years to university research groups and consortia of research groups within 20 specifically chosen areas.[37]

The bills of 2008 and 2012 were based on the assumption and the policy analysis that Swedish long-term competitiveness is under threat and needs to be secured by strategic profiling, resource increases to public R&D, and strengthening of the interaction between academia and industry. The 2012 bill identified four focus areas for specific investments:

- Life sciences, including the national centre for life science research, SciLifeLab
- Strengthened basic funding for universities and other higher education institutions, generally through the base grants for research and doctoral training
- Investments in research facilities; the SciLifeLab facility, and the European Spallation Source and MAX IV facilities

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35 Erawatch website: Sweden

36 Technopolis, 2011

37 Energy, Sustainable exploitation of natural resources, Effects on natural resources, ecosystems and biological diversity, Climate models, Sea environmental research, Cancer, Diabetes, Epidemiology, Molecular biology, Neuroscience, Stem cells and regenerative medicine, Health, Nanoscience, E-science, Material science, IT and mobile communication, Production technology, Transport research, Security and crisis management, Politically important geographical regions

- Policy measures aimed at increasing the commercialisation of academic research, including efforts to strengthen the institute sector

According to the 2012 research bill, medicine is the most prioritised area (consuming 31.4% of the total research budget of the academic sector in Sweden), followed by engineering sciences (23.4%), natural sciences (18.1%), social sciences (14.5%), humanities (6.9%), and forestry/agricultural sciences (3.6%).[38]

A similar assessment of the situation for Sweden was offered in the 2012 **National Innovation Strategy** issued by the Ministry of Enterprise, Energy and Communication. This document is, however, mainly a framework vision statement and does not launch any concrete policies. The National Innovation Strategy largely echoed the research bill in its problem formulation: In order to meet the challenges of the future, including economic globalisation and issues of sustainability, Sweden is in need of purposeful mobilisation within its entire innovation system. The Strategy is significantly vaguer in its character than the research bill and thus much less concrete in its attempted policy solutions to the identified problems. It emphasises the need for high quality education, a vitalised innovation climate among especially SMEs, increased mobility between different sectors of the economy and society, quality enhancements of research in academia, a strengthened research institute sector, and stronger innovation support infrastructures.[39]

The implementation of the Regional/National Research and Innovation Strategies on Smart Specialisation (RIS3) in Sweden is still in the planning stage. Sweden is undergoing a gradual transformation of its regional government subdivisions; and so far, new so called Regional Boards have overtaken responsibilities for regional development from Country Administrative Boards in four regions; Skåne, Västra Götaland, Halland and in Gotland. These Regional Boards have made independent efforts to formulate regional innovation strategies. On national level, the responsibility for RIS3 strategies lies with the Ministry of Enterprise, Energy and Communication, and its agency the Swedish Agency for Economic and Regional Growth (Tillväxtverket). Discussions are still underway regarding the approach to be taken by Sweden in the implementation of RIS3 strategies.[40]

Implementation of the research strategies

National priorities are implemented primarily through the Strategic Research Areas. University research groups have been chosen through open calls and a peer review process organised by the research councils. Besides the Strategic Research Areas, research organisations are free to distribute funding internally according to their own preferences.

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[38] Erawatch website: Sweden

[39] Erawatch country reports 2012: Sweden

[40] Erawatch country reports 2012: Sweden

5.1.3 Level of autonomy of the public research funding bodies

Positioning of agencies/ministries versus the ministries/government

The funding agencies are separate organisations with considerable autonomy in relation to the responsible ministry. Agencies decide on smaller matters themselves, such as internal organisation and staffing, and are free to set priorities on field or programme level according to their own understanding. The Ministries send instructions in the form of regulations with general objectives and annual allocation letters, which include both what kind of activities the agencies should prioritise and the amount of resources they are assigned for these different activities.[41]

The research councils use the money for the respective areas primarily through open calls from individual researchers or from institutional bidders. Governmental funds are rarely earmarked for a specific scientific field. In turn, the agencies are obligated to annually report back to the Ministries about results and costs in relation to the allocation letters. This information then forms the foundation for future new objectives and requirements. Agencies also can receive special objectives, which are often reported respectively.[42]

In practice, Ministries can exercise some steering and control over their agencies. The goals can, e.g. be formulated in a way that allows more or less room for interpretation. The amount of money that is assigned to the different objectives has a very imperative effect and can limit the agencies' room for action.[43]

Funding agencies are not evaluated or monitored in a systematic manner. There are, however, public agencies that perform evaluations of, amongst others, funding agencies and research organisations. Evaluation agencies are the Swedish National Audit Office (Riksrevisionen), the Swedish National Financial Management Authority (Ekonomistyrningsverket) and the Swedish Agency for Public Management (Statskontoret). The agency for Growth Analysis (Tillväxtanalys) plays an important role in evaluations concerning innovation and growth policy. The agencies report directly to either the Government or the Parliament and all reports are publicly available.[44]

Positioning versus the research organisations

Funding agencies do not typically try and influence universities, but they can exercise some influence through the calls they choose. For example, some agencies, like VINNOVA and research funding foundations, sometimes require co-funding from the industry.

The funding agencies are not in charge of the national evaluation of the publicly funded research organisations (HEIs). However, VR is involved in the bibliometric

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[41] Technopolis, 2011

[42] Technopolis, 2011

[43] Technopolis, 2011

[44] Erawatch website: Sweden

evaluation of HEIs, which is part of the performance based research-funding model. VR has provided some methodological support and is in charge of collecting the data.

5.2 The R&D system

5.2.1 Characteristics of the publicly funded research organisations

There are 36 HEIs for which the state is the responsible authority. In addition there are ten or so private higher education providers. The main task of the state HEIs is to organise educational programmes based on scientific or artistic foundations and proven experience, and to carry out research and artistic research.

The Swedish institute sector is small in international comparison. Research Institutes of Sweden (RISE) functions as an umbrella organisation for 16 institutes divided into four corporate groups:

- Innventia (from basic research to direct consulting in paper, pulp, packaging and biofuel)
- SP Technical Research Institute of Sweden (applied research, technical studies and investigations, quality assurances, standardisation and certification in various fields)
- Swedish ICT (Applied research, knowledge creation and innovation in ICT)
- Swerea (Applied research in materials, process, product and production technology)

RISE's vision is a for Swedish research institutes to compete successfully in the global knowledge market, and to be world leading in the development and renewal of Swedish industry.

Table 20 Sweden: RO relative importance in the system, 2013

	SEK billion	%
Governmental appropriations for R&D[45]	**31,5**	
Institutional support for HEIs	15,7	50
Funding agencies	9,2	29
RISE institutes[46]	0,6	0,02

5.2.2 Level of autonomy of the publicly funded research organisations

In 2009, the Swedish Government presented a bill on greater autonomy for HEIs "Academia for this day and age" (Govt. Bill 2009/10:149), which came into effect in 2011. The reform strengthened the formal autonomy of universities and stripped the

[45] Budget bill 2014 (Prop. 2013/14:1)

[46] Budget bill 2014 (Prop. 2013/14:1)

Government of its previous privileges of prioritising between research areas in the R&D appropriations.[47]

HEIs can form decisions about e.g. the organisation, allocation of Government appropriations within the organisation, quality assurance procedures, new professorships and research focus.[48] With the exception of the Strategic Research Areas funding scheme and some similar earmarked funds, the Government relies on the HEIs and the research councils to decide on internal funds distribution and the processes to do so, and to make priorities.[49]

HEIs are not obligated to report back to the Ministry. Funding agencies can, however, require research organisations to report back, but it is up to each funding agency to set their own criteria when allocating funds.

5.2.3 Research infrastructures and Centres of excellence/Competence centres

VR is commissioned by the Government to fund national research infrastructure and Swedish participation in international infrastructure. The council provides funds through calls of proposals. VR also finances memberships in several international infrastructure organisations that give Swedish researchers access to facilities. Contributions can take the form of membership fees, but also in-kind grants where Swedish universities and other research institutions develop components for infrastructures or create nodes in Sweden for international infrastructures.

Research infrastructure is also, to a smaller extent, funded by the research councils (databases, equipment, contributions towards construction of MAX IV). The Swedish National Space Board finances various satellite projects used in astronomy, and the Bank of Sweden Tercentenary Foundation finances archives and libraries. Many infrastructures that are used partially or totally for research are financed by other agencies, research institutes, county councils, and within universities and HEIs.

Since 2009, HEIs are responsible for local infrastructure and equipment; to maintain local resources and to develop technologies and methodologies that can be used for infrastructure. HEIs have since started their own processes for prioritising and financing equipment and local infrastructures.[50] Prior to 2009, the Knut and Alice Wallenberg Foundation (KAW) was the dominant financer of advanced equipment and infrastructure.

Competence centres are funded by the research councils and research foundations through competitive funding. Centres are co-funded by industry and/or academia. Examples include:

- Academically based competence centres that feature notable industry involvement (funded by VINNOVA, Swedish Energy Agency, VR, the Foundation for Strategic Research and the Knowledge Foundation);

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[47] Erawatch country reports 2012: Sweden

[48] http://english.uka.se/

[49] Erawatch country reports 2012: Sweden

[50] http://www.vr.se/

- Research institute based competence centres that feature notable industry involvement (funded by VINNOVA, the Foundation for Strategic Research and the Knowledge Foundation);
- A range of programmes funded by VINNOVA, such as VINNVÄXT and VINN Excellence Centres.[51]

5.3 The funding system

5.3.1 Flows of public research funding

Table 21 Sweden: R&D indicators for Sweden, 2012[52]

Indicator	
GERD	SEK122b
GERD as % of GDP	3,41%
BERD as % of GDP	2,31%
BERD as % of GERD	67,9
HERD as % of GERD	27,2%
GBAORD as % of GDP	0,85%

Table 21, above, presents the R&D indicators for Sweden. The Government sector and the private non-profit sector act mainly as financiers of research (their investments in R&D account for 5% of the total R&D expenditure).

As seen in Table 22, the Government annually invests some SEK30b in R&D. The institute sector is very small by international comparisons.

Table 22 Sweden: Public funding of R&D in Sweden, 2012[53]

Governmental appropriations	SEK30,3b
Institutional funding	SEK14,5b
Funding agency support	SEK8,4b
Public research foundation support	SEK1,3b
Government support for Research Institutes of Sweden	SEK0,5b

There are no comprehensive data of the level of institutional versus competitive funding. Institutional funding for HEIs (block grants and performance based funding) accounted for SEK14,5b of Government appropriations for R&D in 2012. Funding agency support (VINNOVA, VR, Forte and Formas) accounted for SEK9,2b, out of which around 50% is allocated to HEIs. Additionally, public research foundations distributed SEK1,3b in 2012.

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[51] Erawatch website: Sweden

[52] Erawatch website: Sweden

[53] Statistics Sweden

The Government has increased appropriations for R&D the last few years. In the research bill of 2012, the Government suggested an increase of R&D appropriations by SEK0,9b, 2014-2016.

Table 23 Sweden: Funding of R&D performed in Sweden, 2011[54]

Source \recipient	Total	Business enterprise	Higher education	Other[55]
Private funding	70 981	66 191	4 188	602
Public funding	33 709	4 179	24 904	4626
- of which is Govt. funding	29 208	3 989	22 660	2559
Funding from abroad	13 197	10 774	2 154	269
Total R&D in Sweden	117 888	81 145	31 247	5496

As shown in Table 23, above, business enterprises dominate the Swedish R&D sector, both as source of funding and as performer. Most of the R&D funding in Sweden is, in fact, internal to business firms, and generally, the share of total R&D funding that is transmitted between sectors is very low. Public R&D in Sweden is mainly performed by the academic sector.

5.3.2 The institutional funding system

Criteria used for decision-making on sources allocation

Since World War II, Swedish central government-supported basic research has in principle been funded in two ways: through direct appropriations to HEIs and through appropriations via the research councils.56 The first way of funding stream contains the basic funding of HEIs; block grants and a performance-based model. The second stream is the external competitive funding (not a direct resource from the state) and comes from research councils, agencies for support of directed research and so on (for example public or semiprivate foundations for strategic research, environmental research etc.).

The Ministry of Education decides on the distribution of the block grants for research in HEIs. The amount of funding initially allocated to a HEI is related to Government resources at the time. After that, each HEI receives roughly the amount as in previous year, with some adjustment for increased costs.

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54 http://www.scb.se/en_/Finding-statistics/Statistics-by-subject-area/Education-and-research/Research/Research-and-development-in-Sweden---an-overview-international-comparisons-etc/Aktuell-Pong/2012A01P/Funding-of-RD-performed-in-Sweden/

55 Government authorities, county councils, municipalities, private non-profit

56 http://www.regeringen.se/sb/d/10086/a/114033

Since 2009, there is a new model for distribution of direct funds, handled by the Ministry of Education with methodological support from the Swedish Research Council (Vetenskapsrådet, VR). All new direct funding since 2009, plus 10% of every HEIs direct funding from the previous year, is allocated according to the performance system. Indicators are scientific output (publications and citations), and external competitive funding, which account for 5 % each.

The first year, 2009, only the new funding (additional funding compared to 2008) was affected and was allocated based on the indicators. In 2010 all new funding was again allocated based on the same indicators. On top of that, 10 % of the fixed basic funding was also redistributed. However, before the redistribution a guarantee sum is deducted, based on the number of students at each HEI. In effect about 8 % was redistributed. From 2011 and onwards, each HEI 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. It turns out that the loss or gain for a specific HEI is at most 2 % and for the vast majority of HEIs is well below 1 %.

The Ministry of Enterprise, Energy and Communications fund RISE Research Institutes of Sweden, fully owned by the Swedish Government since 2007. As the Swedish institute sector is very small, it will not only be dealt with briefly in this report.

The table below shows institutional funding for HEIs.

Table 24 Sweden: Components of the institutional funding for research

Mechanism	%
Block grant	90%
Performance-based funding – Bibliometrics	5%
Performance-based funding – External funding	5%
TOTAL INSTITUTIONAL FUNDING	100%

5.3.3 Performance contracts & processes

There are no performance contracts for institutional funding.

5.3.3.1 *Processes for funding system implementation*

Entitlement to institutional funding

All public HEIs receive institutional funding, whereas non-public HEIs must be approved by the Government. In order to be approved, HEIs must be accredited according to the Higher Education Act and offer education free of charge for students. There are examples of new HEIs in Sweden, both private and public. Those who were accredited receive institutional funding, and those who have not been accredited do not.

Infrastructure is funded through competitive funding from the research councils and research foundations. Competence Centres and Centres of Excellence are funded through competitive calls, which often require co-funding from the industry and/or

HEIs. HEIs finance local infrastructure and basic equipment themselves, and can use institutional funding for purchasing equipment.

Use and internal decision-making on institutional funding

Sweden does not have a major problem with HEIs using funding earmarked for research for education, and vice versa. Funding for education and research are distributed as two separate appropriations, which are also to be reported back to the Ministry of Education and Research in a separate manner. According to interviews, is it still possible for HEIs to use funds incorrectly, which can be a problem for an individual institution, but it is not considered a national problem and no actions have been taken to prevent this.

5.3.3.2 *Governance of the funding system*

Only one ministry, the Ministry of education, funds institutional research. The ministry is also responsible for R&D in the academic sector at large and public competitive funding through the research councils. The Ministry of Enterprise, Energy and Communications funds applied research at the industrial research institutes, RISE (Research Institutes of Sweden Holding AB), as well as competitive funding through VINNOVA.

There are no formal coordinating mechanisms among research funders, research council are principally free to set their own priorities on field or programme level. There used to be a coordination group for the former research councils (research councils for natural science, medical research and for forest and agriculture, discontinued in 2000), to ensure that some applicants did not receive excessive funding whereas others were left out. The former research councils were reorganised into VR in 2001. There are, however, no formal coordination between VR, Forte, Formas and VINNOVA.

There are some discussions of whether or not the Humanities receive enough funding compared to other fields, such as Medicine, but this discussion not necessarily related to the lack of coordination but more with difficulties of receiving competitive external funds.

There is no national strategy for discipline coverage; HEIs are free to distribute funds according to their own preferences. With the exception of the Strategic Research Areas funding scheme, and some similar funds earmarked for specifically designated research areas, the Government relies on the academic institutions to make priorities. Strategic Research Areas were introduced in the 2008 research bill, allocating 300 m€ over five years to HEI research groups and consortia of research groups within 20 specifically chosen areas.[57]

VR is commissioned by the Government to fund national research infrastructure and Swedish participation in international infrastructure. VR has a Council for Research Infrastructures (RFI) that collaborates with other research councils to develop a long-term strategic plan to give Swedish access to the most qualified research infrastructures in Sweden and other countries.

The RFI includes members from Forte, Formas and VINNOVA and published a guide to infrastructures in 2008, updated in 2012. The guide addresses proposals for new

[57] Erawatch website: Sweden

infrastructures and recommends new infrastructure projects or areas where Swedish research could benefit from greater national and/or international coordination.[58]

5.3.4 Feedback and reflections on the system

In 2012, the Strategic Research Areas funding scheme, as well as preceding programmes aimed at strengthening larger research environments in specially prioritized areas, were critisised by scholars for the one-sided focus on 'excellence', i.e. the allocation of vast sums of money to already comparably successful research environments. The funding schemes have been accused of skewing competition in favour of those prejudiced to be excellent rather than those with proven qualities. Not least the non-university side of the academic sector, i.e. the smaller regional colleges, are said to have been discriminated against by the launch of these programmes.[59]

Also, from scholars' point of view, there is continuous criticism that the system is built on competitive funds, which is very bureaucratic and time consuming. Applying for competitive funds takes too much time, and funding agencies require researchers to report back in formal and time consuming procedures. Competitive funds are also few and far between, and researchers can never feel secure in having sufficient funds.

From the perspective of the HEIs, they seem to benefit from the freedom to distribute funds internally, and from the performance-based model for allocation of research funds. According to a study that Technopolis Sweden conducted in 2012, the introduction of the performance-based model, have encouraged HEIs to create their own performance-based models and strategic priorities for internal distribution of funds. Our study showed that performance-based distribution is more common and more extensive at the HEIs' faculty level than at the central level, mainly because a faculty encompasses only one main scientific field. However, despite the freedom to allocate resources internally, HEIs typically use performance-based models that are very similar to the model used by the Ministry of Education and Research.[60]

There has been some critique from funding agencies, and at Government level, of the lack of coordination between funding agencies. The agencies do not complement each other, as was planned, and do not have enough joint efforts. This issue was particularly raised in a Government inquiry, "Research Funding – Quality and Relevance (SOU 2008:30), where a new public agency for research and innovation was proposed (the new agency was never realised).

It should be noted that, while there are complaints on Government level about the lack of coordinated efforts, the Government continues to delegate responsibilities for quality enhancement and the design of new governance mechanisms, to its agencies and to the HEIs. The most recent governmental reforms have strengthened the formal

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[58] The Swedish Research Council's Guide To Infrastructures 2012

[59] Erawatch country reports 2012: Sweden

[60] Faugert & Co Utvärdering, "Med glädje, men inte med lätthet" –om högskolans fördelning av de direkta statsanslagen för forskning, 2012

autonomy of HEIs, including giving HEIs the right to prioritise between research areas in the R&D appropriations. The responsibility for implementation of new PBFS is laid on VR and Swedish Higher Education Authority.[61]

Effects and risks of the funding system deal not so much with the disadvantages of the academic funding system, but with the strong division between the academic and industrial research sectors. The latter has thus far not been extensively mentioned in this report, perhaps a consequence of the strong split between the two.

The Government has been explicit in at least three consecutive research bills (2004, 2008, 2012), as well as other official documents (e.g. the 2012 National Innovation Strategy) that the public R&D system is in need of strategic mobilisation and purposeful efforts to enhance the level of interaction between academia and industry/society to strengthen the innovativeness of the economy at large.

- Although the general level of quality of Swedish (academic) research is already high, it will have to be improved in order to be globally competitive in the coming decades.
- The degree of interaction between the academic sector (basic research) and industry, and the commercialisation of research results from academia, is unsatisfying and needs to be increased.
- Swedish public R&D is characterised by breadth rather than cutting-edge, and there is a need for specialisation and strengthening in specific areas. [62]

Generally, the policymakers' collective view on shortcomings in the Swedish R&D system relates to the "Swedish paradox", i.e., compared to its strong figures of annual R&D investment as percentage of GDP, Sweden suffers from an inadequate level of returns from public investments in R&D. Several factors for this "paradox" have been stressed:

- A historically determined structural division of labour between the state sponsoring basic research in academia and the private sector sponsoring applied research and development in-house
- A partly historically determined relative dominance of large MNCs in the industrial sector and a consequent relative lack of venture capital and other critical resources for innovation in SMEs
- A generally poor entrepreneurial climate in comparison with many other European countries; mainly comprising of poor incentive structures for starting firms compared to regular employment, that largely stems from the structure of the welfare system which favours wage earners.[63]

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[61] Erawatch country reports 2012: Sweden

[62] Erawatch country reports 2012: Sweden

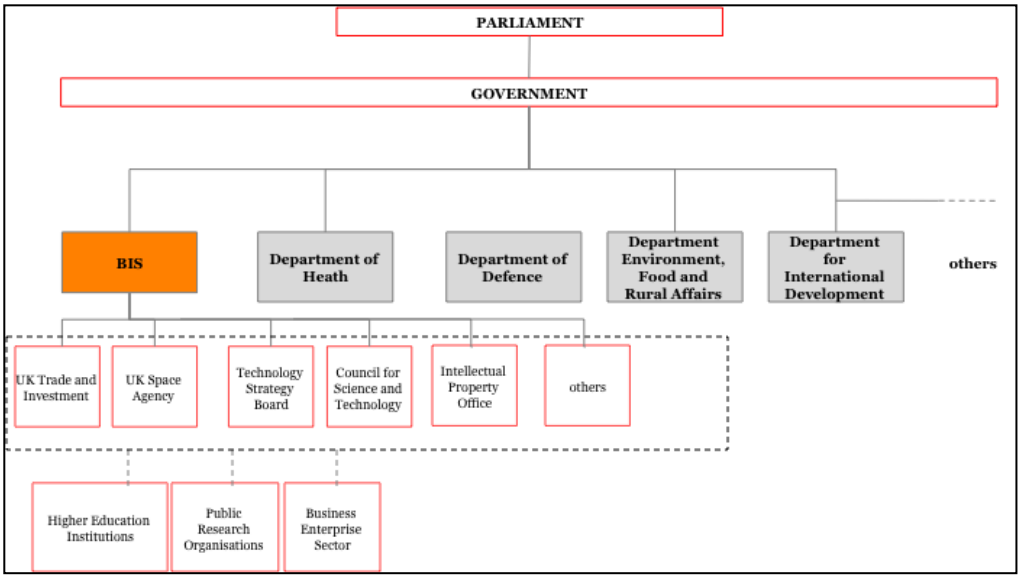
[63] Erawatch country reports 2012: Sweden

6. UK

6.1 The R&D governance system

6.1.1 General oversight

Figure 5 UK: The R&D Governance Structure



Source: Technopolis

The UK has a large and complex national research and innovation system governed by a parliamentary system where the head of government (Prime Minister) is a member of the legislature and is the leader of the largest party in parliament. The government (Level 1) is made up of 24 ministerial departments (Level 2) responsible for putting government policy into practice with their associated agencies, 23 non-ministerial departments usually undertaking regulatory roles and 300 agencies and public bodies[64] (Level 3). The UK ministry with the overall responsibility for science and innovation nationally is the Department of Business, Innovation and Skills (BIS). BIS is also responsible for Higher Education.

BIS has the lead executive role in research issues and maintains the national research strategy as well as being the major source of funds for research in the public sector. It provides funds for the seven Research Councils[65] (organised on a disciplinary basis), which in turn support R&D both in Higher Education Institutions (HEIs) and independent research organisations. They also invest in Research Council Institutes and fund access for UK researchers to international facilities. The current level of council investment into research totals around £3 billion per year.

Thus, with this in mind, BIS has oversight for much of the UK's R&D policy formulation and is the principal author of the national strategy for R&I, although it is

[64] See Appendix XX for list of government departments and the number of agencies and public bodies they each work with

[65] See Appendix XX for lit of research councils and examples of research areas funded

important to note that each Research Council is required to develop its own research strategy and implementation plan against this backdrop (in consultation with the academic community and a wide range of users and stakeholders).

BIS is also responsible for the overall UK science budget with the resource component of the budget in 2011/12 around £4.5 billion and the capital budget around £0.5 billion.

The agencies and public bodies that work alongside ministries such as BIS provide functions and support around regulation, funding, promotion and co-ordination. These agencies are in charge of implementing detailed policy development and co-ordination are the main funders of research and innovation.

There are several other government departments that fund applied research of direct relevance to their own policy activities (departments) or operations (agencies). The main big spenders on research, aside from BIS, include:

- Department of Defence (£1,306 million)
- Department of Health (£904 million)
- Department for International Development (£236 million)
- Department Environment, Food and Rural Affairs (£161 million)

6.1.2 National strategies & priorities for research

In recent years, the UK has returned to using industrial policy and strategy as a mechanism to help the UK economy and business compete and grow. The current UK strategy is the Innovation and Research Strategy for Growth (IRS) was published in December 2011 and is the central guiding document for UK research and innovation policy and priorities nationally.[66] This policy document is supported by an Economics Paper, which provides an analysis of the general context within which the research strategy was situated.[67]

The national strategy emphasised the need to strengthen the country's ability to accelerate the commercialisation of emerging technologies, and to capture the value chains linked to these. Commercialisation of research is recognised globally as a vital part of Research and Innovation and is a key policy and public sector area for investment. There are no established metrics for measuring it, but commercialisation is where the benefits of research and innovation can be realised and the impact felt in the economy and through supply chains. The national strategy also notes that the UK needs to do more to encourage the development of technician-level skills and higher-level skills to support this innovation work.

The UK Industrial Strategy (2012)[68,69] also lists a series of 'eight great technologies' in which the government (with advice from the RCs and TSB) has judged the UK can gain a competitive advantage globally and which have real potential for economic and social benefits in the UK (and internationally too). BIS worked with the Research

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[66] www.bis.gov.uk/assets/biscore/innovation/docs/i/11-1387-innovation-and-research-strategyfor-growth

[67] Innovation and Research Strategy for Growth, BIS Economics Paper No 15, December 2011

[68] www.gov.uk/government/policies/using-industrial-strategy-to-help-the-uk-economy-and-business-compete-and-grow

[69] The UK Industrial Strategy is complemented by a series of home nation strategies focusing on key growth sectors, allowing each part of the UK to build on its assets through Smart Specialisation, and identifying local strengths and building collaborative networks.

Councils and the Technology Strategy Board (an executive non-departmental public body) to select eight great technologies after carefully analysing UK existing scientific and business capabilities. Each technology:

- Is an area in which the UK has world-leading research
- Has a range of applications across a spectrum of industries
- Has the potential for the UK to be at the forefront of commercialisation

The eight great technologies are:

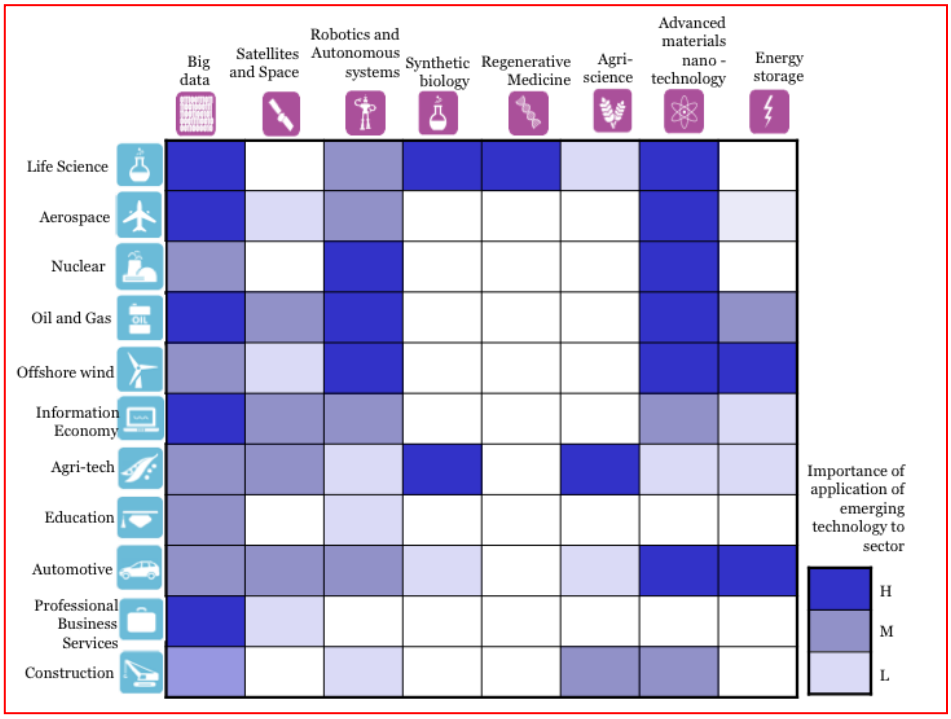
- Big data and energy-efficient computing
- Satellites and commercial applications of space
- Robotics and autonomous systems
- Synthetic biology
- Regenerative medicine
- Agri-science
- Advanced materials and nanotechnology
- Energy and its storage

The targeting of these technology areas shows how the government is working with researchers and industry to foster world-class technology capability in the UK. They are not exclusive or exhaustive, and there are many other important areas of science and innovation in which the UK excels and will excel in future.

Over the past year (2013/14) the "Government has allocated more than £2 billion to industrial strategy objectives, a clear indicator of commitment in a period of fiscal constraint" (HM Government, 2014)[70]. These efforts have been matched by industry, which has invested time and financial resources to set the strategic direction and to provide match-funding the majority of investments made by the government.

[70] HM Government (2014) "Industrial Strategy. Government and Industry Partnership". Progress Report.

Figure 6 UK: Strategic sectors and technology areas



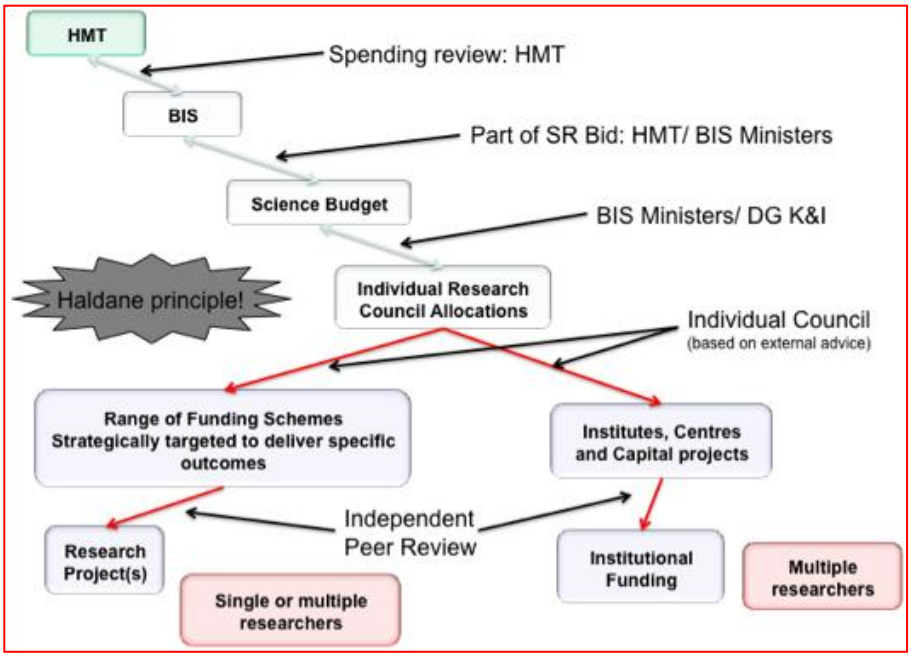
Source: BIS

6.1.3 Level of autonomy of the public research funding bodies

As mentioned previously, BIS has oversight for much of the UK's R&D policy although it is important to reiterate that the Research Councils are required to develop their own research strategies and implementation plans against this backdrop in consultation with the academic community and a wide range of stakeholders and users.

Funding for the Research Councils, it ultimately from BIS and the funding they receive for research is allocated to the research councils under the 'Haldane principle'. This means that while government sets the overall size of funding and its distribution between the research councils according to its strategic priorities and it is then left to the scientific community (coordinated by the Research Councils) to select specific projects within relevant fields on the basis of scientific merit, as assessed by peer review. The government may however, ask the research councils to consider addressing areas of strategic national importance in setting their funding programmes. The Haldane principle does not apply to the research budgets of Government Departments, which are used to fund research to support their departmental policies and objectives.

Figure 7 UK: Haldane Principle



Source : RCUK

Monitoring / evaluation of the efficiency of the research councils is carried out by the Cabinet Office. The Cabinet Office conducts triennial reviews of all non-departmental public bodies. This process started in 2011 or 2012 and has two purposes; to provide a strong challenge of the continuing need for individual NDPBs looking at both their function and form and employing the '3 tests' discipline and to review the control and governance arrangements in place to ensure that the public body is complying with recognized principles of corporate governance[71].

The triennial review of the Research Councils along with Research Council UK was published in April 2014 and was a two-stage process. The first stage assessed the contributing need for the functions and form of the Research Councils and RCUK and stage two subsequently looked at compliance with statutory accountabilities, financial and management responsibilities as defined by the Cabinet Office. The second stage was carried out by a team from BIS, independent from the Research Councils and the BIS sponsor team responsible for overseeing the Research Councils[72].

[71] https://www.gov.uk/government/collections/triennial-review-reports

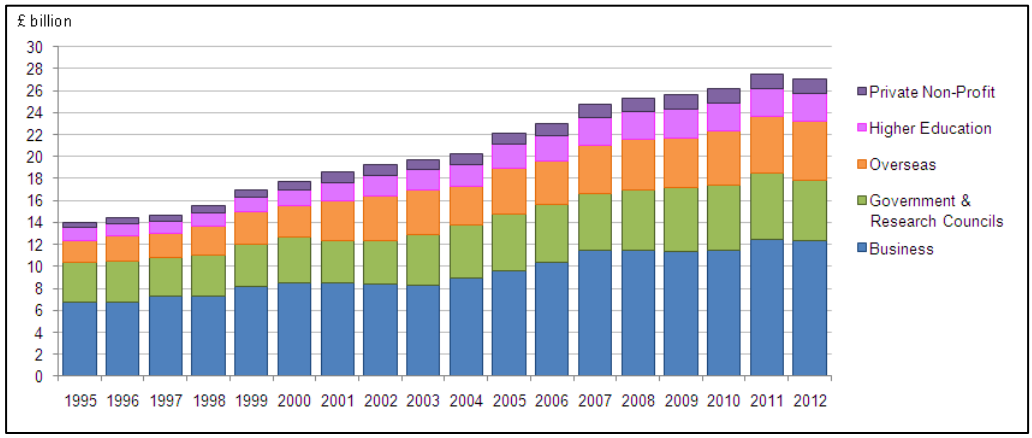
[72] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/303327/bis-14-746-triennial-review-of-the-research-councils.pdf

6.2 The R&D System

6.2.1 Characteristics of the publically funded research organizations

Public funding in the UK accounted for approximately 21% of R&D funding in 2012; just under 40% of this was spent on R&D within UK public research institutes (£2.2bn of a total £5.6bn)[73].

Figure 8 UK: Composition of UK GERD by funding sector 1995-2012



Source: Office of National Statistics

Higher Education Institutions in the UK are autonomous bodies, which have a charitable status and are free to seek funding from a variety of sources. The majority of their funding comes a dual support system. Under this system, the Higher Education Funding Councils (separate bodies exist for England, Scotland, Wales and Northern Ireland, with funds derived from ministries responsible for education) provide general funding, used mainly for academic salaries and research infrastructure, while the Research Councils provide funding for projects (including salaries of contract researchers), research training and centres on a competitive peer-reviewed basis. The other principal funding source for research is the charitable, non-profit sector, notably the Wellcome Trust, which is the largest single funder of medical research. There is one private university: the University of Buckingham. The representative body and membership organisation is Universities UK, whose membership is comprised of the executive heads of the UK's universities.

In recent years, greater emphasis has been placed on the 'Third Mission' of universities, i.e. greater engagement with businesses and local communities. To this end, the HEIF represents the main policy stimulus, although HEIs individually and collectively engage in a variety of 'outreach' activities and several regional and trans-regional consortia have been set up to address this activity.

Public sector research organisations in the UK carry out applied research (an in some instances fund) of relevance to their own requirements or those of their lead department. There are about 100 of these organisations in the UK and an example would be the Health and Safety Laboratory.

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[73] http://www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2012/stb-gerd-2012.html#tab-R-D-Expenditure-by-Funding-Sector

Research Council Institutes and Centres are those institutes for which the Research Councils have established a long-term involvement as a major funder such as the Medical Research Council Cancer Cell Unit. A further list of institutions can be found at http://www.rcuk.ac.uk/funding/noparentrcs/.

6.2.2 Level of autonomy of the publically funded research organisations

In the UK universities are autonomous organisations able to set their own research strategies and make their own personnel decisions. Most UK universities have been through a process over the last 15-20 years of professionalisation of the management structure and system. This has seen a move away from an academic-led collegiate management structure to one that tries to strike a balance between a stronger and more 'corporate' central management system and a collegiate system. This centralisation more readily facilitates the setting of strategies and organisational plans.

However, for most universities much of their research is funded from public funds and therefore they only have the flexibility that the public funding system allows. The block grant from the Higher Funding Councils is the only source of research income truly at the discretion of university management. However, as block grant income is linked to research performance at the discipline level (previously via the RAE and now by the REF), individual departments and research groups have considerable influence over its allocation.

Research Councils have a responsibility to demonstrate the value and impact of the research activities that they fund. The Research Councils UK use information that researchers provide on the outputs, outcomes and impacts of the Research Council funded project to report to both the Government and the public. The collection of this data enables the Research Councils UK to provide a strong evidence base to support the continued funding of research in the UK; improve the quality of reporting research outcomes to government, the public and other organisations; maintain a longer term relationship with grant holders to capture new developments and impacts from research long after a grant has finished and open up communication with researchers and research organisations to offer new opportunities to explore how best to capture the results of research funding. In 2013, the Research Councils undertook the first phase of a project to increase the commonality in which research outcomes are gathered, in response to feedback from the research community and as part of a wider move to greater harmonization across the Research Councils. The second phase of the project, initiated earlier this year was to implement a common user experience for providers of research outcomes data and finalize a common data model across the Research Councils[74].

6.2.3 Research infrastructures and Centres of Excellence / Competence Centres

The UK hosts a large number of national and international research facilities with over €1.14b allocated to construct ten large scientific facilities with another €385m allocated to five future projects since 2000. Apart from the physical scientific infrastructure, the UK's innovation infrastructure also includes the National Measurement System (NMS), the academic IT network, the UK's intellectual property regime and the UK's standards and accreditation system, plus major initiatives such as the Census of Population Programme.

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[74] http://www.rcuk.ac.uk/research/researchoutcomes/

In 2013, Research Councils UK (RCUK) published a Strategic Framework for Capital Investment - Investing for Growth: Capital Infrastructure for the 21st Century. This provides a strategic framework against which Research Councils will plan future investments in the UK's capital infrastructure for research. The new Framework will continue to include large facilities as previously described in RCUK Large Facilities Roadmaps, but has broadened to include other significant capital priorities.

The Research Councils also support infrastructures through the provision of equipment funding and a number have their own institutes with research laboratories and are responsible for maintaining their infrastructure. Research Councils support the provision of access to leading edge international experimental facilities, often through international subscriptions or joint funding. The STFC has a particularly active role in facilitating such arrangements and invested around €674m in 2010-2011.

The Large Facilities Capital Fund (LCFC) is the main source of funding for large facilities in the UK. It provides capital investments in new and existing facilities and infrastructure that Research Council budgets cannot cover. The LCFC has a projected allocation of almost €400m between 2011-2015 which will contribute to the capital costs of the construction, expansion, enhancement, upgrading or replacement of facilities either nationally or internationally.

Institutional funding also extends to a number of Centres of Excellence in the UK. There fall under two different categories:

1. Innovation and Knowledge Centres (IKCs), which are centres of excellence with five years', funding to accelerate and promote business exploitation of an emerging research and technology field. Their key feature is a shared space and entrepreneurial environment, in which researchers, potential customers and skilled professionals from both academia and business can work side-by-side to scope applications, business models and routes to market.
   The EPSRC works with other research councils e.g. BBSRC and public sector funders such as the Technology Strategy Board (TSB) to develop the interdisciplinary skills, infrastructure and research programmes needed to advance the field towards application for UK benefit, with due regard to ethical, social and regulatory considerations[75].
2. Centres forming part of the Centres of Excellence Initiative and under this scheme funders (public and non-profit sources) have come together to fund 5 Centres of Excellence, which are designed to strengthen research into complex public health issues such as as obesity, smoking and health inequalities. The Centres bring together leading experts from a range of disciplines and work in partnership with practitioners, policymakers and wider stakeholders to tackle public health issues[76].

[75] http://www.epsrc.ac.uk/newsevents/news/syntheticbiologyprogress/

[76] http://www.esrc.ac.uk/research/major-investments/ukcrc.aspx

6.3 The funding system

6.3.1 Flows of public research funding

Table 25 UK: Key numbers of R&D expenditure 2009-2012

	2009	2010	2011	2012
R&D Expenditure (total) as percentage of GDP	1.82%	1.77%	1.78%	1.72%
R&D Expenditure funded by Government as percentage of GERD	32.6%	32.3%	30.5%	28.9%
R&D Expenditure in the Higher Education Sector as percentage of GERD	-	27%	26%	27%

Source: Erawatch, Office of National Statistics

Table 26 UK: Institutional and competitive funding allocations 2010-2014

Research funding allocations	2010-11	2011-12	2012-13	2013-14
Institutional	£1,603M	£1,558M	£1,558M	£1,558M
Competitive	£2.55bn	£2.60bn	£2.57bn	2.60bn

Source: HEFCE; BIS Allocation of Science and Research Funding

Table 27 UK: Funding allocations for other types of Research Organisations 2010-14

Funding for additional type of RO	2010-11	2011-12	2012-13	2013-14
National Academies Royal Society British Academy Royal Academy of Engineering	£87.8M	£87.5M	£86.5M	£86.5M
UK Space Agency	£163.1M	£205.6M	£191.9M	£192.8M
Other Programmes Science and Society International Foresight Evidence and Evaluation	£43.6M	£24.5M	£24.1M	£24.1M

Source: BIS Allocation of Science and Research Funding

6.3.2 The institutional funding system

6.3.2.1 *Criteria used for decision-making on sources allocation*

There are two major types of institutional funding in the UK. The first is allocated to universities in the Higher Education sector in the form of a block grant from HEFCE and equivalent bodies in devolved administrations. This has previously been allocated on the basis of the results from the RAE. This has now been replaced by the REF which uses a process of peer-review supplemented by citation data to create quality profiles each submission; comprised of three elements: impact, outputs and environment. In 2011/12 this type of institutional funding was worth □2,752 million.

The second type of institutional support is competitive funding which is provided via Research Council grants and programmes. Grants are awarded on the basis of applications made by individual researchers, which are subject to independent, expert review. Awards are made on the basis of research potential, irrespective of geographical location. This type of funding is relatively flexible and supports projects ranging from small travel grants to multi-million pound research programmes. Funding covers a wide range of activities including the research projects themselves, feasibility studies, instrument development, equipment, travel and collaboration and long-term funding to develop critical mass. In 2011/12 this type of institutional funding was worth □3.8 billion ad all UK HEIs, research institutes for which research councils have a long-term involvement as a major funder are all eligible for this type of funding. Independent research organisations are eligible if they possess an exisiting in-house capacity to carry out research that materially extends and enhances the national research base.

6.3.2.2 *Performance contracts & processes*

The UK does not use performance contracts.

6.3.2.3 *Processes for funding system implementation*

Institutional funding allocated in the form of a block grant by HEFCE is based on the results of the REF and all HEIs are eligible. Although the REF is not mandatory for HEIs, if HEIs do not take part in the REF they are not eligible to be allocated funding in this way. Money allocated in this way is primarily used for academics salaries and research infrastructure.

For institutional funding allocated via competitive funding, all UK HEI's, research institutes and designated independent research institutes are eligible for funding. Any independent research organisation can apply for IRO status and Research Councils UK will send the appropriate documentation to complete to apply.

Research Councils also support infrastructures through the provision of equipment funding and a number have their own institutes with research laboratories and are responsible for maintaining their infrastructure. Research Councils support the provision of access to leading edge international experimental facilities, often through international subscriptions or joint funding. The STFC has a particularly active role in facilitating such arrangements and is responsible for operating large-scale research facilities as well as managing the UK access to large-scale facilities in other countries. The STFC invested around €674m in facilities in 2010-2011.

For facilities and infrastructure that the Research Councils cannot cover the Large Facilities Capital Fund (LCFC) is the main source of capital funding for large facilities in the UK. The LCFC has a projected allocation of almost €400m between 2011-2015 which will contribute to the capital costs of the construction, expansion, enhancement, upgrading or replacement of facilities either nationally or internationally.

In the UK, the primary source of income in HEIs for teaching is through student tuition fees. Where tuition fees cannot meet all of the costs of teaching, HEFCE has a fixed budget to support this. From 2013-14 this covers:

- Funding for high-cost subjects
- Funding to support very high cost STEM subjects
- Taught postgraduate courses
- Flexible learning: part time and alternative modes of study
- Additional funding for providers operating in London
- A Student Opportunity allocation for students from disadvantages backgrounds
- Funders for providers with distinctive provision
- Strategically important and vulnerable subject areas

6.3.2.4 *Governance of the funding system*

BIS provides the institutional funding in the UK and the funding received for research is allocated to the Research Councils under the 'Haldane Principle' described in the R&D section of this case study. The UK does not directly prioritise specific areas of research but instead applies horizontal support to maintain the overall performance of the research system. This is coupled with objectives of making the science base responsive to the needs of the economy and both increasing the level of business investment in R&D and the level of engagement with the science base. Thus thematic and sectoral research policies are operated largely though government expenditure via ministries and departments research to support their specific policy portfolios, either as in-house research or through commissioned research from higher education or the private sector i.e. research and technology organisations. However, it is important to note that certain fields of research funded by the government attract larger budgets simply due to the scale of demand i.e. health.

There are also a number of Cross-Research Council programmes, which receive substantial financial support. The programmes tend to cover novel, multidisciplinary approaches needed to solve many of the big research challenges over the next 10-20 years. The Research Council UK coordinates the delivery of this research under six priority areas:

1. Digital economy
2. Energy
3. Global Food Security
4. Global uncertainties; security for all in a changing world
5. Living with environmental change
6. Lifelong, wellbeing and health

Each theme is important in terms of the knowledge and skilled people, which will be generated as well as having a significant potential for delivering economic impact. Delivery of these benefits and economic impacts will be accelerated by the effective coordination of the programme through the Research Council UK.

Aside from BIS, there are other government departments that fund applied research, which is of direct relevance to their own policy initiative or operations. Funding is competitive and the main spenders include:

- Dept. of Defence (£1,306 million)
- Dept. of Health (£904 million)
- Dept. of International Development (£236 million)
- Dept. Environment, Food and Rural Affairs (£161 million)

6.3.3 Feedback and reflections on the system

6.3.3.1 *Advantages & disadvantages of the system*

Institutional and competitive funding in the UK is dependant largely on peer review which relies on experts making judgements about which research deserves funding

During the process of peer review, multiple panels and UoA lead to greater consistency of panel operation and a fairer assessment of interdisciplinary areas.

Reduced number of panels in the REF versus the RAE may run the risk of undermining confidence in the peer review process that will be carried out in non-science subjects

Less incentive to collaborate within institutions and produce co-author papers as only one colleague can return this as an output for the REF, however, this may increase collaboration with researchers in other institutions as co-authors from separate institutions can return the same output.

Stress-full and time consuming process for those involved, may impact morale

Output for individual researchers limited to four 'items' meaning that large quantities of high-impact research may not be submitted and subsequently not rewarded by the REF

6.3.3.2 *Effects of the funding system*

Top performing academics have seen individual benefits in terms of increased salaries and attractive relocation packages as universities compete for the best researchers, particularly in the period leading up to the RAE / REF.

Institutions may begin selectively directing funding to the highest-rated departments, which in part has some justice, however the degree of selectivity may be cause for concern.

Very small numbers of staff on the borderline could affect the financial outcome for a research area, thus encouraging institutions to leave out staff to raise the overall rating.

Potential over-concentration of funding and under-mining the relationship between teaching and funding.

Funding assigned for according to perceived economic and social benefits. It is often difficult to predict which research will create the greatest practical impact???

Changes in publication behaviour, with academics seeking to publish in journals in disciplines with a higher normalised citations scores and that the opportunity for interdisciplinary dialogue will be lost.

Changes in publication behaviour where research crosses the boundaries between the science-based disciplines and those where a light-touch peer review process is proposed.

Newer journals not as well represented in the Web of Science in terms of content of the in articles cited, this may contribute to behaviour change by researchers in their publication habits.

Added Value attributed to collaboration and interdisciplinarity by the REF may incentivise the dishonest attribution of authorship to boost the department's REF score.

6.3.3.3 *Risks of the funding system*

Huge pressure on academics to publish research papers in the right journals as the REF only funds research that is 'internationally excellent' or 'world leading' with jobs potentially at risk if this is not delivered upon.

Increased separation between teaching and research with some academics now having teaching only contracts leading to separation between teaching and research where in the past excellence in teaching and research have been thought as inextricably linked. A large proportion of an HEIs funding is from teaching and fierce competition for students and so it is important that attention and efforts are not diverted away from teaching and the 'student experience' in the pursuit of research monies when teaching in itself is a big financial consideration for HEIs.

Different prestige and status associated with different academic roles according to those most likely to be entered into the REF leading to certain academic roles being undervalued

Further concentration of research funding would carry the risk of reduced research capacity for some regions, greater differential student experiences and a reduction in the diversity of the UK's research base.

Increase in the bureaucratic nature of the research assessment process

Reluctance of researchers to pursue high-risk long-term projects since these projects are less likely to result in publication. Projects such as these often result in ground-breaking research but the pursuit of publications and impact stories may lead to more conservative research projects to help ensure this before the project starts.

No distinction between different research outputs such as books and articles, therefore there is little incentive for longer term projects with fewer research outputs, despite these taking much longer to produce.

Economic and social impact is more applicable to disciplines closer to the market, making impact proposals for discipline such as the arts and humanities more difficult to score well in, potentially undermining basic research in these areas.

Impact factors will lead to further commercialisation and the subsequent narrowing of the research agenda. Research outputs that attempt to understand the world around us should be evaluated by the quality of their contribution to human knowledge rather than on their contribution to company balance sheets. This is particularly poignant in light of impact indicators revolve around creating new businesses, commercialising new products and attracting R&D investment from global business,

Blue sky research may become increasingly difficult to fund, distorting the nature of research activity carried out in universities with publication becoming the primary end, not knowledge creation or intrinsic interest in a subject.

7. Additional countries

7.1 Belgium/Flanders

7.1.1 Introduction

This chapter focuses on the funding system for research in the Flanders, and more specifically the Special Research Fund (BOF), which is a funding system for bottom-up basic research in the Higher Education Institutes (HEI).

We cover the criteria that are used for the distribution of this fund, based on a formula called BOF key, and the conditions that are set for the internal allocations of this fund. We also look into the developments in the BOF key, its data sources, and the consequences of the BOF system on the research community.

Finally, we briefly cover the principles for the distribution of institutional funding for teaching and research, since the 2008 reform partly based on the BOF key.

Of particular interest for this study and the evauation and funding system to be developed for the Czech Republic are

- The conditions set for the awarding of BOF funding, essentially establishing a light-weight performance contract system
- The minimum threshold set for institutional funding for research (fixed component)
- The adjustments to the BOF fund distribution reflecting the need to take into account the positioning of the medium-sized universities
- The effects of the BOF criteria on the Flemish research system
- The procedures established for the management of the VABB-SHW

7.1.2 Background: description of the R&D System

The governing bodies for R&D

Belgium is a federal country that has three regions: Wallonia, Flanders and Brussels-capital. The federal state retains the responsibility for funding research programmes of national interest, such as in the area of space and defence. The regions have a decentralized and autonomous research policy and are responsible for funding education and fundamental research at universities and higher education establishments. There are different protocols for the evaluation of science, tied to different institutes and to different disbursements of funding. In this chapter we look at the research funding system of the region Flanders.

- Competitive funding for research is coordinated via agencies such as the Fonds voor Wetenschappelijk Onderzoek (FWO) and the Agentschap voor Innovatie door Innovatie en Technologie (IWT).
  - FWO – Flanders provides competitive funding via support grants and programmes
  - IWT funds innovation schemes to enterprise and HEI (hogescholen and Universities).
- The Department of Economy, Science and Innovation (EWI) governs the Flemish research system. EWI coordinates and evaluates a range of instruments that finance fundamental and strategic basic research. It directly funds the six Flemish

universities (institutional funding) and every year, it computes and publishes the funding to be allocated via the Special Research Fund (BOF) and the Industrial Research Fund (IOF). BOF is a fund dedicated to bottom-up basic research; IOF is dedicated to innovation-focused research. Distribution of BOF and IOF funding is based on a performance-based funding model, which includes research inputs and outputs such as counts of academic staff, degrees awarded, publications and citations outputs (see further below). The IOF additionally includes innovation and collaboration performance – see Table 28.

Table 28 Belgium: IOF allocation keys

IOF-Key (2010)	Weight
Proportion (weighted) of doctorates	15%
Proportion of publications and citations	15%
Institution's proportion of industrial contract income	30%
Proportion of income from the European Framework Programme	10%
Proportion of patents	15%
Proportion of spin-offs	15%

Source: OECD (OECD 2010)

R&D actors in the Flemish system

The Higher Education Institutes (HEI) sector .in the Flanders is composed of universities and colleges ('hogescholen').

Universities are highly research-intensive in the Flanders and account for more than 85% of the academic output[77]. There are currently five academic universities in the Flanders:

- Katolieke Universitei Leuven (since 2014 integrates Katolieke Universiteit Brussel)
- Universiteit Hasselt[78]
- Universiteit Antwerpen
- Universiteit Gent
- Vrije Universiteit Brussel

The Colleges have earned a full-fledged higher education status in the reform of 2008. They typically conduct more applied-oriented research. They include:

- Artesis Plantijn Hogeschool Antwerpen
- Arteveldehogeschool
- Erasmushogeschool Brussel
- Groep T Hogeschool

[77] ECOOM. Vlaams IndicatorenBoek, 2013

[78] The University Hasselt has a special agreement with the University of Maastricht – which led to the establishment of a transnational university. Special regulations exist with respect to attributing financing and measuring the performance of the transnational university.

- Hogere Zeevaartschool Antwerpen
- Odisee
- Hogeschool Gent
- LUCA School of Arts
- Hogeschool West-Vlaanderen
- Karel de Grote-Hogeschool
- Hogeschool Thomas More Kempen
- Hogeschool Thomas More Mechelen-Antwerpen
- Katholieke Hogeschool Leuven
- Katholieke Hogeschool Limburg
- Katholieke Hogeschool Vives
- Hogeschool PXL

Next to the universities, which are the most important actors in the field of basic research, the Flemish government decided to concentrate resources in a number of relevant strategic areas of scientific and technological innovation research. For this purpose, it founded four big Flemish research centres, the so-called **SOC – Strategic Research Centres**. Common characteristics of these centres are their institutional funding on the basis of 5-year performance contracts and their explicit focus on industry. The four SOCs are

- The Interuniversity Centre for Micro-electronics – IMEC
- The Flemish Intsitution for Technological research – VITO
- The Flemish Institute for Biotechnology – VIB
- iMinds, previously the Institute for Broadband Technology – IBBT

Other research institutes are the Strategisch Initiatief Materialen – SIM (focused on advanced materials), the Centrum voor Medische Innovatie – CMI (focus on medical innovation) and the FISCH-initiative (focus on durable chemistry and advanced materials). There are also a number of institutes for policy-oriented research and management schools.

7.1.3 The BOF fund for bottom-up basic research

Overview

The Special Research Fund (BOF) is a public fund dedicated to the funding of basic research in HEIs.

It was created in 1985 with the objective to stimulate groundbreaking research. An additional objective is to encourage universities developing an internal research policy. With this intent, specific conditions were set to be elegible for BOF funding (see further below).

The BOF funding is allocated among the universities through a parameter-driven model, also referred to as the BOF key. The rationale for the creation of this model was to allocate funding on a fair basis; contemporaneously, the BOF key is used to reward universities for their performance.

The BOF key is made public. The percentual distribution of the fund, instead, is sent to the universities and other stakeholders, but is not published. Since 2013, the BOF-key

is used also in the calculation of the university institutional funding and other funding mechanisms.

The unit of assessment at the national level is the university, which is also the final recipient of the funding. The individual is the unit of analysis when it comes to the evaluation for the internal funding allocation.

The volume of the BOF fund

The BOF fund budget is set on an annual basis by the Flemish government, deciding on the budget to allocate to the three components of the BOF, i.e. (see Table 29):

- The basic component of the BOF, constituting the major component of the fund
- The sources dedicated for the funding of Tenure Track grants, i.e. for the coverage of the salary costs of postdoc researchers that participate in the programme (5-year term contracts with precise objectives, followed by a fixed-term contract is completed successfully)
- The sources dedicated for the Methusalem programme and ZAP grants, i.e. long-term grants for individual excellent researchers, allowing them to focus exclusively on research and/or pursue international research. The Methusalem programme was launched in 2006 and became part of the BOF fund in 2009. The Methusalem budget has increased substantially from €3,000 in 2006 to almost €20,000 in 2012. ZAP mandates are to the benefit of excellent academic staff

The basic BOF is the key component of the fund distributed among the universities on the basis of the BOF key (Table 29). This is followed by the Methusalem programme components and the Tenure Track grants.

Table 29 Belgium: Components of the BOF fund

	2006	2007	2008	2009	2010	2011	2012
Basic BOF	99,033	100,726	105,140	107,138	107,130	107,677	116,090
BOF - Tenure Track			2,800	5,653	5,645	8,961	9,154
BOF - Methusalem-programme	3,000	10,051	15,242	20,532	20,076	19,402	19,822
BOF – ZAP grants		1,500	3,029	4,587	4,348	4,196	5,586
Total BOF	102,033	112,277	126,211	137,910	137,199	140,236	150,652
Basic BOF	97%	90%	83%	78%	78%	77%	77%
BOF - Tenure Track	0%	0%	2%	4%	4%	6%	6%
BOF - Methusalem-programme	3%	9%	12%	15%	15%	14%	13%
BOF - ZAP-grants	0%	1%	2%	3%	3%	3%	4%

BOF funding has increased fivefold since 1993 (as the allocation criteria have gradually become more complex). From 2006 to 2012 the BOF subsidy has relatively moderately increased from around €99,000 to €116,000.

It has constituted a relatively stable share of 45% in the Flemish public funding of basic research (Table 30). In 2007, the Hercules financing was introduced, aimed at providing Flemish researchers with research infrastructure.

Table 30 Belgium: Allocation of public funds to basic research 2006-2012

	2006	2007	2008	2009	2010	2011	2012
FWO-Flanders (competitive funding)	132,750	138,259	146,504	151,131	148,415	156,186	173,040
BOF	102,033	112,277	126,211	137,910	137,199	140,236	150,652
Hercules (50%)		2,800	7,803	7,803	7,418	5,250	10,270
Total	234,783	253,336	280,518	296,844	293,032	301,672	333,962
FWO-Flanders (competitive funding)	57%	55%	52%	51%	51%	52%	52%
BOF	43%	44%	45%	46%	47%	46%	45%
Hercules (50%)	0%	1%	3%	3%	3%	2%	3%

Source: Vlaams Indicatorenboek Wetenschap, Technologie en Innovatie, 2013

The 2013 changes to the BOF fund

On January 1, 2013, changes were made to the BOF decree. These were

- The introduction of a number of **conditions** for eligibility to BOF funding related to strategic governance, quality management, communication on science and diversity
- The establishment of **dynamic minimum shares** for the University of Hasselt, the University Antwerp, and the Free University Brussels, with the aim to ensure a more stable funding for each university enabling them to undertake longer-term commitments. The minimum shares were, in 2013, 2.91% for the University of Hasselt, 10.12% for the Free University of Brussels and 11.75% for the University of Antwerp. A growth path with an upper limit on the minimum financing is foreseen; this upper limit is, in 2013, 4%, 10.5%, and 13%, for these universities respectively. The minimum shares are dynamic because, depending on the growth / performance of the universities, from 2014 there is scope to increase the share of minimum funding. As the University of Hasselt is still growing in capacity, it will benefit from a guaranteed grow-path in the minimum financing.
- Measures to offer more opportunities to **women in science**, such as priority rulings in case of new openings for independent academic personnel (ZAP) and postdoc researchers through the use of BOF resources
- The revision of some parameters in the formula, the so-called BOF key

The rationale for the minimum share was to take better into account the **diversity** between universities. Universities are scrutinised under the exact same conditions despite great differences in size, objectives and performances. The minimum percentages in the BOF-key for each of the smaller universities are to ensure a more stable funding stream for research. Larger universities also have relatively better access to a wider range of funding channels (e.g. EU funding) and have better opportunities to attract researchers. The minimum share rule is intended to compensate for this financial disadvantage, thereby ensuring a sufficiently differentiated university landscape in the Flanders.

In relation to the BOF key, the 2013 regulation aimed to ensure that the bibliometric parameters envisaged the following:

- Encourage both productivity and visibility;

- Define the degree of excellence via international quality standards;
- Use impact factors to classify groups of magazines (not for the assessment of individual publications);
- Average the extreme variation of impact factors within and between disciplines (to avoid skewing investment in experimental sciences with high impact factors);
- Transparency in the count;
- Apply the count across all disciplines (discipline neutral);
- Ensure that the count is compatible with the VABB-SHW count scheme.

Internal distribution of the BOF fund

The BOF funding for research process is based on the principle of the universities' autonomy. The funding is directly allocated to universities, i.e. granted as a lump sum to specific BOF funds within each university. This is then followed by an internal fund allocation process in each university, deciding on the final allocation of funding to fellowships and projects.

The internal university allocation is usually based on a peer-review process, involving international experts and an assessment of the (bibliometric) performance of the submitters, as well as a detailed review and assessment of the substance of the work proposed. However, the university autonomy in the management of the BOF fund is increasingly limited and precise conditions and expectations are being set for the eligibility to BOF funding (see the next chapter).

And universities are regularly assessed on this process and its outcomes. CRITIQUE ON COSTS.

In order to complement the information provided through the BOF keys, at the national level an **external evaluation** of the universities' research performance is organised every two years. This includes research and HR management as well as the quality of the processes adopted internally to allocate the BOF funding.

Conditions linked to the BOF funds

There are several conditions put on the HEIs to be eligible for BOF funding in terms of research strategy and governance[79]:

- The university management draws up a five-year strategic plan defining its policy for scientific research in general and the focus for spending the BOF funds in particular
- The University Board shall adopt rules for the internal allocation of basic component in the BOF fund; to be embedded in the Charter of Good Governance of the university
- Universities report on their performance on an annual basis

[79] See article 22 BOF 2013, http://www.ond.vlaanderen.be/edulex/database/document/document.asp?docid=14492

- Universities are part of and adhere too the Flemish science communication policy and support the general principles of the relevant marketing and communication plan of the Flemish Government in the matter
- The Flemish Minister is authorized to further determine the regulations and attach funding to the abovementioned conditions.

The strategy plan should include as a minimum

- The key principles of the governance approach
- The instruments and action plan to reach the defined objectives
- The financial means for the achievement of the objectives

Specific attention should be dedicated to

- The monitoring and evaluation of the quality of research
- The principles of good governance in research
- Increase in participation of women and minorities in research
- The training and career development of researchers
- Communication on ongoing and concluded research

There are specific indications also for the **internal use of the fund**. These include:

- Conditions are placed on appointing new ZAP academic staff/post-doctoral staff. Under certain conditions, the under-represented sex is given preferential appointment in order to achieve an improvement in gender balance.
- The BOF-2013 decree outlines that a maximum of 25% of university spending on BOF-ZAP mandates can be allocated to mandates that extend indefinitely. At most 15% of the BOF-ZAP resources are allocated to attract outstanding researchers from abroad or from another research institute, under a minimum employment rate of at least 50%.
- At least 50% of the BOF funds are to be allocated to projects for fundamental research of the following types
  - Projects with a duration of 4-6 years and minimal annual funding of €45,000, carried out by research groups of excellent scientific value. This is to be demonstrated by means of objective data, more specifically on the basis of publications or other indicators of scientific quality. The Flemish minister competent for research governance can increase this minimum value
  - Projects with a duration of 2-5 years and minimal annual financing of €150,000. The Flemish minister competent for research governance can increase this minimum value
- Each year, at least 3.5% of the BOF funding is allocated to grants or projects in the framework of international scientific collaboration. In relation to research grants for researchers from abroad, eligible costs are limited to personnel costs (salary of fellowships), eventually complemented with a bench fee. For the research projects, personnel, operational and equipment costs can be accounted for.
- The allocation of funds for the Methusalem programme must be based on an external evaluation of the research proposals by an international panel, to be organised by the university. Every 7 years, an internal panel is to evaluate the effectiveness of the research project (objectives reached), the HR aspect of the project (research training), and the adequacy of the research plan for the following 7 years

Finally, the **internal regulation** for the allocation of the fund should define

- The research initiatives that can be funded and the conditions and criteria for their selection
- The procedures for the allocation of the resources for the research grants and projects, with as minimum conditions:
  - The funding is allocated by the university management after motivated advice by an internal research council
  - Maximum two third of the internal research council is of the same gender. If the research council does not meet this requirement, it cannot give legal advice; the same ruling accounts for all selection and advisory committees involved in the allocation of the funding
  - The university's research council selects the research grants and projects to be funded
  - Experts will be involved for the appraisal of large project proposals; these experts will be external to the university and will be appointed following a procedure defined by the university management
  - Funding of Methusalem grants are decided through appraisal by an internal panel of experts
- The rules for the organisation of calls and funding approvals
- The methodology for the ex-ante evaluation of the proposals, the ex-post evaluation of the projects implemented, and eventually the interim evaluation
- The process for the communication of the proposal appraisal results to the researchers
- The process for the communication to the researchers on the selection procedures
- The process for the researchers to present appeal

The university is entitled to allocate the following shares of the BOF fund for internal management purposes:

- 2% of the basic BOF fund component for the activities of the offices responsible for research coordination
- 1% of the basic BOF fund component (or at least 100,000 euro) for the expenses related to operational and personnel costs that are directly linked to the management of research projects or initiatives funded by the BOF fund

Critique on the BOF system

In 2010, the Flemish Interuniversity Council (VLIR) nominated an external committee to evaluate the quality of research management in the Flemish universities[80]. The committee concluded its work expressing some major critiques to the BOF system.

[80] Beoordeling van de kwaliteit van het onderzoeksmanagement van de Vlaamse universiteiten, Vlaamse Interuniversitaire Raad, Brussels, 2010

The Commission agreed with the stakeholder communities that the BOF has become too **complex and unclear**. On the one hand, the BOF key has become complex in its parameters used, which is to be added on to their lack of continuity and ongoing changes. In addition, the BOF fund has expanded with the introduction of financing for tenure track academics and Metrusalem financing. Each of these financing streams has independent objectives. At this stage the committee concluded that, with reference to the increased complexity, no additional funding mechanisms should be initiated. Rather, the existing channels of financing should be strengthened.

Following the evaluation by the external committee, additional criticism was made on the use of **journal impact factors** and the lack of normalization across disciplines – disciplines with traditionally higher impact factors receive relatively higher scores. As a result, scholars may choose to invest in disciplines with higher impact factors.

The BOF key has its consequences on the career path of **individual researchers**. The Commission noted that not all academic personnel receive BOF funding internally and the reasons behind this uneven distribution are partly linked to the parameters used for the central BOF funding. There is an uneven distribution of the funding with certain staff members charged with heavy teaching workloads and not having the opportunity to acquire research experience. In some universities, part of the staff is condemned to teaching without acquiring an adequate level of research experience. The Commission expressed concern on the consequences of this phenomenon for the **integration of education and research**, which is a fundamental characteristic of university education. A similar concern was exoressed by the evaluation commission in 2004.

In recent years the discussion on **scientific integrity** and the academic pressure to perform / publish has escalated substantially. The main challenge is the impact of measuring publications/citations on researchers. The BOF explicitly is not meant to rank universities or to do more than divide money in an equitable way. However, universities often use the same principles in their internal distribution of funds and thus substantial pressure is put on the researchers to publish more. The Committee questions whether this so-called 'rat-race' compromises academic integrity. The committee references the 'European Code of Conduct for Research Integrity' and the report of the European Science Foundation (ESF) 'Fostering Research Integrity in Europe' as a relevant benchmark and encourages universities that have not yet implemented specific policy on academic integrity to do so.

Finally, at a more general level, the Committee considered that in the Flemish research funding system as a whole, there is a disproportionate balance between funding of **targeted and bottom-up research**. This is a result of the increased focus on the valorisation of research and research results – by government policy and EU policy. This is also evident in the BOF funding distribution criteria. There has been an increase in the targeted funding for science and innovation, EU funded projects, projects with industrial partners, etc. In contrast, there is stagnation in the financing of bottom-up research, including the BOF fund. A reduction of investment in bottom-up research is a matter of concern.

7.1.4 The institutional funding for teaching and research

In 2008, a University Reform was introduced that set the Colleges firmly at the level of the Universities, jointly forming the Flemish Higher Education Institutions sector, and introduced common funding systems for the two HEI typologies. This included a revision of the institutional funding system for both universities and colleges,

introducing a PRFS component based on quality indicators (for both teaching and research).

The Minister of Education set the following principles for the new institutional funding system[81]:

- The system must be kept **simple**. This will increase the efficiency for reaching the objectives, reducing to the maximum the burden for the governance bodies and the HEIs
- It must be **transparent**. Transparency is needed in order to reach legitimacy. This also means that third parties need to be able to understand the logic and objectives of the data. This implies that teaching and research components of the funding need to be clearly separated
- The new system needs to be **common** for the entire HEI sector in the Flanders, i.e.universities and colleges. Collaboration agreements between these two typologies of institutions will be taken into account
- Institutional funding will be provided as a **lump sum**, including the 'incentive funding' copmponents. The institutions remain autonomous in their decision making on internal allocation of the funding. Obviously, the institutions will be accountable for how they distribute the funding from public sources internally and how they use it
- The new system must be relatively **stable** and foster planning of financial management. This means that changes in the parameters should not be too abrupt. Institutions need to maintain the possibility to do mid-term planning
- There must be a **step-wise** introduction of the new system. In the long-term it will provoke considerable shifts in institutional funding and the institutions need to be given the time to prepare for that. Transition measures will therefore need to be set in place to go over from the old to the new system

A major objective for the introduction of the PRFS was to foster an improvement of teaching and research quality in the region, both for universities and colleges.

After a long period where the number of students mostly determined the overall budget of institutional funding for the HEI's, the decree of 14/03/2008[82] established the new partly formula-based institutional funding model for the Higher Education Institutes (HEI) in the Flanders.

There are two components to the institutional funding budget, one for teaching and one for research, each with a fixed and a performance-based component. The ratio institutional funding for teaching versus research is to gradually increase towards **55%/45%.**

Table 31 shows the budget allocation for the different components in 2011.

[81] Frank Vandenbroucke, Vlaams Minister van Werk, Onderwijs en Vorming, Voorstel aan de werkgroep financiering, 2004

[82] http://www.ond.vlaanderen.be/edulex/database/document/document.asp?docid=13988

Table 31 Belgium: Breakdown of the HEI institutional funding budget for teaching and research in 2011

		In m€	Share
Teaching	Fixed	106	8%
	Variable	888	69%
	Total	994	77%
Research	Fixed	111	9%
	Variable	186	14%
	Total	281	23%
Overall total		1,293	100%

Different shares of the teaching funding (both fixed and variable components) are foreseen for the different HEIs in the educational system, i.e. colleges and universities.

From the year 2014 onwards, distinction is made between

- The professional oriented colleges
- The professional oriented art schools
- The academic universities

In relation to the institutional funding component for research, the Decree set a **minimum threshold** on:

- At least 65 doctorate diplomas awarded over 4 years (the years t-7/t-6 until t-3/t-2)
- At least 1,000 publications over 10 years (the years t-12 and t-3)

The BOF key determines the variable component. Normalisation for the size of the HEI is based on the following weighting scales:

- For the number of doctorate diplomas awarded:
  - Factor 3 - the number of doctoral degrees awarded is less than or equal to 65
  - Factor 2 - the number of doctoral degrees awarded is greater than 65 and less than or equal to 500
  - Factor 0 - the number of doctoral degrees awarded is greater than 500
- For the number of publications:
  - Factor 3 - the number of publications is less than or equal to 600
  - Factor 2 - the number of publications is greater than 600 and less than or equal to 3000
  - Factor 1 - the number of publications is greater than 3000 and less than or equal to 10000
  - Factor 0 - the number of publications is greater than 10000

7.2 Finland

Funding for universities in Finland is formula-based. Crucially, education and research are not considered separately, but instead both feed into the formula, making it partially performance-based and partially based on size (ie number of students, etc) of the institution.

Though an RAE-style comprehensive assessment exercise was proposed in Finland in 2010, this never materialised. Nevertheless, funding allocation in Finland is effectively performance-based, though on a broad range of criteria relating to the full range of HEIs' operations – notably including teaching – is applied and obtained regularly through annual data submission of each institution to MINEDU.

Within the Finnish government, the Ministry of Education and Culture (MINEDU) is responsible for steering science policy. Its remits include the funding of basic research and its infrastructure and the allocation of core funding to Finnish Higher Education Institutions (HEIs) and the Academy of Finland (AKA) - the national agency that funds basic research from individual researchers and research units of universities and research centres. R&D evaluations and impact assessments are also part of its remits, when related to national R&D policies and the Academy of Finland. In Finland universities and polytechnics are responsible for the evaluation of their own quality assurance operations and outcomes, with support from the Higher Education Evaluation Council (FINHEEC).

Some distinction exists in Finland between the universities and the polytechnics. Whilst the mission of universities is to conduct scientific research and provide research-based instruction and postgraduate education, the polytechnics train professionals in accordance with labour market needs. However, the role in research in polytechnics is getting increasingly important, though its focus is much more on applied research, targeting more explicitly the R&D needs of regions and local enterprises. Originally, there were 20 universities and 26 polytechnics in Finland, but following the 2010 University Act (see below), several mergers have taken place, where especially the smaller universities and polytechnics merge with larger ones, with the expected result being 15 universities and 18 polytechnics in total, once all planned mergers are complete.

In Finland, for universities and the polytechnics, the distribution of the institutional funding is partly **performance based**, guided by common criteria, and partly linked to the individual **performance contracts** with the Ministry, taking into account strategic lines and objectives (prospective) as well as evaluation of the achievement of previously agreed targets (retrospective). Finland's use of performance-based funding for HEIs is rather old and well established. It was extensively reformed in 2010, when Finnish universities gained their autonomy with the Universities Act, with introduction of a new set of criteria that focus increasingly on research objectives and outputs.

Overall, the main emphasis is on capacity-building and assisting the institutions to fulfil strategic goals and priorities. Finland especially stands out in terms of the priority given to teaching and training as key indicators of quality.

7.2.1 Inclusion of individual staff

Assessment is conducted at the level of the institution, with individual staff in no way formally highlighted in the assessment. In fact, though each university and polytechnic submits its publication data on an annual basis to VIPUNEN, everything is made public on the VIPUNEN website, except for personal data related to the author (TG 2013). In some part, this is due to the fact that universities/ polytechnics were fully state-owned until 2010 and academics were classed as civil servants, making

individual competitive performance assessment problematic. Since the major higher education reforms of 2010 this status of academics has changed, but there is no evidence that this has lead to any kind of individual-level performance assessment from a national research funding perspective. Internally, there is of course the possibility that research performance assessment is happening, though there is currently no evidence for this either.

The literature frequently notes that the **university** (rather than eg departments or research groups) is the key level of assessment in Finland, but that universities are at liberty to distribute the performance-based share of research funding at their own discretion among their various department. Once again, little is known about how this happens, though the literature notes frequently that universities may choose to reward individual or departmental performance, or align their internal funding allocation with wider strategic science priorities.

7.2.2 Indicators and scoring systems

Specific indicators are:

- Number of teachers/researchers
- Agreed number of doctoral degrees
- Effective number of doctoral degrees
- Funding from Academy of Finland (centres of excellence)
- Funding from TEKES
- Funding form competitive international research programmes
- Number of publications in
  - Peer reviewed international journals
  - Refereed journals
  - Books
  - Number of other publications
- Number of teachers and researchers spending time abroad (> 1 week) (TG, 2013)

The publication indicators noted here of course only reflect the amount of output and say little about quality. To add this dimension, publications are additionally divided into a three-point scale:

Level 1: Channels recognised as scientific

- The channel is specialised in the publication of scientific research outcomes
- There is an editorial board constituted by experts;
- The scientific publications are subject to a peer evaluation focusing on the entire manuscript.

Level 2: Prestigious scientific publication channels

- Mainly international scientific publications channels, with the editors, authors and readers representing various nationalities. The journals publishing reviews only must not account for an overly large share of the whole.

Level 3: channels representing state-of-the-art quality in the respective field

- The research published in them represents the highest level in the discipline and has very high impact (e.g., as measured through citation indicators);
- The series cover the discipline comprehensively, not limiting to the discussion of narrow special themes;

- Both the authors and readers are international and the editorial boards are constituted by the leading researcher in the field;
- Publication in these journals and series is highly appreciated among the international research community of the field. [83]

The scale was built through a publication forum project between 2010 and 2012 with the objective to produce a national rating of journals, conference and book series, and book publishers in all disciplines. It involved 23 field-specific panels with 210 panellists. Ratings are to be reviewed every three years. Besides the criteria, by which publication channels are to be classified, the classification panel additionally is limited by quotas, where no more than 20% of channels can be Level 2 or 3, and the total of level 3 channels cannot exceed 25% of the overall number of level 2 channels.

This ranking system will be put into operation from 2015 onwards, with publication in channels 2 and 3 to be assigned greater weight in the calculation of publication outputs. The ultimate intention here is to avoid publication patterns that emphasise volume rather than quality of outputs.[84]

7.2.3 Use and context of the choice of indicators

Benneworth et al (2011) summarise the rationale behind Finland's funding criteria:

> *The new steering model aims at a structural development of higher education institutions linked with the general reforms of the research system and the modernisation of higher education in Europe. This means that the main objectives are to improve the quality of teaching and research, to boost international competitiveness, greater effectiveness, profiling and internationalisation.*

As such, even at the level of performance agreements between MINEDU and each HEI (universities and polytechnics), five domains of performance are considered:

- Basic studies and study processes (quality of study processes)
- Scientific postgraduate education
- Research, development and innovation
- Internationalisation
- Social impact

The large proportion of weight given to indicators of student numbers and graduates simply reflect the absence of tuition fees in Finland. Other indicators reflect various challenges and priorities. Most notably these include:

- Inclusion of funding from TEKES as an indicator is symptomatic of the changing relationship between research and innovation: there has traditionally been a strong division of labour between science and basic research on one hand, and technology with direct commercial implication on the other. Over the past few years however the co-operation has increased significantly between the Ministry of

[83] For full criteria, see http://www.tsv.fi/julkaisufoorumi/materiaalit/jufo_panelguidelines_17122013.pdf

[84] See Puuska HM (2014) Scholarly Publishing Patterns in Finland. P 81: http://tampub.uta.fi/bitstream/handle/10024/95381/978-951-44-9480-2.pdf?sequence=1

Education and the Ministry of Employment and Economy (and by extension TEKES) on issues related to science and innovation. An example of this collaboration is their participation in the Research and Innovation Council and its steering of Finnish R&D policy. Inclusion of TEKES funding, and more generally of social impact of research in the domains and indicators of funding allocation at Finnish universities is a logical expression of this shift towards closer cooperation.

- Internationalisation is another prominent aspect of the selection of indicators in Finland. This choice reflects a key problem pointed out in the Finnish system, namely its low level of internationalisation, not so much in terms of international co-publication, but in terms of direct international experience, both in-coming and out-going. As such, indicators rewarding time spent abroad are a direct response to this acknowledged weakness.

7.2.4 Scoring system & weights

There is a standard core funding formula for universities, the majority of which is effectively related to the size of the institution or the extent of its activities, with additional parts based on quality. Furthermore, the bulk of this formula consists of teaching and training.

Table 32 Finland: University core funding formula implemented since 2010

Funding based on the quality, extent and effectiveness of the activities: 75%		**Other education and science policy objectives: 25 %**
Education: 55%	**Research and researcher training: 45%**	
Extent of activities 85%	Extent of activities 75%	Strategic development 25%
Quality and effectiveness 15%	Quality and effectiveness 25%	Education and discipline structure 75%

Source: Joint Report by the Economic Policy Committee (Quality of Public Finances) and the Directorate-General for Economic and Financial Affairs, Efficiency and effectiveness of public expenditure on tertiary education in the EU, Annex: country fiche Finland, European Economy Occasional Papers No 70.

The components of the 'Quality, extent and effectiveness' scoring are calculated based on the following aspects:

Extent of activities in education

Degree targets and their attainment continue to play a key part in the model because they are the key outputs of universities. However, the focus on degree-based funding has shifted from targets to outputs, in order to find a balance between plans and reality. The idea is to have incentives in place. Making the number of degrees awarded a criterion in funding encourages universities to organise their activities in such a way as to make it possible for students to complete their degree studies within the normal time.

Up to the early 2000s the institutional funding component of the budget was directly based on annual institutional *targets* for Master's and doctoral degrees, as agreed with the Ministry of Education for each main field of study offered by the university. Target figures were simply multiplied by a field-specific cost factor, which was also agreed for the three-year contract period.

With a view to balancing the annual variations in the number of degrees awarded by the smaller universities, the average number of degrees over several years will be considered. The differences in the cost structure of different fields of education (including the specific nature of the arts; required equipment) and in teacher training colleges will be taken into account in the funding model as part of the educational and

disciplinary structure funding element, which forms part of 'other education and science policy objectives'

Quality and effectiveness in education

- The quality of education and functioning of study processes (80%), of which
  - The number of students studying for first- and second-cycle higher education degrees completing at least 45 ECTS credits in one academic year (50%)
  - The number of student graduates who started studying for their first degree in x after 7 years have passed (50%)
- Internationalisation of education (20%), of which
  - Number of outgoing and incoming exchange students in Finland (duration of exchange over 3 months) (50%)
  - Number of ECTS credits completed in education in a foreign language (and the number of ECTS credits completed abroad included in the degree) (13%)
  - The number of ECTS credits acquired abroad and included in the degree is included in the calculation when the data collection of the statistical material is complete (12%)
  - Number of international degree students (25%)

Extent of activities in research and researcher education

- Teaching and research person-years (50%);
- Total number of doctoral degrees determined in the agreement between the Ministry and the university (25%);
- Total number of doctoral degrees completed at the university (25%)

Quality and effectiveness of research and researcher education:

- Nationally competed research funding (60%), of which
  - Academy of Finland funding for the university (50%),
  - Funding allocated to the university on the basis of the Academy's decisions on Centres of Excellence (30%)
  - Tekes funding for the university (20%)
- Scientific publications (20%), of which
  - Number of refereed international publications (60%)
  - Number of other scientific publications (40%)
- Internationalisation of research (20%), of which
  - Amount of internationally competed research funding (60%)
  - Overall extent of teacher and researcher mobility (40%)

In effect, this means that the element of the formula relating strictly to performance measures for research equates to 8.44% of the entire formula (an increase from previous years, see Ministry of education FI 2005, p63)Reflecting the different mission and focus, there is a different approach to allocation of core funding to polytechnics:

Table 33 Finland: Polytechnic core funding formula implemented since 2010

Government transfer (Unit price*number of students) €849m in 2009		**State subsidy €24m in 2009**
70%	**30%**	
On the basis of calculated number of students	On the basis of completed degrees	Project funding (approx. €20m)
Number of students determined by field of study	2-year average	Performance-based funding (€4m)
Discretionary raise of unit price		

Source: Benneworth et al 2011

For university research specifically, weighting of the different indicators is also available, though it should be noted that this only constitutes 45% of the whole core funding formula where, in the absence of tuition fees, education of non-researchers makes up the bulk of allocation:

Table 34 Finland: The research component of the University core funding formula (2010)

	Metrics	**Weight**
Extent of activities		75%
Researcher training	Number of teachers and researchers	50%
	Agreed number of doctoral degrees	25%
	Effective number of doctoral degrees	25%
Quality and effectiveness		25%
Competitive funding - national	Funding from the Academy of Finland (Centres of excellence)	45%
	Funding from Tekes	15%
Competitive funding - international	Funding from competitive international research programs (does not include contract research and EU structural funds)	12%
Research outputs	Number of publications in peer reviewed international journals, refereed journals, scientific books	14%
	Number of other publications (articles in edited books, printed conference publications, monographs and series of publication of the universities themselves)	6%
Mobility - outgoing	Number of teachers and researchers spending abroad at least one week (at least two weeks, in 2010 and 2011)	8%

Source: Opetusministeriön asetus yliopistojen perusrahoituksen laskentakriteereistä (Ministry of Education Decree university funding criteria for the calculation), 771/2009)

7.2.5 Effects of the use of these indicators

For the bulk of indicators, especially those that are heavily weighted in the funding formula, little can be said, save for the fact that they ensure a relatively high level of stability of funding based on student intake and graduation rates.

The internationalisation-dimension meanwhile seem to be taking hold, with The academy of Finland (2012) producing data indicating increased numbers of non-Finnish PhD students and funding recipients (Academy of Finland 2012).

There is an issue with Finland's measurement of research outputs: the ERAWATCH 2012 country report on Finland notes that whilst the total number of research outputs places Finland in a strong international comparative position, this is not necessarily the case when it comes to research quality, and notes that in terms of international rankings, Finland has few areas of international excellence. As such, the relative emphasis in the indicator selection on numbers of publications is problematic. The inclusion of a rudimentary 3-point scale to gauge quality of research outputs goes some way to address this imbalance between number of outputs and research quality, though ultimately it remains a system that is not especially well aligned to solve the key problem noted in the literature.

7.2.6 Sources:

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Appendix A - UK Government Departments

Department	Function	No. of associated agencies and public bodies
Attorney general's Office	Provide legal advice to the government	4
Cabinet Office	Provide support to the Prime Minister and Deputy Prime Minister	18
Department for Business, Innovation and Skills	Support and drive economic growth	48
Department for Communities and Local Government	Create great places to live and work	10
Department for Culture, Media and Sport	Protect and Promote cultural and artistic heritage	44
Department for Education	Providing education and children's services in England	9
Department for Environment, Food and Rural Affairs	Responsible for policy and regulations on environmental, food and rural issues	35
Department for International Development	Lead's the UK's work to end extreme poverty.	2
Department for Transport	Support the UK's transport network by planning and investing in transport infrastructure.	21
Department for Work and Pensions	Responsible for welfare, pensions and child maintenance policy.	13
Department of Energy and Climate Change	Works to ensure the UK has secure, clean and affordable energy supplies and promote international action to mitigate climate change.	8
Department of Health	Lead, shape and fund health care in England.	23
Foreign and Commonwealth Office	Promotes UK interests overseas	11
HM Treasury	Government's economic and financial ministry, maintaining control over public spending, setting the direction on the UK's economic policy and working to achieve strong and sustainable growth.	7
Home Office	Leads on immigration, passports, drug policy, crime policy and counter-terrorism.	27

Ministry of Defence	Protect the security, independence and interests of our country at home and abroad.	29
Ministry of Justice	Responsible for the criminal justice system and to protect the public and reduce reoffending.	39
Northern Ireland Office	Represent Northern Irish interests within the UK government and represent the UK government in NI>	3
Office of the Advocate general for Scotland	UK government's Scottish legal team.	0
Office of the Leader of the House of Commons	Provide support to the Leader of the House of Commons.	0
Office of the Leader of the House of Lords	Provide support to the Leader of the House of Lords.	0
Scotland Office	Represent Scottish interests within the UK government and represent the UK government in Scotland.	1
UK Export Finance	UK's export credit agency.	1
Wales Office	Represent the UK government in Wales and represent Welsh interests in Westminster.	0

Source: https://www.gov.uk/government/organisations

Appendix B - Research Councils in the UK

Research Council		Examples of research areas funded
Arts and Humanities Research Council	AHRC	History, classics, archaeology, modern languages and linguistics, English language and literature, the visual arts and media, philosophy, law, religious studies, music and creative and performing arts
Biotechnology and Biological Sciences Research Council	BBSRC	Biosciences, including genomics, stem cell biology, food safety, plant and livestock breeding, bio-processing, whole organism biology relevant to the understanding of diet and health, ageing, animal health and welfare, biological populations and systems
Engineering and Physical Sciences Research Council	EPSRC	Mathematics; chemistry; physics; materials science; engineering; computer science, including high performance computing; energy research; research into the built environment; information and communications technology; research into innovative manufacturing.
Economic and Social Research Council	ESRC	Sociology; economics; anthropology; political science; area or regionally based research and geography; international relations; cultural and media studies; law and linguistics; psychology.
Medical Research Council	MRC	Full range of medical research from studies of molecules to the implementation of research findings into clinical practice
Natural Environment Research Council	NERC	Environmental research, survey and observation work across a wide spectrum of disciplines, including the geo- and earth sciences, atmospheric research and oceanography, biodiversity and ecology, climate change research, environmental chemistry and physics; satellite based Earth observation, polar research, and management of land and natural resources.
Science and Technology Facilities Council	STFC	Astronomy; computational science; energy; nuclear physics; particle physics; space science.

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