ERAWATCH COUNTRY REPORTS 2010: The Netherlands

ERAWATCH Network – Technopolis Group

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Acknowledgements and further information

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Executive Summary

The Netherlands is a prosperous, densely populated country with 16.5 million inhabitants. The Dutch knowledge economy is, in economic terms, among the better performing countries in the world. In terms of innovation performance, however, the Netherlands is in the group 'innovation followers', with innovation performance below those of the 'Innovation leaders' but close to or above that of the EU27 average (European Innovation Scoreboard 2009). Within this group, the Netherlands is a 'slow grower'.

GERD as % of GDP amounted to 1.63% in 2008, which is relatively low compared to EU27 average (1.9%). Moreover, the R&D intensity is declining, rather than growing. Especially the BERD/GDP is relatively low and declining. GOVERD/GDP is also below EU27 average, but HERD/GDP is relatively high.

Policy mix

The policy mix for increasing national R&D investments consists of 6 routes: (1) promoting the establishment of new indigenous R&D performing firms; (2) stimulating greater R&D investments in R&D performing firms; (3) stimulating firms that do not perform R&D yet to perform R&D; (4) attracting R&D-performing firms from abroad; (5) increasing extramural R&D carried out in cooperation with the public sector or other firm and (6) increasing R&D in the public sector. The following table presents the summary of an assessment of the importance of each of these routes for Dutch policy and recent policy changes.

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2009
1	Important, but relatively small in terms of budgetary weight	• No significant changes
2	Very important, also in terms of budgetary weight	• WBSO budget increased • Budget Innovation Credit scheme increased • SBIR programme became more important • More attention for the government as (launching) customer
3	Relatively low importance, also small in terms of budgetary weight	• The Innovation Voucher scheme is intensified and broadened in 2008-2010. After 2010, however, it will be discontinued.
4	Increasingly important, but mainly addressed indirectly via other routes	• More emphasis on international aspects of the Innovation Programmes
5	Highly important, with growing budgetary weight in 2005–2010	• The new cabinet announced budget cuts for collaboration subsidies.
6	By far the most important route, also in terms of budgetary weight	• Institutional base funding of technological research institutes replaced by demand-oriented programmatic funding

Barriers to R&D investments
Several barriers hamper a more substantial increase in R&D intensity:

- The sector structure has a low R&D intensity. The services sector is relatively large and it is not as R&D intensive as the industry sector. Within the industry sector, the high-tech sectors are relatively small.
- The share of SMEs innovating in-house and the share of SMEs introducing innovations are below EU27 average.
- The alignment of universities and companies (SMEs in particular) is not optimal. Collaboration between research institutes and companies is, however, higher than in most EU-countries.
- Dutch knowledge workers and businesses have a strong international orientation, which is not matched by a sufficiently high level of attractiveness of the Netherlands for foreign knowledge workers and knowledge intensive businesses.
- Because of demographic and economic trends, a growing number of new graduates in HRST is needed. However, the inflow of new S&E and SSH (doctorate) graduates is below EU27 average. The low attractiveness of a career as a scientists or researcher is one of the explanatory factors. Education and the business sector are not sufficiently aligned.
- There has been a lack of coordination and continuity in policy design and implementation. The policy governance structures have become increasingly complex and fragmented and a coherent overall strategic framework for R&D and innovation policies has been lacking.

Knowledge Triangle
Coordination of policies across policy levels and policy areas, notably between research, education and innovation policies has not been strong. Whereas OCW (responsible for science and education policy) has emphasised the autonomy of universities, the importance of fundamental scientific research and sufficient room for talented researchers, EL&I (responsible for industrial R&D and innovation policy) has emphasised the need for 'focus and mass', demand-oriented strategic research in 'key areas' and public-private collaborations in R&D. The two worlds are, however, gradually moving towards each other. The new cabinet established a new 'super ministry' of Economic Affairs, Agriculture and Innovation (EL&I), strengthening EL&I's role in (cross-sectoral) innovation policy, focusing on nine top sectors ("topgebieden") of economic and societal importance. This may contribute to making the governance system less fragmented, and less dependent upon ad hoc 'task forces' and other temporary governance bodies.

The new cabinet (2010–2014) has discontinued the interdepartmental Knowledge & Innovation programme department (K&I), and it is uncertain whether K&I's long-term strategy will actually guide investments, in particular because budgets are reduced and the FES fund, which led to investments of approximately €3 billion, will no longer be used for investments in knowledge and innovation.

Since the mid-2000s, the ministries now forming EL&I have increased coordination between industrial R&D policy, industry policy, entrepreneurship

policy and regionally oriented policy. The policy mix of EL&I has improved since the streamlining operation, which began in 2005. Further 'streamlining' has been announced by the new cabinet. Taxation policy is used to stimulate innovation and entrepreneurship, e.g. via tax reductions on wages of R&D workers (WBSO) and tax reductions on income from (patented) R&D activities ('innovation box').

The level of public investments in knowledge and innovation has not been sufficient to reach the ambitious targets (top 5 of knowledge economies in the world). Moreover, investments have been rather unpredictable and not guided by a long-term investment agenda. While a large part of Dutch research funding goes via institutional base funding, an increasing part is allocated on a competitive basis, using international peer review.

The table below summarises recent policy changes and strengths and weaknesses of the knowledge triangle policies. It should be noted, however, that recent policy changes have been limited, because of elections and the formation of a new cabinet in 2010.

	Recent policy changes	**Assessment of strengths and weaknesses**
Research policy	A noteworthy recent policy change was the extra policy attention for individual talented researchers (via an extension of the Innovational Research Incentives scheme, a subsidy to introduce aspects of the American Graduate School model and the Rubicon programme for new doctorates). Furthermore, more policy attention was paid to large-scale research facilities (e.g, thanks to the national roadmap for large research facilities).	It is a strength that more budget is allocated to support talented researchers in various stages of their careers. It helps to create an attractive climate for researchers. It does, however, not contribute to creating critical mass in prioritised areas. It may also limit the room for manoeuvre of universities. The national roadmap has created more clarity on the priorities for investment in large facilities. The roadmap is, however, not accompanied with structural long-term investment plans.
Innovation policy	Within the basic package, the fiscal incentive WBSO became more important, shifting the balance between generic and specific policy more towards generic policies. Within the programmatic package more alignment was sought between the modules for Innovation Programmes, the international programmatic instruments and regionally-oriented programmes. Societal challenges	It is a strength that the costs of R&D for entrepreneurs are reduced with a easy-to-use scheme like the WBSO. It is, however, a generic scheme that does not contribute to creating critical mass in prioritised thematic areas. It is a strength that the thematic programmes for innovation, international entrepreneurship and regional strengths are aligned and streamlined. The announced budget cuts, however, create a threat for the effectiveness of the programmatic approach. It is a strength that ministries have collaborated in developing societal innovation agendas and societal

	became more important in innovation policy, not only with the introduction of societal innovation programmes, but also in the innovation programmes, the SBIR programme and with the introduction of demand-driven funding of RTOs.	innovation programmes. It is also a strength that the government uses its purchasing power to stimulate firms to develop new solutions for societal problems (via SBIR). The introduction of demand-driven funding of RTOs may increase economic and societal relevance of the strategic research of RTOs. The main weakness is that the budgets for innovation policy are significantly reduced, making is uncertain if ambitions can be reached.
Education policy	More policy attention for 'excellence' in higher education (e.g. via the Sirius programme), for reducing barriers in higher education with regard to S&T (e.g. via FES investments) and for entrepreneurship in education (e.g. via a special action programme).	It is a strength that the government has recognised that more differentiation between universities and courses is needed and that talented students need to be challenged and encouraged to do their very best. It is, however, only one step and more will need to be done to create an ambitious learning culture. Also the policy measures for S&T in education and for entrepreneurship in education are good initiatives that address real bottleneck in the Dutch knowledge system. Again, more will need to be done to create a learning environment that stimulates students to choose S&T and that fosters entrepreneurship.
Fiscal policy	In the corporate tax system, the patent box was changed in a (broader) innovation box. All profits from innovative activities are taxed under a lowered tariff (5%). Losses on innovative activities are deductable against the normal tariff (25.5%).	This Innovation Box helps to stimulate innovative activities of firms.
Entrepre-neurship policy	A noteworthy policy development was the programme growth accelerator which supports ambitious entrepreneurs in various areas such as strategy development, financing, marketing, innovation and internationalisation in order to enable them to increase their turnover to €20m in five years.	The Netherlands has relatively few fast growing innovative SMEs. Therefore, it is good that more attention is paid to this group of SMEs.

European Research Area

The ERA does not play a pivotal role in Dutch research policies and strategies. Internationalisation is an important element, but this is not restricted to Europe or ERA. 'Quality' is the leading notion in

internationalisation policies: high quality (or research, education, facilities, etc.) is required to be competitive in international settings and to attract talented students, researchers and knowledge workers); and internationalisation contributes to raising the quality of higher education, research and science.

Dutch national policy does aim to increase mobility of researchers ('brain circulation') and to improve career perspectives of researchers. The policy rationale is not explicitly linked to ERA, however, but rather to strengthening the Dutch education/research/innovation system in an international context. The inward mobility of knowledge workers has been made easier, but further reduction of mobility barriers remains a challenge.

It is increasingly recognised in Dutch research policy that excellent research facilities are crucially important for the quality and international competitiveness of the Dutch research system. After a slow start, a Netherlands' roadmap for large-scale facilities was developed in the context of the ESFRI roadmap. The available budgets for large facilities are rather modest in view of the high ambitions and they are not structural.

Dutch universities have a large degree of autonomy, also with respect to ERA-related issues. The development of stronger international profiles remains a challenge for the universities.

While most of the competitive research funding is for researchers affiliated with a Dutch university/research institute, a small but increasing number of subsidies and research programmes aimed at talented scientists are open for applications by researchers affiliated with universities/institutes from abroad (not limited to EU). The Netherlands participates actively in many ERA-NETs, JTIs, ETPs, JPIs and other EU programmes.

The innovation programmes in the key areas have to result in international 'hot spots' that contribute to the attractiveness of the Netherlands for researchers, knowledge workers and R&D intensive companies.

The Netherlands has made progress in mobilising research to address major societal challenges. It should help to position Dutch research in international initiatives to address these challenges

The table below displays the main characteristics of the national measures/policies supporting the strategic ERA objectives in terms of main policy changes and an assessment of strengths and weaknesses of the Netherlands.

	ERA objectives	**Main policy changes**	**Assessment of national strengths and weaknesses with regard the specific ERA objective**
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European	No major changes, but more attention in policy for: • career opportunities of (young) researchers • training of postgraduates	The (future) supply of human resources for research has improved, but is still not sufficiently high (given the ambition to be in the top 5 of knowledge economies in the world). Weaknesses in the Dutch labour market for researchers include

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
	labour market for male and female researchers	• women and minorities in senior positions in universities • entrepreneurship in education	insufficiently attractive career prospects, also to attract and retain talented researchers from abroad, and underrepresentation of female researchers are in senior positions in universities. It is a strength that the training of postgraduates is improved and the efforts have been made to improve career prospects of talented young researchers (e.g. via grants, tenure track)
2	Increase public support for research	The new cabinet (since Oct 2010) announced that the FES fund will no longer be used for strategic investments in the knowledge infrastructure and that budgets for innovation policy will be cut and subsidy schemes will be discontinued or replaced by guarantees and credit schemes (via a revolving fund).	GOVERD (% of GDP) is below EU27 average and decreased in 2004–2008, while HERD remained stable and above EU27 average. Although public investments in education, research and innovation were high on the political agenda, investments fell short of the ambitions. It is a weakness that the Netherlands does not succeed in mobilising more public support for research.
3	Increase European coordination and integration of research funding	No main changes since 2009. The Netherlands remains actively involved in EU level coordination and collaboration initiatives.	It is a strength that the Netherlands is actively involved in COST, EUREKA, FP7, inter-governmental research infrastructures, ERA-NETs, Art.185 initiatives, JTIs and ETPs, joint programming initiatives, etc. It is also a strength that research programmes are increasingly opened up for researchers from abroad. Research funding is, however, not very well coordinated with research in the EU, and remains largely a national affair.
4	Enhance research capacity across Europe	More policy attention for postgraduate training, e.g. via pilot programme to stimulate introduction of aspects of American graduate school model.	It is a strength that postgraduate training has improved since the early 2000s. Although the position and career prospects of PhD candidates have been improved, the attractiveness of a career as researcher is not sufficiently high.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	More policy attention for the importance of large research facilities. A national roadmap has been developed and budgets have been made available (although not on a structural basis).	The Netherlands has strengths in world-class large research facilities, but investments (e.g. in ESFRI) fall short of ambitions and are incidental rather than structural. It is a strength that the national research institutes (of NWO and KNAW) act as portals to international infrastructures.
6	Strengthen research institutions,	Policy has created more room for individual researchers at the	Dutch universities have a good international position, but the level of differentiation is low. Although

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
	including notably universities	expense of the power of decision of universities (by transferring funds from the block grant to a competitive scheme)	some progress has been made, it is a weakness that universities have not created more pronounced and recognisable research profiles by prioritising specific research areas. Universities are increasingly dependent upon project-based funding rather than institutional base funding, reducing their power of decision.
7	Improve framework conditions for private investment in R&D	One noteworthy policy change has been stronger attention for an entrepreneurial culture, also in education.	In general, the framework conditions are good. Specific points of attention are access to venture capital, a looming shortage of HRST and a culture that stimulates entrepreneurship and innovation.
8	Promote public-private cooperation and knowledge transfer	The new cabinet (2010–2014) announced substantial budget cuts for subsidies that stimulate public-private cooperation.	The level of interaction between SMEs and universities is relatively low (also because there are relatively few innovative SMEs). Therefore, it is a strength that the policy mix includes various instruments that stimulate public-private cooperation and knowledge transfer. 'Valorisation' of knowledge is explicitly recognised as part of the mission of universities and professionalisation of valorisation is increasing.
9	Enhance knowledge circulation across Europe and beyond	More policy attention for emerging economies in collaborative research programmes.	It is a strength that Dutch scientists tend to have a strong international orientation and that there are various programmes that stimulate international collaboration and mobility of researchers. It remains a weakness that the Netherlands is insufficiently attractive as a location for talented researchers and knowledge intensive firms from abroad.
10	Strengthen international cooperation in S&T and the role and attractive-ness of Europe-an research in the world	Internationalisation and international collaboration remains one of the key elements in Dutch research policy.	The Netherlands actively (and successfully) participates in many international R&D programmes. It is a strength that international collaboration is perceived as vital for ensuring scientific excellence and for addressing societal challenges. More could be done, however, to strengthen the international profiles of Dutch universities and research institutes.
11	Jointly design and coordinate policies across policy levels and policy areas,	The interdepartmental Knowledge & Innovation programme department was discontinued in 2010. The new 'super ministry'	Policy coordination within the knowledge triangle is a weakness. It has largely depended upon ad hoc initiatives (task forces, working groups, platforms). Coordination

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
	notably within the knowledge triangle	of Economic Affairs, Agriculture and Innovation has been given more responsibilities in R&D and innovation policy.	has, however, increased since the mid-2000s, partly due to interdepartmental initiatives. It is a strength that the Netherlands is actively involved in Joint Programming initiatives.
12	Develop and sustain excellence and overall quality of European research	More policy attention for 'excellence' in universities, e.g. via targeted programmes.	The Dutch research system performs very well in terms of productivity, impact scores and success rates in European programmes (e.g. FP7, ERC). The quality assurance system of public research organisations functions rather well. Special programmes stimulate talented researchers. The overall quality of the broad base in science is good, but is under threat because the budgets (block grant) are under pressure.
13	Promote structu-ral change and specialisation towards a more knowledge-intensive economy	More policy attention for attracting R&D investments from abroad, also to help the Dutch economy become more R&D intensive.	The Netherlands has a relatively large services sector, which is not very R&D intensive. The Netherlands does not succeed in attracting more R&D-intensive companies from abroad. In the longer term, more investments in knowledge are needed to change the Netherlands' industry structure.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
14	Mobilise research to address major societal challenges and contribute to sustainable development	Societal innovation agendas and corresponding societal innovation programmes have been developed. In addition, societal challenges have been linked to the existing innovation programmes in the key areas. Demand-oriented funding of PROs was introduced	It has been a weakness that a coherent and long-term agenda has been lacking. Since 2007, however, the Netherlands has developed strengths in developing interdepartmental societal innovation agendas and corresponding societal innovation programmes. In the Multi-annual Knowledge and Innovation Compass societal challenges are combined with economic and scientific strengths.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	Increased attention for 'research for policy', e.g. via 'knowledge chambers' within ministries where demand and supply of knowledge are aligned.	The Netherlands has a tradition in S&T communication, e.g. via science centres and websites (e.g. www.kennislink.nl). There is an institutionalised evaluation culture to demonstrate effectiveness and to enhance accountability of public funding of R&D. Societal relevance usually is part of such exercises. A weakness is that evaluation results are not always fully used to implement changes. It is a strength that there are many public-private collaborations in R&D programmes and platforms / task forces that enable interaction between various stakeholders and help to build mutual trust. Ministries have increased efforts to better align research of RTOs with policy demands.

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1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the '**interlinkage**' between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter is to assess the performance of the national research system, the **'interlinkages'** between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, by updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and assesses the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national research and innovation system and its governance

This section gives the main characteristics of the structure of the national research and innovation systems, in terms of their wider governance.

The Netherlands is a prosperous, densely populated country with 16.5 million inhabitants (2009), which amounts to 3.3% of the total EU27 population. The Dutch knowledge economy is, in economic terms, among the better performing countries in

the world. The share of the Netherlands in the total GDP of the EU27 is relatively high with 4.3% (2009).[1] The share of the Netherlands in the total R&D expenditures (GERD) of the EU27 is also relatively high with 4.3%. According to the European Innovation Scoreboard 2009, the Netherlands is in the group 'innovation followers', with innovation performance below those of the 'Innovation leaders' but close to or above that of the EU27 average.[2] Within this group, the Netherlands is, however, a 'slow grower'.

The expenditures on R&D in terms of GERD as % of GDP amount to 1.63%[3] (2008) which is relatively low compared to EU27 average (1.9%). Moreover, the R&D intensity is declining, rather than growing (see table below). Especially the R&D intensity of the business sector (BERD) is relatively low (0.89% in 2008, while EU27=1.21%), and declining. R&D intensity of the government sector (GOVERD) is also below EU27 average (0.21% in 2008, EU27=0.24%). On the positive side, the R&D intensity of the higher education sector (HERD) is relatively high with 0.52% in 2008 (EU27=0.43%).

Table 1 Research and development expenditure, by sectors of performance

	2000		2004		2008	
	NL	EU27	NL	EU27	NL	EU27
GERD as % of GDP	1.82	1.85	1.81	1.82	1.63	1.9
BERD as % of GDP	1.07	1.2	1.03	1.16	0.89	1.21
GOVERD as % of GDP	0.23	0.25	0.26	0.24	0.21	0.24
HERD as % of GDP	0.51	0.38	0.52	0.4	0.52	0.43

Source: Eurostat (2010).

The table below gives an overview of the R&D funding streams in the Dutch research system. The business sector funds almost 50% of all R&D expenditures, while the government funds approximately 37%. The government is the main funder of research by universities and the research institutes sector. Approximately 11% is funded from abroad.

Table 2 Funding streams R&D in 2007 (in 1 billion euro)

Destination / Source	Higher education		Research institutes		Business		Total	
Government	2.9	(80,6%)	0.8	(61,5%)	0.1	(1,8%)	3.8	(36.9%)
Business	0.3	(8,3%)	0.2	(15,4%)	4.6	(83,6%)	5.1	(49.5%)
Private non-profit	0.3	(8,3%)	0.0	(0,0%)	0.0	(0,0%)	0.3	(2.9%)
Abroad	0.1	(2,8%)	0.2	(15,4%)	0.8	(14,5%)	1.1	(10.7%)
Total	3.6	(100%)	1.3	(100%)	5.5	(100%)	10.3	(100%)

Source: OCW, Kerncijfers 2005-2009 (2010), own calculations.

[1] Eurostat, Gross domestic product at market prices; Millions of Purchasing Power Standard. GDP of NL (2009) is €507.6b. GDP of EU27 (2009) is €11,785.5b.

[2] Other 'innovation followers' are Austria, Belgium, Cyprus, Estonia, France, Ireland, Luxembourg and Slovenia. (European Innovation Scoreboard (EIS) 2009, http://www.proinno-europe.eu/page/european-innovation-scoreboard-2009).

[3] Eurostat, Research and development expenditure, by sectors of performance; All sectors; % of GDP (provisional value), 2 November 2010.

Main actors and institutions in research governance

Main actors and institutions in research governance include the ministry of Education, Culture and Science (OCW) and the ministry of Economic Affairs, Agriculture and Innovation (EL&I). The latter is the result of a merger in 2010 of the ministry of Economic Affairs (EZ) and the ministry of Agriculture, Nature and Food Quality (LNV). Historically, a strong division of labour has existed between science and basic research (*i.e.* OCW) on the one hand, and technology and innovation (*i.e.* EL&I) on the other hand, both in terms of policy design, funding and research performers. As a result, two different governance cultures in the science and innovation parts of the system have emerged. While EL&I's approach can be characterised as 'hands on' with an active role in policy design, programme design and programme management, OCW's approach is rather 'hands off', delegating more responsibilities to the national research council NWO. However, at different levels in the system these two spheres are gradually moving towards each other. During the previous cabinet period (2007-2010) a temporary interdepartmental "Knowledge & Innovation" programme department (K&I) was established.[4] This department was, however, discontinued in the new cabinet, which came into office in October 2010.

At the time of writing of this report, it is not yet clear what the consequences of the new ministry of EL&I will be for the governance structure. EL&I appears to get more responsibilities for R&D and innovation policy across the various ministries.

Advisory bodies in research governance include the Advisory Council for Science and Technology Policy (AWT) and the Royal Netherlands Academy of Arts and Sciences (KNAW). During the previous cabinet periods, an Innovation Platform (IP) was established as a high-level coordination and strategy-setting mechanism in the Dutch governance structure. In was, however, discontinued by the present Cabinet.

R&D policy is implemented (mainly) by two key agencies: the research council NWO and the innovation agency NL Agency (formerly known as SenterNovem). The Netherlands Organisation for Scientific Research (NWO) is an independent administrative body and functions as a funding agency of the ministry of OCW. NWO is responsible for enhancing the quality and innovative nature of scientific research in all fields, and initiating and stimulating new developments in scientific research. This is mainly done by allocating resources, especially to academic research. NL Agency is an agency of EZ which implements R&D and innovation schemes mainly for EL&I, but also for other ministries. A third organisation in research policy implementation is the Technology Foundation STW, which operates as an independent part of NWO. STW supports and finances scientific-technological research projects and promotes utilisation of results of research by third parties. EL&I and NWO are main financers of STW.

The institutional role of regions in research governance

Given the relatively small size of the Netherlands, regions only play a minor role in research governance. The provinces do not have substantial budgets for R&D. Regional innovation policies at the national level have increasingly become aligned with national priorities.

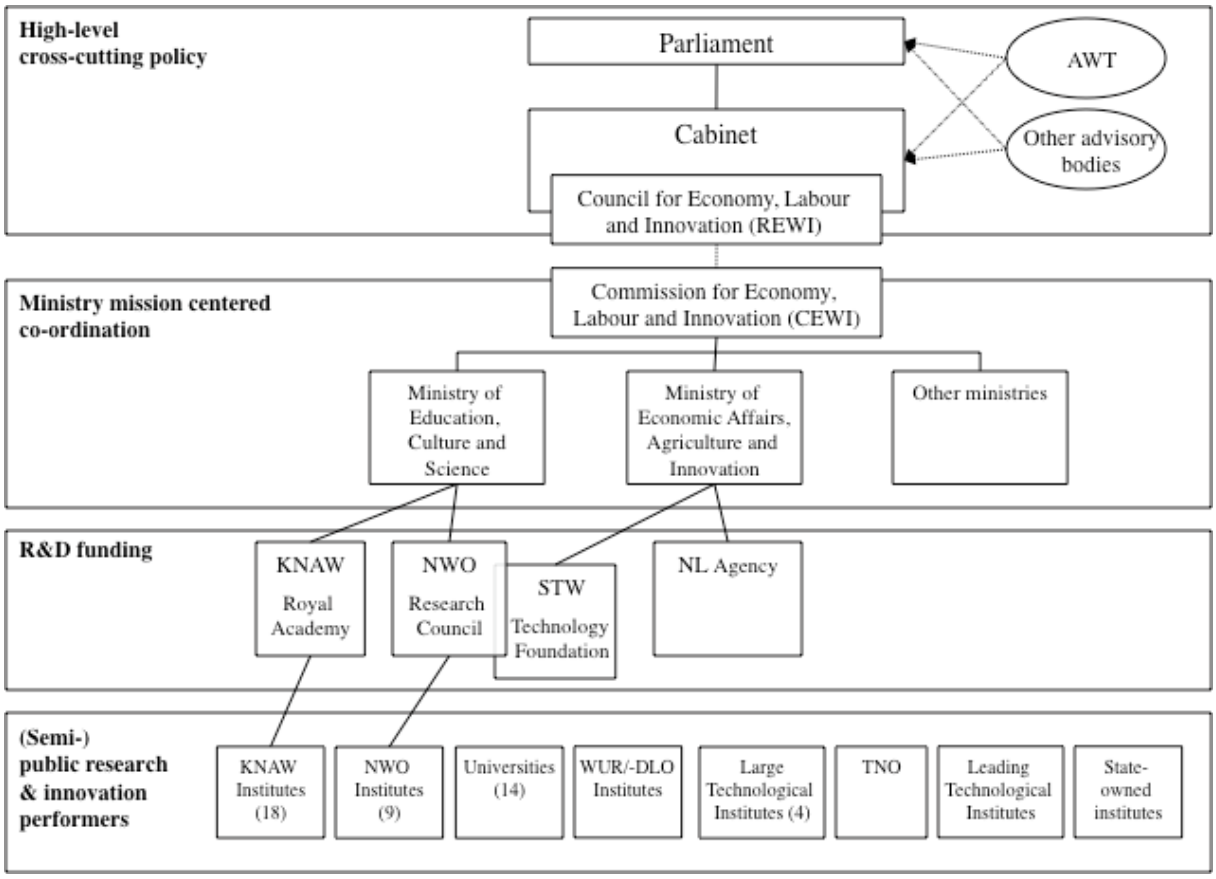
[4] The interdepartmental "Knowledge & Innovation" programme department (K&I) was established in 2007 to increase coherence in policies on knowledge, innovation and entrepreneurship. K&I implemented one of the ten projects of the previous cabinet's policy programme 2007-2011, "Netherlands Entrepreneurial Innovation Country". More specifically, K&I linked societal challenges (e.g. in health care, energy, education, safety & security, water) to economic opportunities.

Main research performer groups

Main research performers in the public knowledge infrastructure are the 14 Dutch research universities (including an Open University), the 19 research institutes of the Royal Academy KNAW, the 9 research institutes of the research council NWO, the research institutes of the Wageningen University and Research Centre (WUR)[5], TNO (Netherlands Organisation for Applied Research), the four Large Technological Institutes (LTIs)[6], various Leading Technology Institutes (TTIs)[7], and several state-owned research and expertise centres.

By far the most important private research performers are 14 large R&D intensive companies (Philips, ASML, Schering-Plough, Shell, NXP, DSM, Océ, Unilever, KPN/Getronics, Thales, Crucell, Corus, AkzoNobel, Stork), which together amount for more than half of all business expenditures on R&D.

Figure 1: Overview of the Netherlands' research system governance structure



Source: Technopolis Group (2010).

A general observation is that the Dutch governance system has been characterised by a lack of coordination and continuity in policy design and implementation. The policy governance structure has become increasingly complex and fragmented while

[5] The specialised research institutes are active in agro technology & food sciences, animal sciences, environmental sciences, plant sciences and social sciences.

[6] The LTIs are active in aerospace (NLR), energy (ECN), water management and hydraulic engineering (Deltares) and maritime research (MARIN).

[7] The TTIs ("technological top institutes") are – often virtual – research organisations in which companies, universities and research institutes participate in public-private partnerships for research and innovation. (See http://www.senternovem.nl/tti/ for more information).

a coherent overall strategic framework for R&D and innovation policies has been lacking.

2.2 Resource mobilisation

Since 2000, Europe has made evident progress towards ERA but at the same time it is clear that Europe's overall position in research has not improved, especially regarding R&D intensity, which remains too low. The lower R&D spending in the EU is mainly a result of lower levels of private investment. Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D investments.

This section assesses the progress towards national R&D targets, with particular focus on private R&D and of recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment includes also the human resources for R&D. Main assessment criteria are the degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

Progress towards R&D investment targets

GERD as % of GDP shows declining trend in the period 2000-2008 (see Table 1). Since 2004 the gap between the Netherlands and EU27 average in GERD/GDP widened. Especially the relative decline in BERD/GDP was significant, but also GOVERD/GDP decreased in 2004-2008. Although public investments in education, research and innovation were high on the political agendas, this was not translated into substantial and structural additional investments in R&D that resulted in progress towards R&D investment targets.

Provisions for R&D activities

Having learnt from a lack coordination, cohesion and continuity in investments in R&D and innovation, the previous cabinet (2007-2010) developed a long-term strategy and a Multi-Annual Innovation and Knowledge Compass (MIKC) to orient future investments. It combined societal challenges with knowledge themes and innovation themes to identify areas where the Netherlands has the potential to excel economically and/or scientifically. The long-term strategy was based on the Knowledge investment agenda 2006-2016 of the Innovation Platform (IP) and was developed by the temporary interdepartmental K&I programme department. It is yet unclear whether the new cabinet (2010-2014) will use these strategic documents to orient their investments.

The following table gives an overview of the main funding instruments.

Table 3 The main research funding instruments

Funding instrument	Target group	Objective	Budget (2009)
OCW Block grant to universities	Research universities	Institutional base funding to universities.	€2b
NWO Free Competition	Researchers from Dutch universities, NWO and KNAW institutes on behalf of a team of researchers from one or more research institutes.	Intended for applications for innovative, risky fundamental research with a high-quality research question and scientific or practical urgency.	€94m
NWO Innovational Research Incentives Scheme	Excellent researchers (Researchers from abroad may apply)	The aim is to promote innovation in the academic research field. The scheme is aimed at individual talented researchers and promotes them to enter and remain committed to the scientific profession.	€125m
NWO Thematic programmes	Funding proposals can be submitted by researchers from Dutch universities and NWO and KNAW institutes. The proposal is submitted on behalf of a research team by a single researcher (the main applicant) who is attached to one of the research institutes stated.	NWO distinguishes thirteen 'society-inspired' themes in her strategy document 'Science Valued!' (2007-2010). NWO aims to improve the harmonisation between current, societal questions and the available scientific potential and to create 'focus and mass' in the prioritised areas.	€65m
EL&I WBSO (tax incentive)	The WBSO Act provides a fiscal facility for companies, knowledge centres and self-employed persons who perform R&D work.	The objective of the WBSO Act is to stimulate R&D by alleviating the wage burden for companies through tax reduction.	€606m
EL&I Innovation Programmes	Firms and knowledge institutes in prioritised 'key areas'	The aim is to improve the sector's innovation ecosystems and to develop international hotspots that help to increase the attractiveness of the Netherlands as an international location for R&D and innovation.	€128m (2008)

Source: investigation Technopolis Group (2010) based on various sources.

Structural funds

Regarding structural funds, the Netherlands has been allocated almost €2b in total for the period 2007–2013.[8] All Dutch regions belong to the Regional Competitiveness and Employment Objective. Under this Objective, the Netherlands has five programmes: one national programme co-financed by the ESF and four regional programmes co-financed by the ERDF. Promotion of research and innovation is the most important strategic priority for the Netherlands in 2007–2013. In financial terms, the Netherlands plans to invest over €800m of Structural Funds (49% of its total Community allocation) in fields that will promote research and innovation.[9]

[8] €1.7b under the Regional Competitiveness and Employment Objective1 and €247m under the European Territorial Cooperation Objective.

[9] The objective is to support over 500 R&D projects attracting more than €220m of R&D investments. For more information, see "European Cohesion Policy in the Netherlands" at http://ec.europa.eu/regional_policy/atlas2007/netherlands/index_en.htm.

Funding mechanisms

The sum of R&D budgets of all ministries was €4.5b in 2009.[10] On average, 68% of these R&D budgets is allocated via institutional funding and 32% via project-based (competitive) funding.[11] OCW is the main R&D funding ministry and allocates 79% via institutional funding, mainly via the block grant (lump sum) to research universities. EL&I, the second largest R&D funding ministry, allocates 'only' 27% via institutional funding. This share will further decline as institutional base funding is increasingly replaced by (long-term) programme-based funding for strategic basic research by research institutes.

A substantial part of the R&D policy mix is aimed at stimulating collaboration. Most of the R&D funding by EL&I, for instance, is via public-private collaboration programmes. The FES fund is also used to stimulate R&D collaboration. The largest funding streams, however, do not target collaboration (block grants to universities, NWO Innovational Research Incentives scheme, WBSO, institutional base funding to research institutes).

Recent policy changes

The Innovation Platform was discontinued in 2010, and the so-called 'Knowledge Investment Agenda (KIA) coalition'[12] has taken over the responsibility for the annual progress report of the KIA – the 'KIA photo'. The KIA is, however, not a formal policy document. It is used by the KIA coalition to signal the importance of (coordinated and coherent) knowledge investments to the government.

In February 2011 the new cabinet (2010-2014) published its first policy letter[13] with general plans on research and innovation policy. The main focus is on nine economic top sectors, which are based on existing innovation programmes: life sciences, high-tech materials and systems, agro-food, water, energy, horticulture and propagation materials, chemistry, the creative industry and logistics. In these sectors knowledge institutes, the private sector and the government collaborate, denoted by the concept of the "golden triangle". A total budget of €1.5b will be made available from the departmental budgets in 2015. This includes budgets that have already been (partly) allocated for the coming years. The available budget is based on existing resources, which means that there is no room for additional investments in R&D. The availablez budget consists of €300m from NWO, €50m from the KNAW, €250m from TNO, the Leading Technology Institutes and research institutes of the Wageningen University and Research Centre (WUR). Other sources are an Innovation Fund of €75m, the extension of the generic WBSO tax scheme of €50m, ministerial contributions of €270m, €310m from the ministry of Foreign Affairs (focusing on development cooperation) and €50m from the European Framework Programmes. R&D and innovation subsidies for companies will be reduced with €500m and replaced by tax reductions and fiscal incentives for companies.

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[10] This excludes the tax incentive WBSO, which has a budgetary size of €0.6b in 2009.

[11] "Overzicht Totale Onderzoek Financiering (TOF) 2008-2014" with an elaborate overview of R&D funding by the ministries which is sent annually to Parliament.

[12] The broad coalition consists of employers' organisations, trade unions and main actors in the fields of education, research and innovation. See http://www.kennisinnovatieagenda.nl/engels.shtml.

[13] "Naar de top: de hoofdlijnen van het nieuwe bedrijfslevenbeleid" http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2011/02/04/naar-de-top-de-hoofdlijnen-van-het-nieuwe-bedrijfslevenbeleid.html.

A major policy change is that the FES fund, which is fed with revenues from natural gas exploitation, will no longer be used for new investments in knowledge and innovation. In the previous cabinet periods, the FES fund was a major source of programmatic investment and led to a total investment in the knowledge and innovation domain of almost €3 billion in four multi-annual investment rounds in the period 2005–2010. In 2010, €658m was invested in knowledge and innovation via the FES fund. In 2015, this will be reduced to €245m. After 2015, no money will be available from the FES fund.

The Innovation Vouchers scheme is abolished as from January 2011. The scheme was created in 2004 to stimulate SMEs updating a product, process or service. SMEs made use of the innovation voucher to procure the relevant knowledge from a knowledge institute. The budget is transferred to the Innovation Performance Contracts (IPC) scheme. The termination is part of the new cabinet's decision to reduce the number of innovation subsidies and to use other policy instruments (e.g. fiscal incentives) to stimulate innovation.

Societal challenges

In the previous cabinet periods (since 2004), societal challenges have become more prominent in R&D and innovation policy. NWO has developed 13 'society-inspired' themes for which thematic programmes have been launched, although budgets were relatively modest. The interdepartmental K&I programme department – together with the Innovation Platform – has identified relevant societal themes for which societal innovation programmes are developed. In the Innovation Programmes of EL&I, societal themes are also addressed, e.g. in the themes Water and Sustainable Energy. The societal themes largely overlap with the European grand challenges.

For societal innovation programmes in the areas Energy, Health, Security and Water, €258m is available for the period 2008–2012, which amounts to an annual average of €52m. For EL&I's Innovation Programmes a budget of €1.1b is available for the period 2005–2014 (including investments from the FES fund), which amounts to an annual average of €110m.[14] NWO allocated €169.5m to society-inspired research programmes in 2010.[15]

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

Evolution of BERD

As Table 1 shows, BERD as % of GDP has dropped significantly since 2000. In the period 2002–2007 BERD was approximately 1% of GDP, but in 2008 it dropped to 0.89%. The economic crisis obviously plays a role in explaining the drop in BERD. The crisis package of the Dutch government, aimed at achieving economic recovery, included several measures with regard to R&D and innovation.[16] The additional public funding was partly aimed at leveraging greater private sector investments.

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[14] Ministry of Economic Affairs (2009) Innovatieprogramma's: De motor achter het innovatienetwerk. With the new cabinet, it is unclear whether the budgets will remain as planned.

[15] NWO (2010) NWO Begroting 2010. NWO allocates €716.6m in total in 2010.

[16] For the years 2009 and 2010, €280m was made available for temporary occupation (on secondment basis) of knowledge workers from the private sector in knowledge institutes in the (semi-)public sector. This should avoid that knowledge workers will have to be laid off and ensure that they are still available for the Dutch knowledge economy once the economy recovers. In addition, €110m was made available for the years 2009-2010 for the continuation of successful existing Innovation

Policy Mixes towards increased private R&D investment

The "Policy Mix Project" identified the following six 'routes' to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet to perform R&D;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one 'route', the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

Route 1 is not one of the dominant routes in the Dutch policy mix. It mainly covered by the integral programme TechnoPartner, which stimulates technology-based start-ups.[17] EL&I allocates ca. €30m/year to TechnoPartner. In addition, the fiscal measure Venture Capital scheme stimulates individuals to lend money to starting entrepreneurs. The Valorisation Grants programme stimulates researchers to start their own business.

Route 2: Stimulating greater R&D investment in R&D performing firms

Route 2 is a very important route stimulating R&D in the Dutch policy mix. The fiscal scheme WBSO is the main generic policy instrument to stimulate companies to invest (more) in R&D.[18] It is a large scheme (€704m in 2009) in the R&D policy mix, and its budgetary size will further increase (routes 1 and 3 are also relevant).

Other schemes in this route are the Innovation Credit scheme (€48m in 2010), the Innovation Performance Contracts (IPC) scheme (€20m in 2010), Eurostars (€3m/year), the Small Business Innovation Research (SBIR) programme (on average €2.6m per call).

Route 3: Stimulating firms that do not perform R&D yet to perform R&D

Route 3 is probably the least dominant, but it does profit from measures that fall under route 1. For instance, the WBSO scheme (see route 1) is also available for firms that start to perform R&D for the first time. Other measures in this route are the

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Programmes. For the fast implementation of new programmes, €218m was made available for 2009-2010. In addition, the fiscal scheme WBSO was broadened with €150m in both 2009 and 2010.

[17] The TechnoPartner Knowledge Exploitation funding programme (SKE) encourages consortia of public knowledge institutes and private parties to set up knowledge-intensive and innovative companies. The TechnoPartner SEED-facility improves supply of venture capital for technostarters via co-financing in venture capital funds. TechnoPartner Certificate decreases the risk for banks to finance technostarters and increases the chance for technostarters to get financing. TechnoPartner Business Angel Programme (BAP) informs (starting) entrepreneurs and starting informal investors (virgin angels) about the possibilities of informal investment. TechnoPartner also supports entrepreneurs from abroad who want to start a new company in the Netherlands, and it helps technostarters to internationalise.

[18] The WBSO alleviates the wage burden of R&D workers for companies through tax reduction.

Innovation Vouchers scheme (€31m/year) and Syntens (€33m EL&I contribution) Both schemes have also relevance for routes 2 and 5. As from January 2011 the Innovation Vouchers scheme is abolished by the new cabinet. The budget of the scheme is transferred to the Innovation Performance Contracts (IPC) scheme.

Route 4: Attracting R&D-performing firms from abroad
Route 4 becomes increasingly important, but it is mainly addressed via other routes (especially 2, 5 and 6).[19] In general, the Dutch government aims to create an attractive climate for R&D intensive firms from abroad in terms of an attractive fiscal climate, an ambitious learning culture and an excellent research climate. Initiatives in this route include the Netherlands Foreign Investment Agency (NFIA) and a network of Offices for Science and Technology (TWA network) in various countries. Increasingly, the Innovation Programmes (see Route 5) are used to create a recognisable profile (or "brand") of the Netherlands and to attract foreign R&D intensive firms to the Netherlands.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector
Route 5 has become increasingly important with the introduction of the Innovation Programmes (EL&I contribution ca. €110m/year) and the regional innovation programmes under the Peaks in the Delta initiative (EL&I contribution ca. €68m/year). In addition, substantial investments have been made from the FES fund for collaborative R&D and innovation.[20] In the coming cabinet period (2010–2014), however, the FES fund will no longer be used for new investments in the knowledge infrastructure and the budget for (regional) innovation programmes will be cut.

Route 6: Increasing R&D in the public sector
The largest stream of public research funding is the institutional base funding (block grant) of the research universities (ca. €2b/year). This is complemented by funding in competition via NWO. In addition, NWO and the KNAW both have a number of research institutes for fundamental research under their wings that receive institutional funding (ca. €230m/year for 28 institutes). In the area of applied research, there are also a number of public research institutes. Their institutional base funding is being replaced by (long-term) demand-oriented programme-based funding.

The table below summarises the importance of the six routes and recent policy changes. The coalition agreement of the new cabinet announced a significant reduction in budget for subsidies and the number of subsidies. The budget for Innovation Programmes will also be reduced. It is yet unclear how the reduction will affect the balance in the policy mix.

[19] In 2006, EL&I published the policy memorandum "In action for acquisition" which set out the policies to attract more foreign investments, also in R&D.

[20] In 2009, an impulse of €500m has been given to consortia of public and private parties for multi-year projects in eight themes: high-tech systems & materials; food & flowers; life sciences & health; water, climate and spatial research; ICT; advanced chemistry and energy; creative industries and education.

Table 4: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2009
1	Important, but relatively small in terms of budgetary weight	• No significant changes
2	Very important, also in terms of budgetary weight	• WBSO budget increased • Budget Innovation Credit scheme increased • SBIR programme became more important • More attention for the government as (launching) customer
3	Relatively low importance, also small in terms of budgetary weight	• The Innovation Voucher scheme is intensified and broadened in 2008-2010. After 2010, however, it will be discontinued.
4	Increasingly important, but mainly addressed indirectly via other routes	• More emphasis on international aspects of the Innovation Programmes
5	Highly important, with growing budgetary weight in 2005–2010	• The new cabinet announced budget cuts for collaboration subsidies.
6	By far the most important route, also in terms of budgetary weight	• Institutional base funding of technological research institutes replaced by demand-oriented programmatic funding

Source: assessment Technopolis Group (2010).

Accessibility and quality of public support to R&D and innovation by firms

Since the streamlining operation in 2005, EL&I has brought the instruments in various 'packages' (see Figure below).

Table 5: NL Agency (Division NL Innovation) support in four packages

	Starting, growing, transfer of firms	Regional economic strengths	Basic package innovation	Programmatic package innovation
Target group	All companies	Companies within regional priority areas	All innovative companies	Innovative leading companies within national priority areas
Effects	• More investments • Interaction Education and Labour market	• Regional clusters of world class	• More investments • Knowledge exchange with knowledge institutes	• International excellence in specific thematic areas
Means	• Guarantees • Start-up funds • Education linked to labour market	• Targeted investments in proven strengths of regional economies	• Tax reduction • Innovation vouchers • Joint innovation • Credits	• Innovation programmes with R&D agendas • Connection to international networks and programmes
Financial support (excl. guarantees)	167 million euro	68 million euro	823 million euro	307 million euro

Source: facts and figures NL Agency, Division NL Innovation (2010).

Several initiatives have been taken to make the instruments more accessible for companies, e.g. brochures and websites. For instance, the website

www.antwoordvoorbedrijven.nl ('answers for companies') helps companies to find the right subsidies.

In 2010 the Netherlands Foreign Trade Agency (EVD), the Netherlands Patent Office and SenterNovem merged into one NL Agency.[21] An aim of the merger is to create one front office for companies that can be supported more effectively and efficiently.

Typically, the policy instruments in the R&D and innovation policy mix are evaluated, often by external professional evaluators. EL&I uses a set of indicators to monitor the performance of NL Agency.

Innovation-oriented procurement policies

PIANOo, the government's Public Procurement Expertise Centre, was established to support public procurers. It offers a platform for all contracting authorities to share problems encountered and to discuss applied solutions. With regard to innovation, PIANOo stimulates innovation in procurement by supporting innovative pilot procurements, by financing and giving advice. The experiences of these pilots are shared in the network. PIANOo also develops a national and international network in cooperation with lead market initiatives and gives advice on applicable instruments.

The government also introduced an SBIR scheme in 2004, which is a form of pre-commercial procurement of R&D.

Other policies that affect R&D investment

One of EL&I's main policy objectives is to create "an excellent climate for entrepreneurship and business location". Policy is aimed at removing barriers for entrepreneurs and to build on existing strengths together with companies and stakeholders (clusters, 'key areas'). One element of EL&I's policy is strengthening of the spatial economic main structure of 'mainports' (airports, harbours, etc.).

The Dutch policy mix includes various instruments that stimulate entrepreneurship in various stages the business life cycle (e.g. guarantees, access to risk capital). Efforts are made in reducing the administrative burden for firms and improving business parks. Eco-innovation is stimulated, inter alia, by green procurement initiatives.

Barriers and risks for attaining the 2% BERD

In the Dutch research system several barriers can be found that hamper a more substantial increase in R&D intensity.

- The business sector structure has a low R&D intensity. The services sector is relatively large and this sector is not as R&D intensive as the (high-tech) industry sector.[22] Industry constitutes a relatively small part of the total Dutch economy, and within the industry sector the high-tech sectors are relatively small.
- The share of SMEs innovating in-house and the share of SMEs introducing innovations are also below EU27 average.[23]

[21] The new NL Agency consists of five thematic divisions, defined by their areas of expertise: NL Innovation, NL Energy and Climate, NL Environment and Spatial Planning, NL Patent Office and NL EVD International.

[22] In addition, R&D in the services sector is not captured adequately with current measurement methods.

[23] PRO-INNO Europe, INNO-Metrics, European Innovation Scoreboard 2009.

- The alignment of universities and companies (SMEs in particular) is not optimal.[24] However, collaboration between research institutes and companies is higher than in most EU-countries.
- Dutch knowledge workers and businesses have a strong international orientation, which is not matched by a sufficiently high level of attractiveness of the Netherlands for foreign knowledge workers and knowledge intensive businesses.
- Because of demographic and economic trends, a growing number of new graduates in HRST is needed. However, the inflow of new S&E and SSH (doctorate) graduates is below EU27 average.[25] The low attractiveness of a career as a scientists or researcher is one of the explanatory factors. Education and the business sector are not sufficiently aligned.
- There has been a lack of coordination and continuity in policy design and implementation. The policy governance structures have become increasingly complex and fragmented and a coherent overall strategic framework for R&D and innovation policies has been lacking.

2.2.3 Providing qualified human resources

National context

A first factor that influences the future provision of researchers is aging. More than one-third of the tertiary graduates in the Netherlands belongs to the age group 45-64 years. The post-World War II 'baby boom' generation will retire in the coming years. To ensure a balanced composition of scientific staff in universities, NWO has introduced the Innovational Research Incentives scheme, which stimulates career opportunities for talented researchers in various stages of their careers.

A second factor is internationalisation of the labour market for researchers and international mobility. The Netherlands has a relatively high 'brain drain', which is not compensated by 'brain gain'. The brain gain from non-EU countries is relatively low.[26] A Knowledge Migrant scheme was introduced (and later adapted) to increase the attractiveness of the Netherlands for international knowledge workers. Although Dutch universities attract more foreign students, they tend not to stay in the Netherlands after their graduation.

Labour participation is one of the ways to counter outflow due to aging and mobility. Among tertiary graduates, labour participation is high (83.5% in 2008) and shows an increasing trend, which is mainly due to increasing participation of women. Unemployment among tertiary graduates is relatively low (1.6% in 2008). The effects of the economic crisis on the unemployment among knowledge workers appear to be limited, in part thanks to the Knowledge Workers scheme.[27] The share of women in senior positions in Dutch universities is low in international comparison and special schemes have been set up to address this underutilisation of talent.

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[24] In the Community Innovation Survey only 12% of all innovative Dutch companies mention a university as partner. Few innovative companies (3%) see universities as very important sources. (OCW/NOWT, 2008).

[25] PRO-INNO Europe, INNO-Metrics, European Innovation Scoreboard 2009.

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

[27] With this temporary scheme, industry and (high tech) businesses that are suffering from an acute drop in turnover can be supported by a governmental fund that enables the outsourcing of researchers from the companies to public organisations.

Another way to balance the outflow is training of new researchers. The share of tertiary graduates in the age group 25–64 has increased from 23% to 30% in the period 2001–2006. This share will most likely increase, because the share of tertiary graduates in the age group 25–34 increases from 26.5% to 36% in the same period. The annual amount of new tertiary graduates in S&T increased from 6.1 to 9.0 per 1,000 in the age group 20–29 (2001–2006). Although this is a strong growth, the share is still relatively low. Indeed, a shortage of graduates in S&T is looming, and a special Platform Science and Technology was set up in 2004 by the government to promote the availability of sufficient technicians and engineers. In 2007/2008 there were 3,200 PhD graduates, which is an increase of 25% compared to 2002/2003. 1.3 per 1,000 persons between 25-34 years obtains a doctorate, which is, however, not more than an average score in international perspective. The low attractiveness of a career as a scientist/ researcher is one of the explanatory factors.

HRST as a share of labour force has increased from 45.5% in 2000 to 50.9% in 2009. Compared to EU27 average (40.1% in 2009), this is relatively high.[28] The number of R&D personnel, however, is relatively low: 1.00% of total labour force in 2008, which is slightly below EU27 average (1.03%). Moreover, the trend is gradually decreasing (it was 1.09% in 2000). The number of researchers within R&D personnel is low (0.5% of the total labour force in 2007), but rising. The share of support staff is relatively high.

Articulation of education policies within the knowledge triangle

The general policy objective of higher education policy is to have a higher education and research system that ensures that students and (scientific) personnel can fully develop their talents and research capacities. One of the operational policy objectives is to stimulate 'excellence' in higher education. For this, various schemes are used. Higher education policy also aims to prepare students for a career in an international context and to give higher education institutes more freedom to create a strong international profile and to partner with foreign institutes.

A second operational policy objective is that students can follow higher education that fits best with their talents and specific needs, and that students are stimulated to successfully finish their education. Various policy instruments are in place to promote a good flow through within the education system, less drop-outs in higher education and life-long learning.

A third operational policy objective is to strengthen the alignment of higher education institutes and society (firms and societal organisations). Policy aims to stimulate the role of higher (vocational) education in knowledge transfer through good connections with the (regional) business sector and performing applied and innovation-oriented research. For instance, as part of the Delta plan Science & Technology (2005), 14 'technocentres' were established to solve bottlenecks in regional labour markets for technical professions. Furthermore, practice-oriented research in universities of applied sciences is stimulated via lectors and a so-called RAAK-subsidy.

Main societal challenges

To ensure sufficient (future) supply of science, maths and engineering graduates the Platform Science and Technology was established in 2004. The aim is to achieve a structural increase of 15% more pupils and students in S&T education and to use existing talent more effectively in businesses and research institutes (see the Delta

[28] Eurostat.

plan Science & Technology, 2005). Careers in science should be made more appealing and educational innovations should be introduced that inspire and challenge young people. The Platform therefore targets schools, universities, businesses, ministries, municipalities, regions and sectors.

Since 2000, the ministries of EL&I and OCW have stimulated entrepreneurship in education in collaboration with organisations from the education and business sectors, e.g. via the action programme Education and Entrepreneurship.[29] EL&I and OCW have each made available €15m for the period 2008–2011 to stimulate knowledge exchange between education institutes and entrepreneurs. Part of this initiative is the Valorisation programme which aims to promote that HEIs set up high-quality facilities for entrepreneurship education (in Centres of Entrepreneurship) and for starting and supporting knowledge-intensive firms.

2.3 *Knowledge demand*

This section focuses on structure of knowledge demand drivers and analysis of recent policy changes.

Business driven knowledge demand

The business sector structure of the Netherlands is characterised by a number of strong sectors, i.e. the community services, business activities and the ICT sectors, electronic equipment and office machinery industries, the chemicals and the food industry and mining (natural gas & oil) and agriculture. There are correlations between economic, technological and BERD specialisations in the Netherlands. Compared to EU15 average, sectors that have relatively high BERD include mining, electronic equipment and office machinery, trade, food, agriculture, construction, chemicals, ships, and basic metals.[30] A large part of R&D by Dutch businesses is performed by a limited number of large multinationals.[31] Together they amount for more than half of all business expenditures on R&D. These companies have good absorptive capacities and are well-connected with the public knowledge infrastructure. They are also actively involved in the Innovation Programmes.

Approximately 11% of all R&D expenditures in the Netherlands is funded from abroad. In the business sector, the share is 15%. In the public research institutes sector and the university sector the shares are 15% and 3%, respectively. Therefore, FDI in R&D is not a major factor in business driven knowledge demand.

Since the early 2000s, thematic public R&D funding has become relatively more important vis-à-vis generic funding in an effort to align public knowledge production with business driven knowledge demand. A relatively new mode of programmatic R&D funding since the 1990s is funding in competition to consortia of public and

[29] The objectives: (i) An increasing number of educational institutions have integrated entrepreneurship in their policy, their organisation and their curriculum; (ii) A growing number of pupils and students show more entrepreneurial behaviour and start up their own business within a period of five years after completing their education. More information: the brochure Education takes Action! and the progress report Entrepreneurship and Education.

[30] ERAWATCH (2006) Country Specialisation Report: The Netherlands, June 2006.

[31] Philips (electronics), ASML (integrated circuits equipment), Merck/Schering-Plough (pharma), Shell (oil&gas), NXP (semiconductors), DSM (nutritional and pharma ingredients, performance materials and industrial chemicals), Océ (copiers), Unilever (food, personal care), KPN/Getronics (ICT services), Thales (aerospace, space, defence, security), Crucell (biopharmaceuticals), Tata Steel/Corus (steel), AkzoNobel (healthcare products, coatings, chemicals) and Stork (technical services and aerospace).

private parties in thematic areas. The goal of this type of instrument is to create more 'focus and mass' and to improve public-private interaction and coordination in the prioritised areas. The total size of the consortia-based funding is relatively small, but because the funds are concentrated in a few areas and because there has been a quick succession of this type of instruments, these instruments have been very visible. Moreover, this type of funding often requires co-funding, thus tying up parts of the block grant to universities.

While the balance in generic versus specific R&D funding has been moving towards specific, the new cabinet (2010–2014) has announced budget cuts for thematic programmes.

Society driven knowledge demand
Societal challenges have become increasingly important in public R&D funding.

- In the period 2007–2010 societal innovation agendas have been developed, which have been operationalised in societal innovation programmes.
- NWO has identified 13 themes, which are operationalised in society-inspired research programmes. For the coming period (2011–2014) NWO has chosen six broad themes (Healthy living, Water and climate, Cultural and societal dynamics, Sustainable energy, Connecting sustainable cities, Materials: solutions for scarcity).
- The investments via the FES fund have also been targeted at societal and economic themes.
- The institutional base funding of the research institutes (e.g. TNO) is being replaced by programme-based funding, guided by a set of (societal) themes.
- OCW has appointed four Leading Societal Institutes, which are virtual research institutes that perform excellent research that is relevant for societal themes. The institutes are HiiL–Hague Institute for the Internationalisation of Law; Netspar–Network for Studies on Pensions, Aging and Retirement; NICIS–Netherlands Institute for City Innovation Studies; TIER–Top Institute for Evidence Based Education Research.

Major (overarching) themes in programmatic R&D funding are High Tech Systems and Materials, Life Sciences and Health, ICT, Infrastructure/mobility/public space/construction, Food and Flowers, Chemicals and Energy, Water, Creative industry and Services. In the thematic programmes for these areas economic strengths and opportunities are connected with societal challenges (e.g. health care).

In terms of GBAORD specialisation, Netherlands is highly specialised in civil research and land use, while there are also specialisations in a large number of socio-economic objectives such as energy, space, industrial technologies, agriculture and the environment.[32] This largely corresponds to the structure of knowledge demand drivers.

2.4 *Knowledge production*

The production of scientific and technological knowledge is the core function a research system must fulfil. While different aspects may be included in the analysis of this function, the assessment provided in this section focuses on the following

[32] ERAWATCH (2006) Country Specialisation Report: The Netherlands, June 2006.

dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve the knowledge creation.

2.4.1 Quality and excellence of knowledge production

The international position of the Dutch HE sector is good. Dutch scientists have relatively high publication output (especially in Nature and Health) and have relatively high impact-scores. The Netherlands produces circa 2.5% of all scientific knowledge in international journals, which is more than its share in the world population (0.2%). The growth of scientific publications in the Web of Science database was 47% in the period 2000–2008 for the Netherlands.[33] Researchers in the Netherlands are one of the most productive in the world with 72 publications in international scientific journals per 100 researchers. Also in terms of publications per million euro R&D expenditures the Netherlands scores very well. The citation impact for the Netherlands is high (the field normalised impact is 1.33 for 2005–2008). The impact scores are particularly high in Nature, Health and Agriculture. The good position of the Netherlands is, however, under pressure due to international competition and moderate (additional) investments in research.

The Netherlands also has (very) good scores in terms of patents. This is largely due to Philips. All Philips patents are applied by the Dutch head office, but approximately half of the R&D that led to the patents was performed in the Netherlands.

While the output of the Dutch research system is quite good, the input shows a declining trend. The GERD is relatively low and declining. Also the GOVERD is below EU27 average and shows a declining trend. The HERD, however, is relatively high and stable. It could be argued that the good performance of the Dutch research system is the result of investments in the past, and that the future performance is under pressure because the current levels of investment in R&D are insufficiently ambitious. In addition, the share of R&D personnel in the labour force is relatively low.

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

The Dutch research system has a tradition of evaluation of public research organisations and research programmes. The Standard Evaluation Protocol 2009-2015[34] (SEP) plays a central role. According to the SEP universities must carry out a self-evaluation of their research activities once every three years, and these research activities must also be assessed by an external panel once every six years. The external assessment covers not only the content of the research programme but also the management, strategy and mission of the research centre where it is carried out. The SEP leaves scope for assessment of one or more research centres (Institutes) within the same university or for comparison with similar centres at home or abroad. The protocol has two objectives: (1) Improvement of research quality based on an external peer review, including scientific and societal relevance of research, research policy and research management; (2) Accountability to the board of the research organisation, and towards funding agencies, government and society at large. The evaluation does not affect the institutional base funding of the universities.

[33] OCW (2010) Wetenschaps- en technologieindicatoren 2010.

[34] The SEP 2009-2015 is formulated by the Royal Academy KNAW, the research council NWO and the VSNU (Association of Dutch Universities).

To assure the quality of the research schools, the KNAW established the Research School Accreditation Committee (ECOS) in 1992, at the request of the minister of OCW. ECOS organises annual assessment rounds, and ECOS decides on applications for the (re)accreditation of research schools. The assessment is based on a protocol established by the KNAW. The accreditation of a research school is valid for six years. After this period an application for reaccreditation needs to be submitted. The ECOS accreditation procedure aims at granting a quality stamp to research schools. ECOS also provides advice to research schools on how to further improve their core activities. The revision of the ECOS, effectuated in 2010, aims to synchronize the ECOS procedure and evaluations according to the SEP (see above).

At the level of project selection, NWO usually uses selection procedures that include an assessment of the scientific quality and feasibility of the proposals by international experts in accordance with a system of hearing both sides of the argument. Based on this standard peer review procedure and the written reaction of the applicants on the comments of the reviewers, an independent international evaluation committee uses its scientific expertise to formulate a recommendation for funding for the involved NWO Division Boards, who will formalise the advice of the evaluation committee.

As part of the policy objective to stimulate 'excellence' in the public research system, NWO has several programmes that stimulate talented researchers in various stages of their careers, e.g. the Innovational Research Incentives Scheme. Improving quality and excellence of knowledge production is a main driver of internationalisation strategies of OCW and NWO (see next chapter).

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences, e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or Member States acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section provides an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

Various incentives and mechanisms for inter-sector R&D cooperation and R&D personnel circulation are in place. The relatively large PRO sector (TNO and the Large Technological Institutes) has an intermediating role between universities and companies. Other mechanisms include a range of policy schemes to stimulate public-private R&D collaboration and clusters (e.g. the Innovation Programmes, Leading Technological Institutes, Leading Societal Institutes, FES-funded programmes for public-private consortia). Indeed, public-private partnership in research and innovation has become an important element in the Dutch R&D and innovation policy mix. Other (generic) programmes that stimulate cross-sectoral knowledge circulation include the Innovation Vouchers scheme, which stimulates SMEs to interact with knowledge institutes, and the TechnoPartner programme, which includes various schemes to stimulate technology-based start-ups and spin-offs from universities.

The universities' 'third mission' (valorisation) has received more attention since the early 2000s. Universities have developed more explicit strategies and instruments for valorisation. Societal and economic relevance of research has become an integral part of the SEP (see section 2.4.2) and of the set of selection criteria in many R&D and innovation programmes.

In December 2008 a large number of organisations signed the Valorisation Agenda, which includes twelve concrete steps to develop new knowledge and to make it available for utilisation in new products, processes and services.

It can be concluded that the Dutch policy mix does pay attention to cross-sectoral knowledge circulation and that this has contributed to more cross-sectoral interactions. Especially in the 'key areas' the focus is on stimulating innovation ecosystems where public and private actors collaborate in an 'open innovation' setting.

2.5.2 Cross-border knowledge circulation

In 2008 OCW published the internationalisation agenda. The main policy objectives are to increase the mobility of Dutch students, stimulate an international orientation of education institutes, increase 'brain circulation' and improve the location climate for education and research institutes.

Research collaboration between national and foreign research organisations
There are several policy measures that reinforce international cooperation:

- NWO has a set of programmes that stimulate international collaboration.[35]
- NWO provides opportunities and incentives for international research talent.[36]
- An increasing number of NWO subsidies and research programmes aiming at talented scientists are open for applications by researchers affiliated with universities and institutes from abroad.
- NWO participates in multilateral collaborations under the auspices of ESF (e.g. EUROCORES) and the European Commission (e.g. ERA-NET, ERA-NET+).
- EL&I stimulates international R&D collaboration in its Innovation Programmes. Indeed, international collaboration is a key success factor for the programmes.
- NL Agency runs the National Contact Point FP7, which is the centre of expertise for the European Framework Programme in the Netherlands.[37]
- The Netherlands participates in the Eureka network and has subsidy schemes for International Innovation and Eurostars.

Participation of national teams in projects involving inter-governmental Research Infrastructures
The Committee National Roadmap Large-Scale Research Facilities published in 2008 a report to the minister of OCW with recommendations on research facilities that should be built in the Netherlands and facilities that should be shared internationally. The roadmap included 35 projects that are on the European (ESFRI)

[35] For instance, programmes for collaboration with Germany (Von Humboldt Stiftung, DFG), the United State (e.g. Fulbright Award), China (NSFC, JSTP), India (SSCIN), Japan (JSPS), Taiwan (NSC), South-Korea (KOSEF) and Africa (WOTRO NACCAP, EDCTP).

[36] For example, the Innovational Research Incentives Scheme stimulates international 'top talents' and the Rubicon scheme offers doctoral graduates the chance to gain experience at a top research institution outside the Netherlands.

[37] The NCP FP7 is the former EG-Liaison.

Roadmap and have a Dutch component. In 2009 a call of €63m was organised for the first eight projects of the Dutch Roadmap (via bundling of resources for Large Infrastructure of the period 2008–2011). Five projects have been awarded.

The Netherlands contributes substantially to large international research organisations such as ESA, ESO, CERN, EMBL, and EMBC. Via NWO, the Netherlands participates in several large research facilities.[38] When appropriate, the research institutes of NWO and KNAW are encouraged to function as national 'portals' to international research programmes.

Individual mobility of researchers

NWO manages the Rubicon scheme offering doctoral graduates the chance to gain experience at a top research institution outside the Netherlands. Furthermore, an increasing number of subsidies and research programmes aiming at talented scientists are open for applications by researchers affiliated with universities and institutes from abroad.

National measures supporting cross-border co-operation in areas with EU added value

Cross-border co-operation in areas with EU added value is visible in the Innovation Programmes. In principle, the Innovation Programmes are open for participation of foreign partners (with requirements of co-funding and complementarity). The prioritised 'key areas' largely overlap with the 10 thematic priorities, which have been identified as bringing European added value under FP7. The Innovation Programmes must have an international component and also tie in, wherever possible, with international programmes such as FP7 and EUREKA.[39]

2.5.3 Main societal challenges

The Innovation Programmes of EL&I combine economic and scientific strengths with societal challenges, for instance in health and sustainable energy. The societal innovation agendas form the basis for societal innovation programmes. In 2011 several societal innovation agendas are executed: Health, Water, Security, Energy, Education, Sustainable supply chains in Agriculture and Fishery.

2.6 *Overall assessment*

The table below gives an overall assessment of the four domains (resource mobilisation, knowledge production, knowledge demand and knowledge circulation). It should be noted that at the time of writing this report, a new cabinet was installed. The budgets for R&D and innovation are under pressure. The R&D and innovation policy mix is likely to be changed considerably. This will have consequences and provide new policy opportunities and policy-related risks.

A main policy-related risk remains that efforts in the Netherlands will fall short of raising the R&D intensity, in particular in the private sector. Policy opportunities lie in

[38] For instance, the Dutch-Flemish synchrotron radiation research facility (DUBBLE) within ESRF (Grenoble), the James Clerk Maxwell Telescope (Chile) and the Isaac Newton Group of Telescopes (La Palma).

[39] The innovation programmes have the ambition to improve access to international knowledge. By creating focus and (critical) mass in a limited number of key areas, the Netherlands aims to internationally distinguish itself and create a distinct (research) profile for itself – for example in FP7. By creating internationally renowned R&D clusters, the innovation programmes should improve the attractiveness of the Netherlands for foreign knowledge workers and foreign investors in R&D.

increasing the attractiveness of the Netherlands for talented students and researchers and R&D intensive firms, also from abroad. It contributes to resource mobilisation (via provision of qualified human resources and attracting foreign R&D intensive firms), knowledge production (by fostering excellent research) and knowledge circulation (by profiting from international knowledge).

With R&D budgets under pressure, it will remain a policy-related challenge to find a good balance between stimulating excellence in prioritised areas and ensuring a high-quality broad base in scientific research. It would be helpful if the long-term strategy and the Knowledge Investment Agenda (KIA) were used to guide investments in knowledge and innovation. The Dutch governance system would benefit from better co-ordination between the part of the policy system that deals with scientific research and the part of the system dealing with industrial R&D and innovation.

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	• The long-term strategy and the Knowledge Investment Agenda could allow for a better coordinated and coherent approach. • The attractiveness of the Netherlands for students, knowledge workers and R&D intensive firms, also from abroad, could be increased by creating an ambitious learning culture and research culture that fosters excellence.	• Efforts to raise R&D intensity fall short of ambitions.
Knowledge demand	• Key societal needs could be addressed by translating the societal innovation agendas into substantial societal innovation programmes. • Coordination between ministries could be made more effective	• Decreasing budgets for thematic demand-oriented R&D and innovation programmes.
Knowledge production	• The research climate could benefit from more policy emphasis on ‘excellence’ and talented researchers	• Too much emphasis on ‘excellence’ and thematic priorities could result in too little policy attention for ensuring a high-quality broad base in scientific research.
Knowledge circulation	• Further improvement of coherence and continuity in policy regarding knowledge circulation and valorisation. • The Netherlands could be made a more attractive international location for (investments in) research and innovation.	• Decreasing budgets for public-private R&D collaborations could endanger cross-sectoral knowledge circulation.

The table below gives an overview of the main barriers to R&D investments and the opportunities and risks generated by the Dutch policy mix.

Table 7: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Industry structure with low R&D intensity	More R&D intensive firms, also from abroad, are needed. The Netherlands should develop a strong recognisable profile.
SMEs not sufficiently innovative; low level of interaction between SMEs and universities	Although the barrier is addressed in the policy mix, more could done to stimulate SMEs that do not perform R&D yet to perform R&D.
Attractiveness of the Netherlands for foreign knowledge workers and R&D intensive firms	The Netherlands should develop a strong recognisable profile and an ambitious learning culture and an research climate that fosters excellence.
Looming shortage of graduates in S&T	The Platform S&T has started to have good effects. A career as scientist or researcher is still not yet sufficiently attractive.
Governance structures too complex and fragmented	A more thorough policy streamlining and a more coherent and long-term approach of the knowledge triangle would be helpful. Giving EL&I a stronger, central role (including transfer of budgets for applied research) may improve governance and achieve a more focussed thematic innovation profile.

3 Interactions between national policies and the European Research Area

3.1 Towards a European labour market for researchers

The Communication Better careers and more mobility: A European Partnership for Researchers proposed by EC in May 2008 aims to accelerate progress in four key areas:

- Open recruitment and portability of grants;
- Meeting the social security and supplementary pension needs of mobile researchers;
- Providing attractive employment and working conditions;
- Enhancing the training, skills and experience of researchers

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped under the name of EURAXESS – Researchers in Motion. Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced 'brain circulation', with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the 'brain drain' rather than brain circulation.

3.1.1 Stocks and mobility flows of researchers

In section 2.2.3 figures on stocks of researchers were presented. In the Netherlands, HRST as a share of labour force amounted to 50.9% in 2009, which is above EU27 average (40.1%).[40] The trend is gradually increasing (it was 45.4% in 2000). The number of R&D personnel, however, is relatively low: 1.00% of total labour force in 2008, which is slightly below EU27 average (1.03%). Moreover, the trend is gradually decreasing (it was 1.09% in 2000). The number of researchers is rising, but is still low (0.5% of the total labour force in 2007). The share of support staff in the R&D personnel is relatively high.

Data on mobility and levels of inward versus outward flow or researchers are not available for the Netherlands. In general, young Dutch researchers are stimulated to gain experience abroad, as this is considered beneficial for their scientific careers. In specific sectors, especially in science and engineering, many doctoral candidates from abroad are recruited mainly because of a shortage of domestic candidates. There is no evidence in the Netherlands that academic positions are often exclusively reserved for internal staff or people from the domestic labour market. In view of increasing international competition, knowledge institutions tend to be motivated to attract the best international researchers, including those from other world regions.

There are several measures in the Netherlands that stimulate mobility of researchers.[41] In addition, the Innovational Research Incentives scheme is made accessible for foreign researchers that want to come to the Netherlands. Dutch researchers actively participate in European programmes such as Marie Curie actions and ERC grants.

In 2009 a new Admission Scheme for Highly Educated Migrants was introduced.[42]

In general, the Dutch labour market for researchers suffers from a lack of career perspective. Within universities it is difficult to make a career, and outside the universities there is little demand for doctorates. This is related to the relatively low R&D investments and the relatively low societal status of a PhD degree in the Netherlands. In practice, there is no real labour market for doctoral graduates in the Netherlands.[43] The training for PhD candidates tends to be too specialised or narrow for the business enterprise sector. The alignment of research training and the labour market outside the university sector is insufficient. Although the training of PhD candidates is in general of good quality, there is room for improvement in supervision and a broadening of the training.

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[40] Eurostat.

[41] E.g. NWO Rubicon-mobility grants, NWO exchange programmes with China, Japan, South Korea and Taiwan, NWO Visitors Travel Grant for foreign senior researchers and grants of universities.

[42] This scheme allows highly-educated foreign nationals who have attained at least a Master's degree can obtain a residence permit with a maximum term of 1 year in the Netherlands in order to find a job as a highly-skilled migrant or to start an innovative company. This scheme can ensure that foreign exceptional talents (who currently do not yet come to the Netherlands, but who can create economical added value for the Netherlands) are more easily admitted to the Netherlands. See http://www.ind.nl/ for more information.

[43] In addition, most research is performed by PhD candidates rather than postdocs. The lack of postdoc positions contributes to worsening career perspectives. Postdocs often find it difficult to get a permanent position at a university. Most of them are forced to find an occupation outside the universities – after having had several temporary postdoc positions. (OCW, 2005, Making the most of talented researchers).

Unemployment of doctoral graduates is not a major problem: 90% has a job. Most of them work in the business enterprise sector. About 20% works as a researcher. Of these 20%, ca. one quarter works in the higher education sector.[44]

3.1.2 Providing attractive employment and working conditions

Dutch universities are actively seeking international talents to work or study in the Netherlands. To attract talented researchers (also from abroad), universities promote themselves, inter alia, with a tenure track system, attractive employment conditions (also for PhD candidates), high success rates in European fund and grant applications and state-of-the-art research facilities.

According to the 2007 EC report Remuneration of Researchers in the Public and Private sectors the total yearly salary average of researchers in the Netherlands is relatively high.[45] The Netherlands not only has relatively high remuneration of researchers, but also a high relative increase in salaries as the career progresses.

The comparison of researchers' remuneration per scientific domain against the situation of similar professions in the Netherlands shows that, in most scientific domains, the total yearly salary costs of researchers are higher than the total yearly salary costs of similar professions.

Implementation of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers is the responsibility of the knowledge institutes, which have a large degree of autonomy. The Dutch government sees the Charter as voluntary and non-legally binding nature.[46] The VSNU is signatory to the Charter.[47] The second signatory is the Maastricht Graduate School of Governance of the Maastricht University.

In the Collective Labour Agreement (CAO) for universities several agreements have been made to reduce the negative effects of career breaks on women's research careers.[48] The employer is forbidden to terminate a permanent employment contract and prematurely terminate a fixed term employment contract during pregnancy or during the period in which the employee is on maternity leave and during a period of six weeks after resuming work or a period of incapacity for work as a result of the birth or the preceding pregnancy following maternity leave.

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[44] CBS, 2007, Careers of Doctorate Holders 2005,

[45] The remuneration average was €59,103 in 2006, while EU25 average was €37,948. The report concludes that the Netherlands is one of the few countries that has an average remuneration similar to that of the United States, considering the cost of living in each country.

[46] Government response to the green paper: the European Research Area: new perspectives. And 22112, no. 460, 22-8-2006.

[47] The VSNU has initiated drawing up its own Code of Conduct with regard to the recruitment of international researchers, based on the Charter and Code of Conduct, the European Guideline for the admission of researchers from third countries and the Code of Conduct for International Students in Dutch higher education. (OCW, *Voortgangsrapportage Wetenschapsbeleid* [Science Policy Progress Report] 2007, 29338, no. 55).

[48] The maximum term of a temporary employment contract (6 years) can be extended with the amount of maternity or parental leave taken if the employee requests this. A female employee who enjoys pre and post maternity leave by virtue of the Work and Care Act is entitled to full remuneration during this leave. The total term of the pre and post maternity leave is at least 16 weeks. In addition, an employee who has a parental relationship with a child is entitled to parental leave on partial pay.

Because women are underrepresented in senior scientific and management positions, several measures have been introduced. OCW has asked universities to make diversity an integral part of their regular personnel and career policies.[49] In response, universities have committed themselves and introduced plans to improve the representation of women in higher scientific and management functions. OCW has made available extra funding within the Innovation Research Incentive scheme to give grants to excellent women that were not awarded in the first instance (because lack of funds, not because insufficient quality). OCW also gives financial support to the renewed Aspasia programme,[50] to the ESF-Equal project 'participation as priority', to a study of gender bias in selection mechanisms for higher scientific functions and to the Dutch Network of Women Professors (LNVH).

NWO also has a number of policy initiatives and special programmes (e.g. MEERVOUD and FOm/v) to improve the position of women in science.[51].

3.1.3 Open recruitment and portability of grants

Academic staff in the Netherlands does not have the status of civil servant. Universities have a relatively large autonomy in their HRM policies. Non-nationals are eligible in competition for permanent research and academic positions. There is no national legislation that regulates (access to) permanent research positions and that helps or hinders the openness towards non-nationals.

With regard to the European Higher Education Area, the Netherlands introduced a Bachelor-Master structure and the European Creditpoint Transfer System. Accreditation and quality assurance are important aspects in international mobility of students and staff. The Netherlands (and Flanders) has contributed in developing the Dublin Descriptors (operationalising Bachelor's, Master's and Doctoral awards).

Research vacancies supported by public funds tend to be internationally advertised, especially on the European Researcher's Mobility Portal.

Euraxess The Netherlands is an information and advice point for internationally mobile researchers wishing to come to or staying in the Netherlands. The website offers information on funding opportunities, job offers, immigration procedures, social security and tax issues and other topics relating to researcher mobility.

With regard to the portability of research grants, NWO has signed EUROHORCs' Money Follows Researcher initiative. Researchers that have been awarded a personal subsidy from NWO can make a request to continue their research abroad.

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[49] In the CAO it is agree that within the recruitment and selection policy, the employer (university) shall pursue an incentive policy aimed at women, the occupationally disabled, foreigners and other employee groups in a disadvantaged or otherwise vulnerable position.

[50] Aspasia aims to increase the number of women senior lecturers. In Aspasia new-style the procedure is as follows: Women wanting to qualify for promotion to senior lecturer or professor via an NWO programme can submit a proposal in the Innovation Research Incentive scheme. The laureates will be recommended by NWO to the University Boards for promotion; the universities make the decision.

[51] Age limits will be abolished (as much as possible). An extension clause is introduced (based on pregnancy, parenthood, part-time work in combination with care). A systematic data gathering of men/women scores in applications and awards is set up. Committees and boards will be composed in accordance with the man/woman distributions in academic populations. Women committee or board members are actively sought. The NWO Governing Board has established target figures for the male/female distribution in committees and boards.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

Foreign researcher that come to the Netherlands face relatively low barriers in terms of social security. They participate in several national (compulsory) insurance schemes, which provide cover for all people living or working in the Netherlands with a legal residence status.[52] Furthermore, there are employee insurance schemes, which provide various forms of insurance cover for anyone employed in the Netherlands.[53] Researchers that stay on the basis on an employment contract participate in the Dutch social security system and the organisation's occupation pension scheme.

Dutch researchers that start working abroad can hardly avoid a break in their pensions. Within the EU, the Netherlands is one of the few countries where specific rules towards international value transfers/transition of accrued pension are deployed. Under conditions, Dutch pension and fiscal regulations allow international pension transfers from abroad to the Netherlands.

When a foreign researcher leaves the Netherlands to carry on his/her career in another country, the pension fund ABP offers several possibilities, e.g. a lump sum payment.

Entry barriers for third country researchers

For short stays (max. 90 days), visiting researchers who are not nationals of a EU/EEA member state or Switzerland may need a short stay visa. In many cases, the Dutch employer or host institution will need to apply for a work permit. For stays of longer than 90 days, visiting researchers from third countries usually need an entry visa and they need to apply for a residence permit. In cases where a work permit is needed, it is the responsibility of the employer to apply for one.

The Netherlands participates in the Scientific Visa Package for long-term admissions.

For 'knowledge migrants' a fast-track procedure for admission and residence exists that lowers the entry barriers.

3.1.5 Enhancing the training, skills and experience of European researchers

Since the 1990s, postgraduate research training is usually organised in (inter)university research schools or graduate schools, which create a recognisable environment for PhD candidates. There is a system of accreditation and evaluation of research schools which has contributed to a better quality of postgraduate researcher training. Research school function as autonomous organisational units with their own budget and control responsibilities. Universities have to guarantee sufficient funding for a research school to be accredited.

Since the mid-2000s, most universities have established local graduate schools to support postgraduate researcher training throughout the institution. This new organisational principle was introduced as an answer to perceived lack of clarity in the divisions of responsibilities between research schools, institutes and faculties. In

[52] There are schemes for elderly, surviving dependents, exceptional medical expenses, healthcare and children. These insurances are paid with tax money. Only when someone lives in the Netherlands temporarily and is not working there as an employee, they will fall outside these insurance schemes.

[53] These schemes provide cover for illness, occupational disability and unemployment.

time, the system of graduate schools should cover all PhD candidates in Dutch universities. The minister of OCW during 2007–2010 was a proponent of graduate schools based on the American model. This means: a fixed time of entry, a strong focus on training and an orientation within the research school, followed by the choice of a doctorate subject. In other words, the PhD candidate would be able to chose his/her own subject, promoter and university. NWO received funding to develop a programme for graduate schools. In the pilot programme national and local research schools or graduate schools can be nominated for a block grant of about 800,000 euro for the appointment of PhD candidates who will carry out their research within the school.

Since 2002, the ministry of OCW explicitly pays attention to the postgraduates,[54] and several measures were introduced: NWO programmes for individual researchers in different stages of their scientific careers; increase in salaries for PhD candidates; and improving conditions for recruiting foreign researchers. Since many PhD candidates are of non-Dutch origin, English tends to be the standard language in research/graduate schools, especially in S&E fields.

International experience is usually considered a pro in career development of researchers.[55]

3.2 *Research infrastructures*

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in the so-called National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RIs have already been created in Europe. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section assesses the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

In 2008 the Committee National Roadmap Large Scale Research Facilities published The Netherlands' Roadmap for Large-Scale Research Facilities for investments in large-scale facilities that enable groundbreaking research and that cannot be

[54] The policy analysis identified several problems for which policy needed to finds answers: aging of scientific staff; underrepresentation of specific groups; few career opportunities for talented researchers; too tight budgets; competition on the labour market (national and international); and low mobility of scientific staff within the research system.

[55] For instance, Dutch universities have introduced the instrument of tenure track to offer talented (young) researchers the prospect of a tenure and career development opportunities. One of the selection criteria is that the candidate has international experience (as a postdoc).

financed by individual institutes because of their scale, making international collaboration necessary. In the process, an inventory was made which identified 66 publicly funded large-scale facilities in the Netherlands.[56] The Netherlands has a relatively strong position in ICT infrastructure (including e-science facilities), physics and materials science, (bio)medical research, astronomy and facilities for storing and accessing research data. The total gross value of the research facilities is estimated at €3.5b (excluding the intrinsic value of collections). By far the largest part of the large-scale facilities has at least a national character, and almost half has (at least partly) an international orientation.

A reliable assessment of the public investments in research infrastructures (e.g. as share of GBAORD) is difficult because these investments have not been a separate budget line in ministries' budgets since the 1980s. Instead they have been subsumed under the institutional base funding and budgets for programme-based and project-based R&D funding. It also makes a coherent coordinated approach to such investments more difficult. National coordination for investments in research facilities has been weak.

NWO aims to provide Dutch researchers with optimum access to high-quality research facilities, including large international facilities. NWO has a variety of structural and incidental grants that are aimed at realising research facilities. In addition, NWO facilitates the setting up of high-quality national research infrastructure via its divisions and through its own NWO institutes: partly by its own investments and partly by participation in European and global projects. NWO aims at creating more space for research facilities and international agreements about the use of these. This has resulted in a range of international partnerships.

The Netherlands' Roadmap for Large-Scale Research Facilities prioritises 25 large-scale research facilities: five in Humanities and Social Sciences, eight in Natural Sciences and Technology, six in Environmental Sciences and Energy, five in Life Sciences and Medical Sciences and one in E-Science. The Committee recommended immediate political and financial support for eight facilities that are also listed in the ESFRI and to use NWO's budget for large-scale research facilities (€63m for the 2008-2012 period) specifically to finance these ESFRI facilities. As a result, a call was organised and five proposals were awarded in astrophysics, astronomy, biomedical research, languages, and social sciences.[57]

Investments in large facilities are often not structural, but depend on incidental investments. Since 2008, NWO has a relatively modest structural funding for large-scale facilities (up to €20m annually). The Committee National Roadmap recommended the minister of OCW to establish a structural budget for investments in large-scale facilities. This advice was, however, not followed. Instead, a new 'Committee Taskforce Stimulating Large Scale Research Facilities' was established with the task to stimulate the implementation of the Dutch Roadmap and to advise the minister on alternative funding options for these facilities.

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[56] The inventory showed that large-scale research facilities in the Netherlands have become more diverse in the last three decades, that no clear overview of facilities existed, leading to lack of visibility, and that the long-term nature of the facilities is at odds with the way there are funded (project-based). (Horlings, E. and A. Versleijen (2008) Groot in 2008 - Momentopname van Grootschalige Onderzoeksfaciliteiten in de Nederlandse Wetenschap. Den Haag, Rathenau Instituut).

[57] The proposals are: KM3NeT (astrophysics; €8.8m), BBMRI (biomedical research; €22.5m), ESSurvey (social sciences; €4m), E-ELT (astronomy; €8.8m plus €10m in a later phase), and CLARIN (languages; €9m).

3.2.2 National participation in the *ESFRI roadmap*. Updates 2009-2010

The Netherlands published a national roadmap in October 2008. In November 2008, five projects were awarded (see above). In 2009, an investment of €184m was made (from the FES fund) in large-scale infrastructure.[58] Six projects were awarded, one with direct linkages to an ESFRI project (BBMRI). It is unclear what levels of funds can be expected to be committed by the Netherlands for the second phase of the implementation of the ESFRI infrastructures. The new cabinet announced that it will no longer use FES funds for investments in knowledge and innovation.

3.3 *Strengthening research organisations*

The ERA green paper highlights the importance of excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. The universities/ research institutions should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system, assessing its research performance, the level of academic autonomy achieved so far, dominant governing and funding models.

3.3.1 Quality of National Higher Education System

Size and composition of HE sector

In the Netherlands there are two main types of regular higher education: research universities and universities of applied sciences (UAS). The 47 UAS specialise in technical and vocational training, while the 14 research universities focus on providing scientific instruction and conducting scientific research. The research universities include six general research universities, three universities of technology, four specialised research universities and the Open University. In addition, there are a few private universities, including a business school and a handful of theological universities with a small student and research volume. Non-university private higher education also exists, offering sub-degree level education and BA-level education often on a part-time basis (or at a distance). Private higher education is predominantly catering to the lifelong learning market.[59]

The total number of university students is 229,233 (2007). This represents 1.4% of the total population. The total number of tertiary students is 590,100, which is 3.6% of the population.[60] The number of tertiary students has steadily increased in the last decade (487,600 in 2000). The number of PhD graduates is relatively low (3,200 in 2007/2008) or 1.3 per 1,000 persons between 25-34 years. The trend is, however, upward.

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[58] The facilities are: Lifelines (€40m) (linked to ESFRI project BBMRI), Surfnet 7 (€32m), NCB: Biodiversiteit (€30m), NanoLab (€27.7m), Delta Faciliteit (€25.3m), Second generation lab solar cells (€15.1m), Dynamic Two Phase Flow Lab (€14m). OCW (2010) Wetenschaps- en Technologieindicatoren 2010.

[59] Progress in higher education reform across Europe: Governance and Funding Reform. Report for the EC DG Education & Training by CHEPS et al.

[60] Eurostat.

Total university personnel is 37,986 (FTE; 2007), 55% of which is scientific personnel. The scientific staff has increased steadily since the mid-1990s, mainly thanks to project-based research funding.

HERD as share of GDP is relatively high and has been stable in the last decade. Approximately 8% of HERD is funded by the business sector.

Mission of HEIs

All research universities have a three-fold mission: teaching, research and utilisation of knowledge (valorisation). The third mission has received more explicit attention since the early 2000s by all universities. Within the research mission, universities have started to create more pronounced research profiles by prioritising specific research areas.

The level of differentiation between the universities is low. There is hardly any reputational and quality differentiation between the universities. Dutch universities have a good reputation, but none of them belong to the international elite or rank at the top of international ranking lists.[61]

Research performance

In section 2.4.1 the good international position of the Dutch HE sector was described. Researchers in the Netherlands are productive and their publications have high impact scores. International co-authorships of the Dutch universities are between 38% and 52%. FP7 participation of Dutch parties in relatively high. The Netherlands has a retour of 6.6% of the allocated subsidies, which is higher than the contribution of circa 5% to FP7. The Netherlands is represented in 20% of all FP7 projects. In the part 'Cooperation' the share is 40%. The average success rate in FP7 is 18%, while the consortia in which the Netherlands participates have an average success rate of 23%.[62] 50% of all FP7 subsidies that go to the Netherlands are awarded to universities, 25% to research institutes, 12% to SMEs, 8 % to large firms, and 5% to other organisations.

Two of the 14 research universities are in the top 100 of the Academic Ranking of World Universities 2010, four in the 101-150 group, and three in the 151-200 group.

[61] Several policy instruments have been implemented which could have induced quality and reputational differences, like the systematic evaluation of research, funding of top graduate schools and the Innovational Research Incentive scheme, but this has not happened. Instead, some of these instruments have led to a strong networking of university research into inter-organisational graduate schools, virtual institutes, research consortia and the like. These inter-organisational constructions appear to prevent the differentiation of universities instead of induce it. (James Dawson, Jan van Steen, Barend van der Meulen (2009) Science systems compared: A first description of governance innovations in six science systems, The Hague: Rathenau Institute.)

[62] Ministry of Economic Affairs / NL Agency (2010) Nederland in KP7 2010.

In section 2.4.2 the Dutch system for academic quality assurance was described. The Standard Evaluation Protocol 2009-2015[63] plays a central role. The evaluation does not affect the institutional base funding of the universities. The quality assurance system is well accepted, but its impact on strategic reallocation of research funding (toward 'excellence' and/or 'relevance') is small.

3.3.2 Academic autonomy

The 1993 Higher Education and Research Act codified the institutional autonomy and introduced the principle of self-regulation for HEIs. In exchange for more autonomy, the HEIs were expected to play an active role in the establishment of a new quality assurance system for teaching and research.[64]

One effect of the introduction of self-regulation has been the increased importance of the central institutional management. In the 1997 Act 'Modernising University's Governance Structures' (MUB) executive leadership was further strengthened, powers became more concentrated, and representative bodies where academics, non-academics and students held seats became advisory instead of decision-making bodies. The Act promulgated a significant shift in internal authority distribution; new bodies were created (Supervisory board) and some old ones were formally abolished (disciplinary teaching and research units; *vakgroepen* in Dutch).

The Supervisory Board is made up of five highly respected persons from outside the university. Members are appointed by the minister. It is meant as a buffer between the government and the executives of the university and to enhance the university's role as a 'societal entrepreneur'. The central Executive Board is made up of three members, including the rector, that are appointed by the Supervisory Board.

Human resources policy has been decentralised to universities. Universities have large degrees of autonomy in appointing academic staff, in determining the salaries and in financial management (e.g. borrowing funds on the capital market, building up reserves and/or carrying over unspent financial resources from one year to the next).

3.3.3 Academic funding

Universities are publicly financed via three 'flows' of funds. The first – the base funding – originates directly from the ministry of OCW and tuition fees paid by students[65]. It is approximately 60% of total university revenue. There is an allocation model that distributes a given sum of money (set by Parliament) across the research universities. The formula takes into account the relative performance of each university and includes measures of volume (student numbers, diplomas), prices (rates per student) and historical considerations. The allocation consists of a *teaching*

[63] The SEP 2009-2015 is formulated by the Royal Academy KNAW, the research council NWO and the VSNU (Association of Dutch Universities).

[64] Quality assurance was based on self-evaluation reports prepared by the institutions and site visits were carried out by experts (peers) for each disciplinary area in a six-year cycle. The acceptance of the system is partly due to the fact that government does not translate the outcomes of the quality assessments into its budget allocations. It was agreed that the intermediary bodies representing the institutions (the VSNU for the research universities) play the coordinating role with respect to quality assessment.

[65] Students pay a uniform tuition fee (the same across all institutions and all programmes). Fees account for 6% (universities) of revenues.

component and a *research* component, but this distinction is for calculation purposes only.[66]

The 'second flow' of funds consists of NWO funding and represents 10% of total university revenue. NWO receives funding from the ministry of OCW and the ministry of EL&I (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. Researchers from universities, NWO and KNAW institutes and a few selected research institutes can apply for competitive research council grants. Such grants have become more important over the years but their share in total funding is still not very large.

The 'third flow' of funding consists of a heterogeneous mix of revenues from activities such as contract research, contract teaching, consultancies, research commercialisation, endowments and renting out university facilities. The third flow of funds makes up 30% of total university revenue..

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the ERA Green Paper in April 2007, the EC Communication "Improving knowledge transfer between research institutions and industry across Europe" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs.

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the transnational dimension of knowledge transfer. This section will assess the national policy efforts aimed to promote the national and trans-national public-private knowledge transfer.

3.4.1 Intellectual Property Policies

In 2004 the universities (VSNU), the federation of medical centres NFU and the employers' association VNO-NCW have established the Innovation Charter, which contains the principles for collaboration between knowledge institutes and the business sector, in particular with regard to intellectual property.

Any employee of a Dutch university is obliged to comply with provisions reasonably laid down by the university with regard to patent right and copyright, with due observance of the legal provisions. If the invention is the work of someone carrying

[66] The teaching component is 42% of the lump sum (excluding the Academic Hospital allocation), and the research component makes up the remaining 58%. The **teaching component** consists of: a new entrants allocation (±15%); a diploma (BA/MA) based allocation (±60%); and a basic allocation (±25%). The **research component** of the funding model consists of various parts, including: an amount for each university depending on the number of BA and MA diplomas (±20%); allocation for PhD degrees and designer certificates (12-15%; allocation for research schools (±3%); allocation for excellent research schools (±3%); and Strategic Considerations Allocation (±55%).

out research in the employ of a university, the right to patent falls to the university.[67] The university may agree to transfer the right to patent to a third party (usually the cooperation partner) beforehand, or apply for the patent itself and only at a later stage transfer the IP rights or grant licences under them. According to the Collective Labour Agreement (CAO) Dutch Universities (2007–2010), an employee who creates a possibly patentable invention is obliged to report this and to transfer these rights to the university if so requested. When the university makes use of these rights, the employee is entitled to fair reimbursement (e.g. 25% of revenues).

Patent applications, and their financing, are the responsibility of the universities. Several universities have set up a patent fund (sometimes a revolving fund). Some universities use the revenues of a patent to reward their inventors; and often a part of the revenues is used to fund research of the involved research group. Some universities have established holdings for patenting activities; others have set up transfer or liaison departments. Since the mid-2000s, universities have made efforts to professionalise 'valorisation' activities as part of their 'third mission' (see next section).[68]

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Since the 2000s, funding in demand-oriented R&D and user-oriented R&D has increased, signalling the increased importance of 'relevance' in addition to 'quality' of research. Especially programmatic R&D funding of public-private consortia has become a much used policy instrument.

Spin-offs

Dutch universities are working to further professionalise their support systems for spin-offs. Most universities have developed (or are developing) central technology transfer offices (TTO) or 'valorisation centers', which include support to spin-offs.[69] Universities have established holdings to organise participations in start-ups. Most universities have incubators and 'science parks' for start-ups and growing companies. Several universities collaborate in 'centres of entrepreneurship' that stimulate students to start their own business.

In the national policy mix, several instruments stimulate and support spin-offs directly or indirectly. For instance, the TechnoPartner Knowledge Exploitation funding programme (SKE) provides support to consortia of public knowledge institutes and private parties with regard to screening of research and scouting of entrepreneurs, patents, access to equipment, coaching and support, and provision of pre-seed funding.

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[67] Article.12, paragraph 3 of the National Patents Act of 1995.

[68] In the Innovation Platform's valorisation agenda 'Knowledge must circulate' (2009) various parties made agreements on actions to improve valorisation. One of the agreements is that HEIs will pay systematic attention to valorisation in their quality assurance systems. They also agreed to further professionalise valorisation activities, to value and reward employees that contribute to valorisation objectives of the HEIs and to take up valorisation in the function structures.

[69] Other tasks may include: to facilitate access to scientists and their research results; to develop strategic R&D partnerships with companies and other societal/governmental organisations; to offer support to scientists in setting up and managing programmes (national and European); to support academic inventors in patenting/licensing activities; to manage the IP portfolio of HEIs; to stimulate valorisation, e.g. by improving valorisation processes of the HEIs and development of competences of employees of the HEIs.

Inter-sectoral mobility
Inter-sector mobility is stimulated indirectly via the increased usage of programmatic funding for public-private consortia. The Innovation Programmes tend to have a human capital component, which also involves public-private interaction to increase inter-sectoral mobility. Inter-sectoral mobility is also addressed via preparing PhD candidates for the labour market in their postgraduate training programmes.

Quantitative evidence is not available on inter-sectoral mobility.

Promoting research institutions - SME interactions.
The interaction between knowledge institutes and SMEs remains a relative weakness in the Dutch innovation system. The Innovation Programmes in the key areas stimulate interaction between research institutes and SMEs. Also the Innovation Vouchers scheme promotes knowledge transfer from knowledge institutes to SMEs to make them more innovative and R&D-intensive.

A typical feature of the Dutch innovation system is that it contains several large RTOs (e.g. TNO, the Large Technological Institutes), which have an intermediary role in translating scientific knowledge into applicable knowledge for companies, including SMEs. TNO, by far the largest RTO, has introduced an SBIR scheme (inspired by the US Small Business and Innovation Research programme) to allow companies (SMEs in particular) to commercialise product ideas of TNO employees.

EU cohesion policy
In the Netherlands, there are four Objective 2 ERDF programmes, through which nationwide commitment of the structural funds is possible. The objective of these programmes is to boost regional competitiveness.[70] The ERDF programmes link up with the regionally oriented programmes, which are drawn up by the regions in cooperation with EL&I under 'Peaks in the Delta' approach. This approach aims to stimulate regional clusters in areas with national relevance. The ERDF programmes can have a broader range, however, and need not to be limited to the regional programmes.

Involvement of private sector in the governance bodies of HEIs and PROs
The private sector may be involved in the Supervisory Board of universities, which consists of five members external to the university. The Executive Board of universities may also have members that originate from the private sector. The private sector is also involved in the governance bodies of PROs. TNO, for instance, has a Supervisory Board of seven members, appointed by the government, that come from various sectors.

3.5 *Cooperation, coordination and opening up national research programmes within ERA*

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of coordination, synergies, efficiency and simplification. The policy fragmentation at EU and national level, and between EU and national policies can hinder the build of critical masses of research excellence, leads to the duplication of efforts, sub-optimal

[70] One of the 'priority axes' for these programmes is 'Innovation, entrepreneurship and knowledge economy'. Corresponding objectives are: (1) increase in private investment in R&D; (2) better utilisation of public knowledge by the business community; (3) more innovative business start-ups and specifically more start-ups from knowledge institutions; (4) better knowledge infrastructure.

impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section assesses the effectiveness of national policy efforts aiming to improve the coordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

Participation in COST, EUREKA and FP7

The Netherlands is a founding member of EUREKA and has actively participated in the initiative since 1985. Since then, the Dutch project portfolio has grown to more than 700 projects, of which about 100 are still running. This makes the Netherlands one of the biggest participants in EUREKA. EL&I has introduced the grant scheme 'International Innovation' for Dutch participants in EUREKA projects.

The Netherlands is also participates in all scientific domains of COST in 77% of all COST actions (June 2006–June 2010). The Netherlands is particularly active in the domains Transport and urban developments, Food and agriculture, Individuals, societies, cultures and health, Biomedicine and molecular biosciences, Forests, their products and services and Earth system science and environmental management.

The Netherlands is very successful in FP7 with a retour of 6.6% of the allocated subsidies, which is higher than the contribution of circa 5% to FP7. The Netherlands is represented in 20% of all FP7 projects. In the part 'Cooperation' the share is 40%. The consortia in which the Netherlands participates have an average success rate of 23% while the average success rate in FP7 is 18%.[71]

National participation in inter-governmental Research Infrastructures

The Netherlands is co-founder and member of several large inter-governmental research organisations because membership creates synergies and critical mass. It also gives researchers access to advanced research facilities, which could not be financed by one single country because of the size. The concentration of researchers within these research organisations gives significant scientific added value. The Netherlands participates in CERN, EMBL, EMBC, ITER, ESO and ESA.[72]

Via NWO, the Netherlands participates in several large research facilities, including the Dutch-Flemish synchrotron radiation research facility (DUBBLE) within ESRF (Grenoble), the James Clerk Maxwell Telescope (Chile) and the Isaac Newton Group of Telescopes (La Palma).

3.5.2 Bi- and multilateral agreements with other ERA countries

The Netherlands has signed Letters of Intent with Flanders (Belgium) and North Rhine-Westphalia (Germany) for cross-border collaboration in research and

[71] The Netherlands has a particularly high retour in Food, agriculture and fisheries, and biotechnology (11.4%), Environment (9.9%), Health (9.0%) and Socio-economic sciences and humanities (8.0%). The retour is relatively low in General Activities (1.6%), Space (2.6%), Euratom (4.5%) and Nanosciences, nanotechnologies, materials and new production technologies (4.8%). In absolute figures, the Netherlands receives most subsidies from Information and Communication Technologies (€202m). In addition, the Netherlands receives a high subsidy from Health (€168m), Ideas (€134m) and Capacities (€112m). (Ministry of Economic Affairs / NL Agency (2010) Nederland in KP7 2010).

[72] OCW, Internationaliseringsagenda

innovation. One of the three action lines is sharing of large facilities. In the coming years, concrete collaborative projects will be developed.

3.5.3 Other instruments of cooperation and coordination between national R&D programmes

Participation in ERA-NETs: The Netherlands is actively involved in ERA-NETs. In Life Sciences is the Netherlands participates in 12 ERA-NETs, in Environment & Energy in 18 ERA-NETs, in Humanities & Social Sciences in 8 ERA-NETs, in Fundamental Research in 9 ERA-NETs and in Industrial Technologies in 21 ERA-NETs.

Participation in initiatives undertaken under Art. 185 of the Treaty of Lisbon: In 2010, the Netherlands is involved in three of the four article 185 TFEU Initiatives in FP7: Ambient Assisted Living (AAL); EUROSTARS and European Metrology Research Programme (EMRP).

Participation in activities undertaken through frameworks supported by the ESF: The Netherlands participates actively in ESF's Exploratory Workshops, Networks and à la carte Programmes.

Participation in European public-private partnerships: The Netherlands plays an active role in five Joint Technology Initiatives: embedded systems (ARTEMIS), nano-electronics (ENIAC), innovative medicines (IMI), aeronautics (Clean Sky) and Fuel Cells and Hydrogen (FCH). These JTIs overlap with some of the prioritised 'key areas' in the Netherlands. Dutch parties are also actively involved in about 40 European Technology Platforms (ETP).

Involvement in Joint Programming (JP) initiatives: The Netherlands participates in almost all JPIs (below marked with an *). The High Level Group for Joint Programming identified the first themes for JPIs in November 2009: (1) Agriculture, food security and climate change*; (2) A healthy diet for a healthy life*; (3) Cultural heritage & global change*. The 'second wave' of themes for Joint Programming Initiatives includes: (4) Urban Europe*; (5) CliK'EU*; (6) More years, better lives*; (7) Antimicrobial resistance; (8) Water challenges*; (9) Healthy & productive seas and oceans*.

3.5.4 Opening up of national R&D programmes

An increasing number of NWO subsidies and NWO research programmes aiming at talented scientists are open for applications by researchers affiliated with universities and institutes from abroad. The demands for admission may vary for each subsidy. Usually, researchers must perform the research in the Netherlands. NWO wants to facilitate the attraction and retention of scientific talent from abroad. All NWO grants will remain accessible for researchers from throughout the world, on the condition that the research is carried out in the Netherlands.

In the Innovation Programmes in the key areas, foreign partners may participate. Indeed, international participation is promoted because the programmes should strengthen the international position and attractiveness of the Netherlands for foreign firms, investors and talented knowledge workers. They should stimulate clusters of international excellence and attract the best firms and researchers.

3.6 *International science and technology cooperation*

In 2008, the European Commission proposed the Strategic European Framework for International Science and Technology Cooperation to strengthen science and technology cooperation with non-EU countries. The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies worldwide. Having in view these aspects, the following section analyses how national policy measures reflect the need to strengthen the international cooperation in S&T.

3.6.1 International cooperation

NWO's strategy aims to strengthen investments in emerging science nations, building upon the experience already acquired in China and India. NWO also aims to continue to make efforts to strengthen the knowledge base in less-developed countries. It will do this by contributing to the global research area, building up research capacity and by encouraging the translation of knowledge into sustainable development.

The rationale is that world-class research must not be hindered by borders. It is therefore vital that the Netherlands can continue to play a prominent role in international scientific research. NWO aims to provide possibilities for international cooperation and to strengthen the role that Dutch research plays in challenges at a global scale.

With regard to international collaboration with third countries (outside Europe), NWO cooperates with the USA (NSF, Fulbright Award), with Russia and various Asian countries such as China, Taiwan and Korea. Possibilities for strengthening cooperation with a number of fast-growing economies, such as India, are being explored. Existing cooperation programmes with China focus on joint scientific thematic research (e.g. on 'Integrated Water Management in relation with climate change and sea level rise') and on inviting highly talented Chinese PhD candidates to conduct research at selected Dutch graduate schools. In addition, there is a cooperation agreement between NWO and the National Natural Science Foundation of China (NSFC), which offers Dutch researchers a chance to do joint research.

NWO has a cooperation programme with India that aims to stimulate sustainable research collaboration by funding joint research projects on the topic medical devices that have the explicit goal to reduce the costs of health care either in India or in the Netherlands.

Via the WOTRO Foundation (Netherlands Foundation for the Advancement of Tropical Research) NWO supports research in and about the tropics in the broadest possible scientific context. Capacity building in the countries involved plays a major role in this. NACCAP (Netherlands-African Partnership for Capacity Development and Clinical Interventions against Poverty-related Diseases) is an example of this.

The KNAW sees it as its task to encourage cooperation with rapidly developing countries, in particular China (in coordination with NWO) and Indonesia. The Academy aims to contribute to capacity-building and to improving the knowledge infrastructure in developing countries. It is concentrating on Africa in this respect, and in particular on cooperation with African academies of science.

Indonesia and the Netherlands have a long history in cooperation in scientific research. The KNAW works with Indonesia in a scientific research programme: the Scientific Programme Indonesia – Netherlands (SPIN), which capitalises on existing networks between the two countries.[73]

3.6.2 Mobility schemes for researchers from third countries

NWO has cooperation agreements with the National Natural Science Foundation of China (NSFC), the Japan Society for the Promotion of Science (JSPS), the Korea Science and Engineering Foundation (KOSEF), the National Science Council of Taiwan (NSC), which offers Dutch researchers a chance to do research in those countries.

NWO also has a Visitors Travel Grant that allows foreign visitors to stay in the Netherlands.

4 CONCLUSIONS

4.1 *Effectiveness of the knowledge triangle*

Coordination of policies across policy levels and policy areas, notably between research, education and innovation policies has not been strong. Whereas OCW (responsible for science and education policy) has emphasised the autonomy of universities, the importance of fundamental scientific research and sufficient room for talented researchers, EL&I (responsible for industrial R&D and innovation policy) has emphasised the need for 'focus and mass', demand-oriented strategic research in 'key areas' and public-private collaborations in R&D. The two worlds are, however, gradually moving towards each other. The new cabinet established a new 'super ministry' of Economic Affairs, Agriculture and Innovation (EL&I), strengthening EL&I's role in (cross-sectoral) innovation policy. This may contribute to making the governance system less fragmented, and less dependent upon ad hoc 'task forces' and other temporary governance bodies.

Since the mid-2000s, EL&I has increased coordination between industrial R&D policy, industry policy, entrepreneurship policy and regionally oriented policy. The policy mix of EL&I has improved since the streamlining operation, which began in 2005.

Taxation policy was also used to stimulate innovation and entrepreneurship, e.g. via reductions on wages of R&D workers (WBSO) and reductions on income from (patented) R&D activities ('innovation box').

The new cabinet (2010–2014) will not continue interdepartmental Knowledge & Innovation programme department (K&I), and it is uncertain whether K&I's long-term strategy will actually guide investments, in particular because budgets are reduced and the FES fund will no longer be used.

[73] The main aim is to promote long-term cooperation between Indonesian and Dutch research groups and to help develop and consolidate multidisciplinary knowledge networks in the Netherlands focusing on Indonesia. SPIN consists of a number of larger integrated research programmes and supporting activities.

The level of public investments in knowledge and innovation has not been sufficient to reach the ambitious targets (the Netherlands in the top 5 of knowledge economies in the world). Moreover, investments have been rather unpredictable and not guided by a long-term investment agenda. While a large part of Dutch research funding goes via institutional base funding, an increasing part is allocated on a competitive basis. International peer review is a normal element in the selection procedures to evaluate scientific quality.

There is a well-functioning quality assurance system in place to evaluate PROs/HEIs, including international peer review.

The table below summarise the recent policy changes and the strengths and weaknesses of the knowledge triangle policies. It should be noted, however, that recent policy changes have been limited, because of elections and the formation of a new cabinet in 2010.

Table 8: Effectiveness of knowledge triangle policies

	Recent policy changes	**Assessment of strengths and weaknesses**
Research policy	A noteworthy recent policy change was the extra policy attention for individual talented researchers (via an extension of the Innovational Research Incentives scheme, a subsidy to introduce aspects of the American Graduate School model and the Rubicon programme for new doctorates). Furthermore, more policy attention was paid to large-scale research facilities (e.g, thanks to the national roadmap for large research facilities).	It is a strength that more budget is allocated to support talented researchers in various stages of their careers. It helps to create an attractive climate for researchers. It does, however, not contribute to creating critical mass in prioritised areas. It may also limit the room for manoeuvre of universities. The national roadmap has created more clarity on the priorities for investment in large facilities. The roadmap is, however, not accompanied with structural long-term investment plans.
Innovation policy	Within the basic package, the fiscal incentive WBSO became more important, shifting the balance between generic and specific policy more towards generic policies. Within the programmatic package more alignment was sought between the modules for Innovation Programmes, the international programmatic instruments and regionally-oriented programmes. Societal challenges became more important in innovation policy, not only with the introduction of societal innovation programmes, but also in the innovation programmes, the SBIR programme and with the introduction of demand-driven funding of RTOs.	It is a strength that the costs of R&D for entrepreneurs are reduced with a easy-to-use scheme like the WBSO. It is, however, a generic scheme that does not contribute to creating critical mass in prioritised thematic areas. It is a strength that the thematic programmes for innovation, international entrepreneurship and regional strengths are aligned and streamlined. The announced budget cuts, however, create a threat for the effectiveness of the programmatic approach. It is a strength that ministries have collaborated in developing societal innovation agendas and societal innovation programmes. It is also a strength that the government uses its purchasing power to stimulate firms to develop new solutions for societal problems (via SBIR). The introduction of demand-driven funding of RTOs may increase economic and societal relevance of the strategic research of RTOs. The main weakness is that the budgets for innovation policy are significantly

		reduced, making is uncertain if ambitions can be reached.
Education policy	More policy attention for 'excellence' in higher education (e.g. via the Sirius programme), for reducing barriers in higher education with regard to S&T (e.g. via FES investments) and for entrepreneurship in education (e.g. via a special action programme).	It is a strength that the government has recognised that more differentiation between universities and courses is needed and that talented students need to be challenged and encouraged to do their very best. It is, however, only one step and more will need to be done to create an ambitious learning culture. Also the policy measures for S&T in education and for entrepreneurship in education are good initiatives that address real bottleneck in the Dutch knowledge system. Again, more will need to be done to create a learning environment that stimulates students to choose S&T and that fosters entrepreneurship.
Fiscal policy	In the corporate tax system, the patent box was changed in a (broader) innovation box. All profits from innovative activities are taxed under a lowered tariff (5%). Losses on innovative activities are deductable against the normal tariff (5.5%).	This Innovation Box helps to stimulate innovative activities of firms.
Entrepre-neurship policy	A noteworthy policy development was the programme growth accelerator which supports ambitious entrepreneurs in various areas such as strategy development, financing, marketing, innovation and internationalisation in order to enable them to increase their turnover to €20m in five years.	The Netherlands has relatively few fast growing innovative SMEs. Therefore, it is good that more attention is paid to this group of SMEs.

4.2 *ERA 2020 objectives - a summary*

The table below displays the main characteristics of the national measures/policies supporting the strategic ERA objectives in terms of main policy changes and an assessment of strengths and weaknesses of the Netherlands.

Table 9: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	**Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers**	No major changes, but more attention in policy for: • career opportunities of (young) researchers • training of postgraduates • women and minorities in senior positions in universities • entrepreneurship in	The (future) supply of human resources for research has improved, but is still not sufficiently high (given the ambition to be in the top 5 of knowledge economies in the world). Weaknesses in the Dutch labour market for researchers include insufficiently attractive career prospects, also to attract and retain talented researchers from abroad, and underrepresentation of female researchers are in senior positions in universities. It is a strength that the training of postgraduates is improved and the efforts have been made to improve career prospects of talented young

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
		education	researchers (e.g. via grants, tenure track)
2	**Increase public support for research**	The new cabinet (since Oct 2010) announced that the FES fund will no longer be used for strategic investments in the knowledge infrastructure and that budgets for innovation policy will be cut and subsidy schemes will be discontinued or replaced by guarantees and credit schemes (via a revolving fund).	GOVERD (% of GDP) is below EU27 average and decreased in 2004–2008, while HERD remained stable and above EU27 average. Although public investments in education, research and innovation were high on the political agenda, investments fell short of the ambitions. It is a weakness that the Netherlands does not succeed in mobilising more public support for research.
3	**Increase European coordination and integration of research funding**	No main changes since 2009. The Netherlands remains actively involved EU level coordination and collaboration initiatives.	It is a strength that the Netherlands is actively involved in COST, EUREKA, FP7, inter-governmental research infrastructures, ERA-NETs, Art.185 initiatives, JTIs and ETPs, joint programming initiatives, etc. It is also a strength that research programmes are increasingly opened up for researchers from abroad. Research funding is, however, not very well coordinated with research in the EU, and remains largely a national affair.
4	**Enhance research capacity across Europe**	More policy attention for postgraduate training, e.g. via pilot programme to stimulate introduction of aspects of American graduate school model.	It is a strength that postgraduate training has improved since the early 2000s. Although the position and career prospects of PhD candidates have been improved, the attractiveness of a career as researcher is not sufficiently high.
5	**Develop world-class research infrastructures (including e-infrastructures) and ensure access to them**	More policy attention for the importance of large research facilities. A national roadmap has been developed and budgets have been made available (although not on a structural basis).	The Netherlands has strengths in world-class large research facilities, but investments (e.g. in ESFRI) fall short of ambitions and are incidental rather than structural. It is a strength that the national research institutes (of NWO and KNAW) act as portals to international infrastructures.
6	**Strengthen research institutions, including notably universities**	Policy has created more room for individual researchers at the expense of the power of decision of universities (by transferring funds from the block grant to a competitive scheme)	Dutch universities have a good international position, but the level of differentiation is low. Although some progress has been made, it is a weakness that universities have not created more pronounced and recognisable research profiles by prioritising specific research areas. Universities are increasingly dependent upon project-based funding rather than institutional base funding, reducing their power of decision.
7	**Improve framework conditions for private investment in R&D**	One noteworthy policy change has been stronger attention for an entrepreneurial culture, also in education.	In general, the framework conditions are good. Specific points of attention are access to venture capital, a looming shortage of HRST and a culture that stimulates entrepreneurship and innovation.
8	**Promote public-**	The new cabinet (2010–	The level of interaction between SMEs and

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
	private cooperation and knowledge transfer	2014) announced substantial budget cuts for subsidies that stimulate public-private cooperation.	universities is relatively low (also because there are relatively few innovative SMEs). Therefore, it is a strength that the policy mix includes various instruments that stimulate public-private cooperation and knowledge transfer. 'Valorisation' of knowledge is explicitly recognised as part of the mission of universities and professionalisation of valorisation is increasing.
9	**Enhance knowledge circulation across Europe and beyond**	More policy attention for emerging economies in collaborative research programmes.	It is a strength that Dutch scientists tend to have a strong international orientation and that there are various programmes that stimulate international collaboration and mobility of researchers. It remains a weakness that the Netherlands is insufficiently attractive as a location for talented researchers and knowledge intensive firms from abroad.
10	**Strengthen international cooperation in S&T and the role and attractiveness of European research in the world**	Internationalisation and international collaboration remains one of the key elements in Dutch research policy.	The Netherlands actively (and successfully) participates in many international R&D programmes. It is a strength that international collaboration is perceived as vital for ensuring scientific excellence and for addressing societal challenges. More could be done, however, to strengthen the international profiles of Dutch universities and research institutes.
11	**Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle**	The interdepartmental Knowledge & Innovation programme department was discontinued in 2010. The new 'super ministry' of Economic Affairs, Agriculture and Innovation has been given more responsibilities in R&D and innovation policy.	Policy coordination within the knowledge triangle is a weakness. It has largely depended upon ad hoc initiatives (task forces, working groups, platforms). Coordination has, however, increased since the mid-2000s, partly due to interdepartmental initiatives. It is a strength that the Netherlands is actively involved in Joint Programming initiatives.
12	**Develop and sustain excellence and overall quality of European research**	More policy attention for 'excellence' in universities, e.g. via targeted programmes.	The Dutch research system performs very well in terms of productivity, impact scores and success rates in European programmes (e.g. FP7, ERC). The quality assurance system of public research organisations functions rather well. Special programmes stimulate talented researchers. The overall quality of the broad base in science is good, but is under threat because the budgets (block grant) are under pressure.
13	**Promote structural change and specialisation towards a more knowledge-intensive economy**	More policy attention for attracting R&D investments from abroad, also to help the Dutch economy become more R&D intensive.	The Netherlands has a relatively large services sector, which is not very R&D intensive. The Netherlands does not succeed in attracting more R&D-intensive companies from abroad. In the longer term, more investments in knowledge are needed to change the Netherlands' industry structure.
14	**Mobilise research to address major**	Societal innovation agendas and corresponding societal	It has been a weakness that a coherent and long-term agenda has been lacking. Since 2007, however, the Netherlands has

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
	societal challenges and contribute to sustainable development	innovation programmes have been developed. In addition, societal challenges have been linked to the existing innovation programmes in the key areas. Demand-oriented funding of PROs was introduced	developed strengths in developing interdepartmental societal innovation agendas and corresponding societal innovation programmes. In the Multi-annual Knowledge and Innovation Compass societal challenges are combined with economic and scientific strengths.
15	**Build mutual trust between science and society and strengthen scientific evidence for policy making**	Increased attention for 'research for policy', e.g. via 'knowledge chambers' within ministries where demand and supply of knowledge are aligned.	The Netherlands has a tradition in S&T communication, e.g. via science centres and websites (e.g. www.kennislink.nl) . There is an institutionalised evaluation culture to demonstrate effectiveness and to enhance accountability of public funding of R&D. Societal relevance usually is part of such exercises. A weakness is that evaluation results are not always fully used to implement changes. It is a strength that there are many public-private collaborations in R&D programmes and platforms / task forces that enable interaction between various stakeholders and help to build mutual trust. Ministries have increased efforts to better align research of RTOs with policy demands.

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List of Abbreviations

AWT	Advisory Council of Science and Technology Policy (*Adviesraad voor het Wetenschaps- en Technologiebeleid*)
BERD	Business Expenditures for Research and Development
CAO	Collective Labour Agreement (*Collectieve Arbeidsovereenkomst*)
CBS	Statistics Netherlands (*Centraal Bureau voor de Statistiek*)
CEKI	Committee on Economy, Knowledge and Innovation (*Commissie voor Economie, Kennis en Innovatie*)
EC	European Commission
ECOS	Research School Accreditation Committee (*Erkenningscommissie Onderzoekscholen*)
EL&I	Ministry of Economic Affairs, Agriculture and Innovation (*Ministerie van Economische Zaken, Landbouw en Innovatie*)
ERA	European Research Area
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ESF	European Science Foundation
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-27	European Union including 27 Member States
EZ	Ministry of Economic Affairs (*Ministerie van Economische Zaken*) – in October 2010 changed into Ministry of Economic Affairs, Agriculture and Innovation
FES	Economic Structure Enhancement Fund (*Fonds Economische Structuurversterking*)
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
HEI	Higher Education Institution
HERD	Higher Education Expenditure on R&D
HES	Higher Education Sector
HRST	Human Resources in Science and Technology
ICT	Information and Communication Technology
IP	Innovation Platform (*Innovatieplatform*)
K&I	Inderdepartemental "Knowledge & Innovation" programme department (*Interdepartementale programmadirectie Kennis en Innovatie*)
KIA	Knowledge Investment Agenda (*Kennis en Innovatie Agenda*)
KNAW	Royal Netherlands Academy of Arts and Sciences (*Koninklijke Nederlandse Akademie van Wetenschappen*)
LNV	Ministry of Agriculture, Nature and Food Quality (Ministerie van Landbouw, Natuur en Voedselkwaliteit) – in October 2010 changed into Ministry of

	Economic Affairs, Agriculture and Innovation
LTI	Large Technology Institute (*Groot Technologisch Instituut*)
NFIA	Netherands Foreign Investment Agency
NOWT	Netherlands Observatory of Science and Technology (*Nederlands Observatorium van Wetenschap en Technologie*)
NWO	Netherlands Organisation for Scientific Research (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek*)
OCW	Ministry of Education, Culture and Science (*Ministerie van Onderwijs, Cultuur en Wetenschap*)
OECD	Organisation for Economic Co-operation and Development
PIANOo	Public Procurement Expertise Centre (*Expertisecentrum Aanbesteden*)
PRO	Public Research Organisation
R&D	Research and Development
REKI	Council for Economy, Knowledge and Innovation (*Raad voor Economie, Kennis en Innovatie*)
RI	Research Infrastructure
RTDI	Research Technological Development and Innovation
RTO	Research and Technology Organisation
S&T	Science and Technology
S&E	Science and Engineering
SBIR	Small Business Innovation Research
SME	Small and Medium Sized Enterprise
TNO	Netherlands Organisation for Applied Research (*Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek*)
TTI	Leading Technology Institute (*Technologisch Topinstituut*)
VSNU	Association of Universities in the Netherlands (*Vereniging van Samenwerkende Nederlandse Universiteiten*)
WBSO	Research and Development (R&D) tax credit (*Wet Bevordering Speur- en Ontwikkelingswerk*)
WUR	Wageningen University and Research Centre

Annex: Expert appraisal (not to be published)

Analysis of the country situation and responses to the research-related items covered by the Commission assessments 2008 and 2009 progress reports on the implementation of the national reform programmes

The Commission recommended[74] that the Netherlands should develop further measures, including fostering labour market transitions within an integrated flexicurity approach, to improve the participation of women, older workers and disadvantaged groups with a view to raising overall hours worked. With regard to research, the Commission noted that there has been some progress made in improving the governance structures and putting in place a coherent strategy for R&D and innovation, as well as streamlining the innovation policy mix. It also noted that the challenge is to translate the long term R&D strategy into a set of coherent and effective policy measures to stimulate in particular private R&D expenditure.

In the Netherlands, a new cabinet took office in October 2010. At the time of writing this report, it is unclear what the precise policy plans will be for research and innovation. It is, however, clear that substantial budget cuts will be implemented, especially for innovation. Moreover, the FES fund will no longer be used as a source of investments in strategic (thematic) knowledge and innovation programmes.

Therefore, the challenge of translating the long term R&D strategy into a set of coherent and effective policy measures will be even more challenging. Indeed, it is unclear whether the long-term agenda will be used to guide investments. The Knowledge Investment Agenda (KIA) is not mentioned in the new coalition agreement. According to the KIA, an additional investment of at least €1.8b would be needed during the new cabinet period (2010–2014) in order to come in the top 5 of knowledge economies in the world. Instead, the new cabinet announced budget reductions, rather than additional investments, making it unlikely that the Netherlands will meet the top 5 ambition.

The creation of one large ministry for Economic Affairs, Agriculture and Innovation (EL&I) does offer opportunities for better coordination of innovation policy in the Netherlands. Innovation policy, its coordination and the desk for innovation funds will be concentrated at the Ministry of Economic Affairs, as will the funds currently available to the education and other ministries. At this time, it is still uncertain how this will develop and how it will improve the governance system. □

The coalition agreement of the cabinet (2010–2014) states that the funds available to strengthen the position of enterprises and entrepreneurs will be reviewed and access to them will be simplified. For instance, existing funds for export, innovation and international business will be combined to form a 'Homogeneous Budget for Economic Spearheads'. Grants will be awarded only in the case of proven

[74] European Commission, Implementation of the Lisbon Strategy Structural Reforms in the context of the European Economic Recovery Plan – Annual country assessments: Recommendation for a COUNCIL RECOMMENDATION on the 2009 up-date of the broad guidelines for the economic policies of the Member States and the Community and on the implementation of Member States' employment policies, COM(2009) 34 final, Volume I, Brussels, 28.1.2009.

effectiveness. This will lead to a retrenchment at NL Agency, because many subsidies will be discontinued. Grants will be reviewed, combined and simplified. The government expects that grant reductions will be compensated for by reducing the corporate tax burden and through the fiscal incentive WBSO.

Other initiatives that are announced include:

- Innovation grants will be awarded by means of a revolving fund so that successful innovations pay themselves back.
- The implementation of the WBSO will be broadened, as will that of the Innovation Performance Contracts and the Knowledge Workers Scheme.
- Greater priority will be given to knowledge valorisation in business, especially for SMEs.
- Central government's regional economic policy ("Peaks in the Delta") will be scrapped and decentralised. This will have serious consequences for the regional innovation programmes.
- Regional development organisations will be involved in regional economic planning.

It is clear that the budget for innovation policy is reduced significantly. The balance between generic and specific policy is shifted more towards generic (e.g. WBSO), which will not help to strengthen the international profile of the Netherlands and the capacity to attract foreign (EU) R&D funds, private R&D investments, and talented students and researchers.

Impacts of the recent financial and economic crisis

After the initial round of measures to combat the economic crisis (see annual report 2009), the new cabinet will focus on reducing the budget deficits and the public debt. No additional investments in R&D are foreseen. Indeed, public investments in R&D will probably decrease, also because the FES fund will no longer be used to strengthen the knowledge infrastructure. This is part of a broader approach in which many policy domains have to cut budgets.

Although innovation and the knowledge economy are important elements in the text of the new coalition agreement, R&D has apparently not been a budget priority. Instead, health care, security, immigration and integration, infrastructure and the quality of education have been prioritised. This is largely in line with the party programmes of the right-wing coalition partners.