Facts and figures: Public research institutes in the Netherlands

Jan van Steen

Content

Characterization of the public and semi-public research institutes

Research[1] is divided among four different sectors in the Netherlands. More than half of research and development is carried out by the business enterprise sector. The universities are the second sector. In addition, public research institutes perform a great deal of the research conducted in the Netherlands. Finally, there is a small sector of private non-profit institutes (PNP)[2].

This issue of *Facts and Figures* provides a summary of basic information on the public research institute sector. Together, these form a heterogeneous group of institutions with varying tasks and functions in the research system. They account for one third of public research and approximately fifteen percent of the total volume of research carried out in this country. Statistics Netherlands defines this group as governmental or semi-governmental institutions whose primary or secondary activity is R&D. Typical of these institutes is the fact that there is a governance relationship with one or more ministries; they receive a major proportion of their funding or research contracts from public sources and/or the government has a significant say in the way they are run. The private non-profit institutions are included in this group. The institute sector may be categorized as follows[3]:

(1) Institutes that are nearly exclusively involved in research;
(2) Government agencies involved in research as a major secondary activity (including planning offices);
(3) Healthcare and welfare institutions that carry out research as a major secondary activity, and
(4) Other institutions in the field of culture, public administration, advising/consulting, umbrella organizations and private non-profit funds that are engaged in research activities to a greater or lesser degree.

There are about 110 of these institutions throughout the country.[4] The first group represents about 80% of the entire sector in financial terms, and the second and third about 10% each. There are relatively few institutions in the last group.

The research carried out by the public research institutes ranges from basic to strategic and to applied, at a ratio of 25-25-50, respectively (Statistics Netherlands, 2005). In addition, some institutes are also engaged in other activities, including

1 In this issue of *Facts and Figures* the term 'research' is used interchangeably with the terms 'research and development' and 'R&D'.
2 In 2003 Statistics Netherland (CBS) merged PNP figures into the greater research institute sector due to the relatively small size of the PNP sector.
3 See the appendix for the Statistics Netherlands description of these four groups.
4 Speelman, 2006. This number is very close to the number of institutions included in Statistics Netherlands R&D data for 2006.

Rathenau Instituut

The **Rathenau Instituut** focuses on the influence of science and technology on our daily lives and maps its dynamics; through independent research and debate.

consultancy and other services. The size of the institutes varies greatly, from small to large. They are chiefly publicly funded (70 percent), but the variation between the institutes is also large in this respect. This issue of *Facts and Figures* classifies the organizations in the research institute sector as follows:[5]

- The institutes of the Netherlands Organisation for Scientific Research (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW), which are primarily engaged in basic research and conserving scientific collections;
- TNO (the Netherlands Organization for Applied Scientific Research), which focuses on applied research and making scientific knowledge available to private-market parties;
- The large technological institutes (GTIs), which carry out applied research and related activities;
- The agricultural research institutes;
- Institutes which are closely affiliated with government ministries and departments;
- Leading institutes (technological and social);
- Other institutes in the fields of the social and medical sciences.

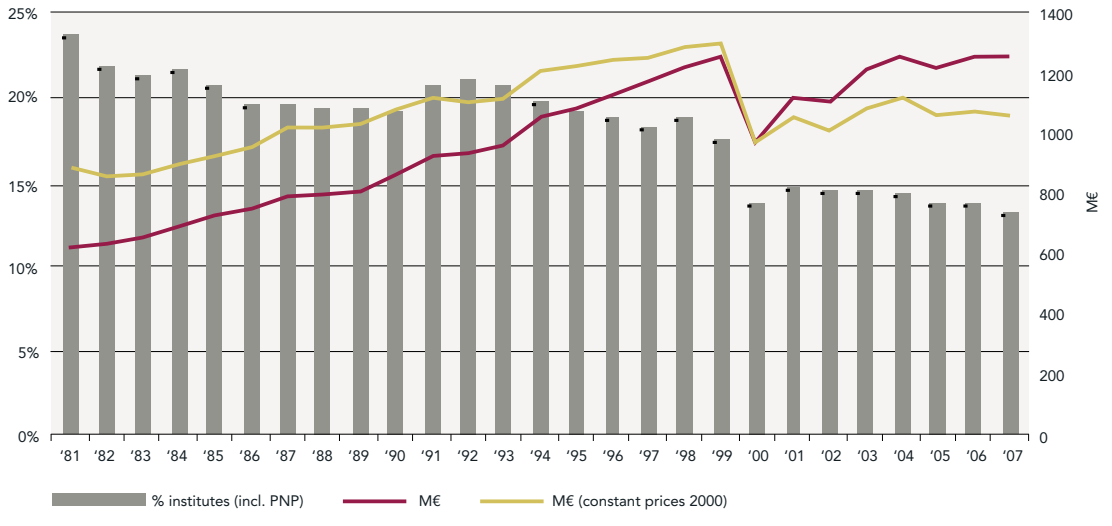
The debate is ongoing about the role of these institutes and the context in which they operate. From an international perspective, too, there is a need for greater understanding of the role of these institutes, in particular their role in processes related to innovation. The OECD, for example, started a project in 2008 to identify and map public research institutes with an aim to broadening the traditional concept of public management of research institutes to include new forms of governance.

The size and development of the research institute sector in the Netherlands

Input: funding

In 2007, funding for the research institute sector amounted to 1.260 million (1.26 billion) euros. This funding covered 13 percent of all research carried out in the Netherlands. In the entire public sector (public research institutes and universities combined) the institutes' share of funding is 33 percent.[6] We will now examine the development over time of the relative size of the research institute sector. Figure 1 shows the evolution of the sector starting in 1981, both in terms of the share of this sector as part of the national total and with regard to financial development. The share of the sector as part of all R&D in the Netherlands fluctuates around 20 percent for many years. Starting in 2000 it dipped below 15 percent. The main reason for the decline in 2000 onward is that some of the expenditures were transferred to the higher education sector[7]. This is indirect funding provided by NWO to the universities.[8] Actual spending increased in the years leading up to 1999. Following the disruption in the trend in 2000, expenditures began to rise again.

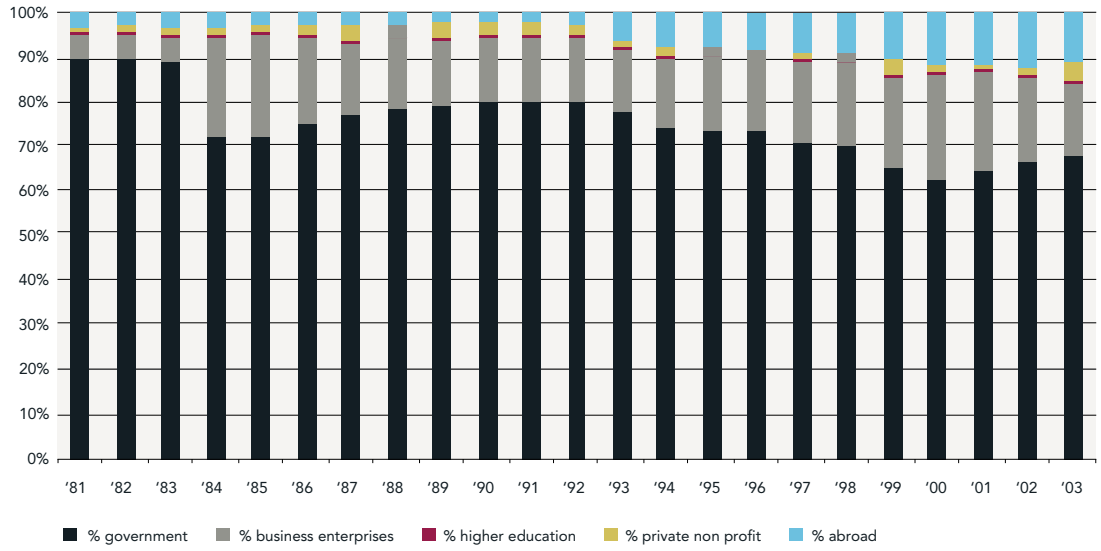
Figure 1 Development of the research institute sector in the Netherlands as a percentage of total, in M€ (at current and adjusted prices)



Source: OECD/MSTI (2008 / 2) based on Statistics Netherlands data

Who provides the funding for the research carried out at these institutes? Figure 2 shows that the government was the largest source of funding in 2003; nearly 70 percent of the total was derived from public sources.[9] Between 1984 and 1998 the government's share of funding even ranged between 70 and 80 percent. Later in this Facts and Figures we will see that there are significant differences in the proportion of public funding within the sector. These differences can partly be ascribed to the specific mission of the individual institutes. The share of funding derived from the business enterprise sector fluctuates. This share of funding was more than 20 percent in the mid 1980s, followed by a downturn and then an increase to 24 percent in 2000, followed by a decline to 16 percent in 2003. Funding of foreign origin increased from about 2 percent in the early 1990s to more than 10 percent (11.1 percent) in 2003.

Figure 2 Sources of funding in the research institute sector in the Netherlands as a percentage of total



Source: OECD/MSTI (2008 / 1) based on Statistics Netherlands data

Rathenau Instituut

The research institutes' fields of activity

A recent study (Speelman, 2006) includes an overview of the research and innovation activities in the institutions in the non-university research base. The report describes approximately 110 non-university institutes[10], with a turnover of € 2.7 billion in 2003 and approximately 27,400 man-years of work[11]. The institutes are grouped into twelve thematic clusters (Table 1). These clusters represent a broad distribution of research activities, and it is striking that the agriculture cluster is the largest in terms of man-years.

The turnover and man-years listed in Table 1 cover all activities of the public research institutes, and are not limited to research. These activities can include the provision of services and advisory tasks. On average, research accounts for approximately 45% of all activities. Expressed in man-years, this is about 58% of the total.

5 The Science Policy Advisory Council (RAWB) used this classification in its 1988 advisory report. The Ministry of Education, Culture and Science also uses this classification in its reports on research in the Netherlands.
6 The provisional Statistics Netherlands estimate for the university sector in 2007 is 2.566 million euros.
7 See Statistics Netherlands publication, *Kennis en economie 2002, Onderzoek en innovatie in Nederland* (Knowledge and the economy in 2002, Research and Innovation in the Netherlands), Voorburg / Heerlen, 2003, Annex B2, page 232.
8 The KNAW funding flow for universities may also be characterized as indirect funding, but KNAW funding for universities is rather small in comparison to NWO university funding (10 million versus 250 million euros).
9 Based on the most recent Statistics Netherlands data.
10 Speelman defines a non-university research institute as an organizational unit with its own administrative and/or organizational and/or financial identity and management.
11 The data in this study therefore differ from the Statistics Netherlands data.

Table 1 Characteristics of the semi-public research institutes

Cluster	Man-years 2003	Turnover 2003 (M€) *	Institutions involved 2005	Number of institutions 2005
Total	**Approx. 24,700****	**Approx. 2,710*****	**> 50**	**113**
Social structures and relationships	2,100	210	13	29
Exploration and exploitation of the earth	3,000	320	7	10
Control and care of the environment	500	50	2	2
Infrastructure and general planning of land-use	2,900	420	4	8
Protection and improvement of human health	3,900	420	16	23
Production, distribution and rational utilization of energy	2,600	300	5	5
Agricultural production and technology	4,200	410	5	14
Exploration and exploitation of space	1,020	90	2	5
Telecommunications and information systems	540	55	3	3
Transportation	1,780	195	5	7
Industrial production and technology	1,160	125	1	4
Defence	950	115	1	3

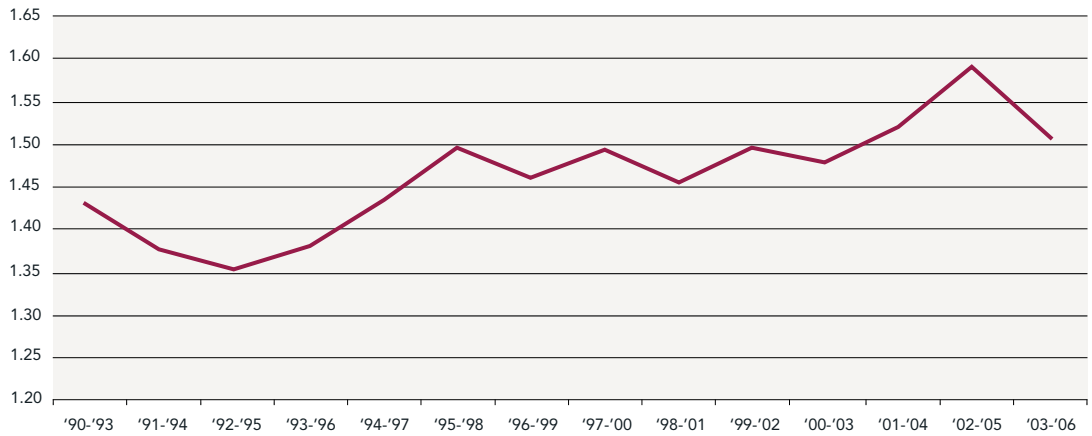
Source: Speelman (2006), p. 38 **Rathenau Instituut**

* Figures are subject to a degree of overlap due to outsourcing between institutes
** Of which 14,292 man-years for R&D (Statistics Netherlands)
*** Of which M€ 1,216 for R&D (Statistics Netherlands)

Output and impact

A portion of the output of the institutes, especially the institutes engaged in basic research, consists of scientific publications in international journals. From 1990 to 2006 this output remained at a fairly constant level: around 12 percent of the national total (Netherlands Observatory of Science and Technology NOWT, 2008). If we look at the scientific impact of these publications based on citations scores, we can ascertain a rising trend. The 2003-2006 average citation score is 1.51 (compared to 1.34 for the Netherlands as a whole). The development of these citation scores is shown in Figure 3.[12]

Figure 3 Citation impact of the research institute sector, 1990 – 2006 *



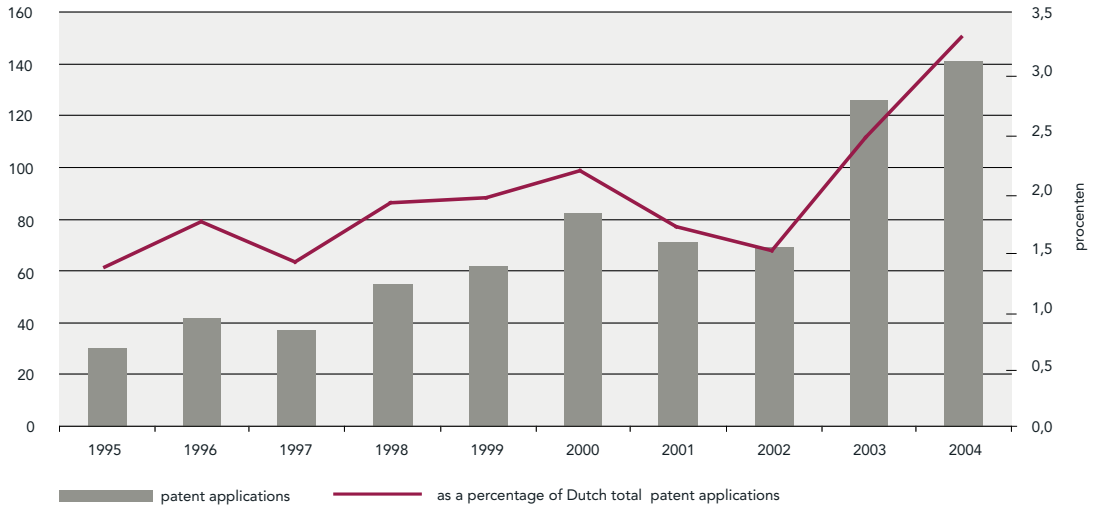
Source: CWTS / Thomson Scientific Web of Science database; data treatment: CWTS **Rathenau Instituut**
* Field-normalized citation impact score, world average = 1.0

The output of the institutes consists not only of scientific publications, but also of many other products, including patents. These are the result of the development of new products and processes that have

12 The fluctuations at the macro level, which can be rather acute, are mainly due to the (very) skewed distribution of actual citations in scientific publications; 80 percent of the citations appear in about 20 percent of the publications. Score fluctuations may be caused by one or more of these publications no longer falling within the citation window.

economic value and are then patented to protect against undue use by others. Most patents are secured by companies, but research institutes also make use of the opportunity to patent their research results, as shown in Figure 4.

Figure 4 European Patent Office patent applications by non-university public institutions



Source: NOWT 2008 (Figure 3.14); Policy Research Centre for R&D Indicators, University of Leuven.

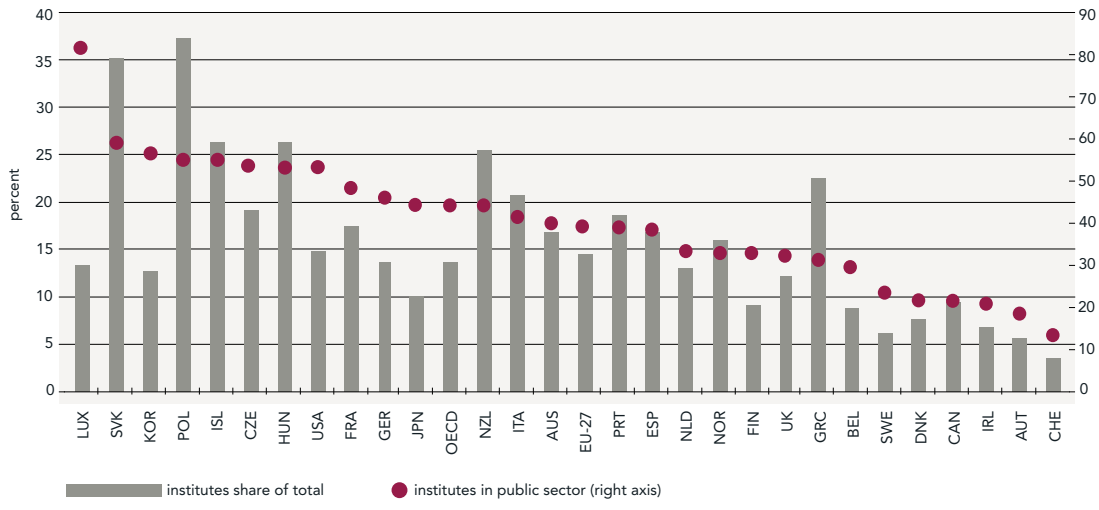
Rathenau Instituut

International comparison

The size of the research institute sector

The public aspect of the research system is structured differently country to country. This is often the result of historical developments. There is significant variance in the relative size of the higher education sector and the research institute sector. This is because the type of research conducted at institutes of higher education and at research institutes can be very similar, so that some activities in one country take place in the university sector, while the same or similar activities take place at public research institutes in other countries. One example is TNO. There is no organization like TNO in many countries outside of the Netherlands.

Figure 5 International comparison of the share of the institute sector in R&D expenditure, 2007 (percentage share of the national total, and the proportion within the public sector)



Source: OECD / MSTI (2008/2)

Rathenau Instituut

Figure 5 shows the proportion of the research institute sector, both in relation to the national total as well as compared to the entire public sector. In the OECD countries the average share of the research institute sector within the total R&D sector is 14 percent, but this proportion varies among the OECD countries, from 3.4 percent for Switzerland to 37.5 percent for Poland. The Netherlands has an average score: 13.0 percent. It is striking that many Eastern European countries have a relatively large research institute sector. The Russian academy model is the most likely explanation. In this model, research is carried out in academy institutes.
In the OECD countries, the public research institutes account for an average of 44 percent of public R&D. Higher education accounts for the remaining 56 percent. There is, however, great variation between countries: the institutes' share varies from 12.9 percent in Switzerland to 81.7 percent in Luxembourg. The figures for the Netherlands are 32.9 percent (institutes) and 67.1 percent (universities).

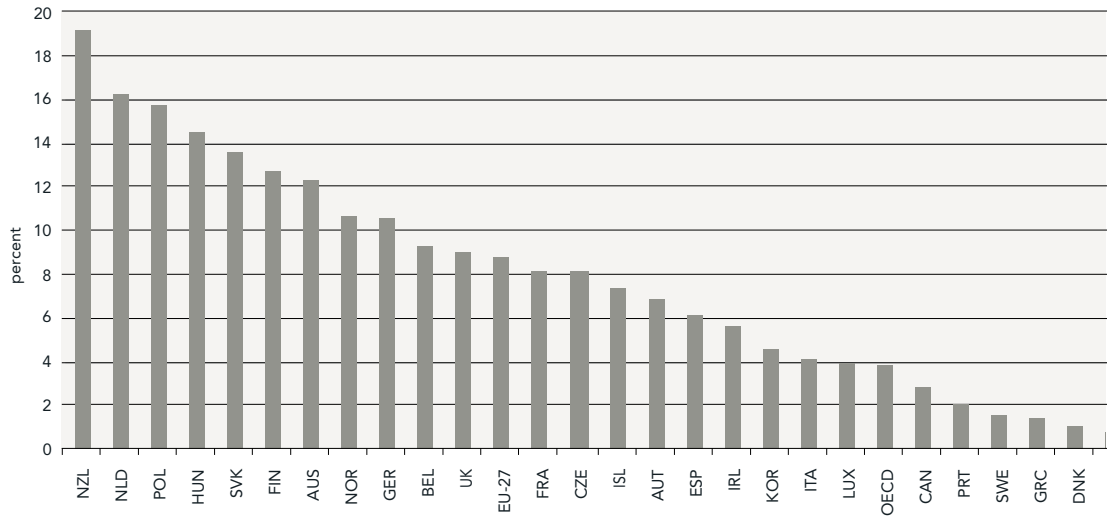
The relationship with business enterprises

The institutes carry out some of their research in the form of contract work for private parties. Research projects may be of interest to the business enterprise sector in other ways as well. Public research institutes, together with companies, are "the main engine for economic and social value creation and thus for the continuation and further development of prosperity and welfare for Dutch society" (Speelman, 2006, p17). On the other hand, they appear to have only a relatively limited impact on economic and social value creation. The innovation survey that Statistics Netherlands conducts on a regular basis (see Statistics Netherlands, 2006) highlights the importance of research institutes as a source of information for the activities of innovative companies. In addition to data on the Dutch research and innovation landscape, there is also data available on all EU member states (EUROSTAT: various editions of the publication *Statistics in Focus*). The information available is uniformly indicative of the following:

- knowledge from private sources is more important than knowledge from public sources, including non-university research institutes;
- universities are a more important source of information for innovative companies than non-university research institutes.

When compared with other countries, however, the Dutch institutes acquire a relatively high proportion of their funding from private companies (Figure 6). No other country in Europe has a higher proportion of privately funded R&D in this sector. The proportion in the Netherlands is 16.1 percent (2003), while the EU-27 average is 8.7 percent, and 3.7 percent for the OECD countries as a whole. With regard to the Dutch situation, it must be noted that that public research institutes' portfolio of contract funding is larger than that of the universities, not only in relative terms but also in absolute terms, while the universities conduct twice as much research.

Figure 6 The share of privately funded R&D at public research institutes, 2006



Source: OECD / MSTI (2008/2)

Rathenau Instituut

A detailed look at the institutes

Below is a description of the various categories of institutes as mentioned on page 2. They are described primarily on the basis of quantitative data. We will discuss staff size and expenditures at the various institutes. For the more scientifically oriented institutes, we will also specifically examine the scientific output and impact of that output. In the case of the more socially oriented institutes, we will focus our attention on the presence of different funding sources or other data to describe how the institutes fit in the social spectrum. We will also report on the relationship between the institutes (or their parent organizations) and the government.

NWO and the NWO institutes

The mission of the Netherlands Organisation for Scientific Research (NWO) is to improve the quality of research and to initiate and encourage new developments in the field of research. NWO also promotes knowledge transfer of the results of NWO-funded research for the benefit of society. To achieve this mission, NWO not only funds research activities at universities (indirect funding) but also at nine research institutes that are part of the NWO organization. These institutes are independent legal entities with their own managing boards. NWO works within a legal framework (the NWO Act of 7 July 1987, with subsequent amendments). NWO is part of the portfolio of the Minister of Education, Culture and Science. The chair and members of the Board of NWO are appointed by Royal Decree, which also applies to interim suspension or dismissal.
The Minister of Education, Culture and Science takes a stand on the institute's long-term strategy, decides on approval of the budget and annual accounts, and he can impose parameters on the structure of the budget, annual report and accounts. The regulations governing the organizational structure must also be approved by the Minister of Education, Culture and Science.

The NWO institutes have various tasks: 1) carrying out scientific research, 2) the management of major national research facilities and serving as a gateway to international facilities for Dutch research, 3) providing laboratories and other research-specific accommodations to researchers as part of this facilitating role and 4) developing new technology. The relationship between these tasks varies by institute.

The funding mechanism of the NWO institutes

The NWO research institutes secure their funding in a variety of ways. Their primary funding source is a basic grant from NWO to cover staffing and materials. The amount of this structural grant is based on a comprehensive review of the institute with regard to its performance, development potential and financial situation. There is also grant money available for maintenance and/or renovation of buildings and other infrastructure. NWO also occasionally awards additional non-recurring grants, which may be based on the results of evaluations or other factors. The institutes may also obtain funding by participating in NWO programmes (on a competitive basis, such as the *Vernieuwingsimpuls* programme), or acquire funds from third parties.

The institutes accounted for 23.5 percent of NWO turnover in 2007.[13] Since 2001, the level of expenditure of the NWO institutes has increased by 24 percent. This lags slightly behind the growth of total NWO expenditure (36 percent).[14] In this group of institutes, FOM is (and traditionally has been) the largest recipient of NWO; its share is 38 percent.

A major part of the output of the NWO institutes consists of publications in scientific journals with a referee system (in which the publications are peer reviewed). The institutes also produce many other types of products, which is indicative of the their social relevance and key role in knowledge transfer.

13 The universities receive more than half of NWO expenditure as indirect funding. In 2007 this was 54.0 percent of the NWO expenditures.
14 Expenditures for indirect funding increased in this period by 39 percent.

Table 2 Staff size and expenditures of the NWO institutes, 2007

NWO institutes	Staff (FTE)		Expenditure (M€)
	Total	% scientific staff	
Total	**1,659.2**	**55**	**124.3**
Institute for Astronomical Research in the Netherlands (ASTRON)	187.0	31	18.0
Centre for Mathematics and Computer Science (CWI)	208.0	76	16.2
FOM institutes	828.4	62	47.6
- Institute for Atomic and Molecular Physics AMOLF			
- Institute for Plasma Physics Rijnhuizen			
- Institute for Subatomic Physics NIKHEF			
Institute for Dutch History (ING)	42.9	54	3.2
Royal Netherlands Institute for Sea Research (NIOZ)	191.0	43	20.6
Netherlands Institute for the Study of Crime and Law Enforcement (NSCR)	18.5	77	1.5
SRON Netherlands Institute for Space Research	183.4	40	17.1

Source: NWO Annual Report 2007 and Social Annual Report 2007

Rathenau Instituut

Table 3 NWO institutes output

	2003	2004	2005	2006	2007
Publications (in refereed journals)	1,383	1,105	1,576	1,137	1,248
Other journal publications		212	511	355	281
Contributions to books	61	63	148	55	69
Monographs	22	29	98	36	27
Dissertations	40	49	64	49	56
Other professional products	829	933	1,843	870	946
Patents	4	6	8	3	7

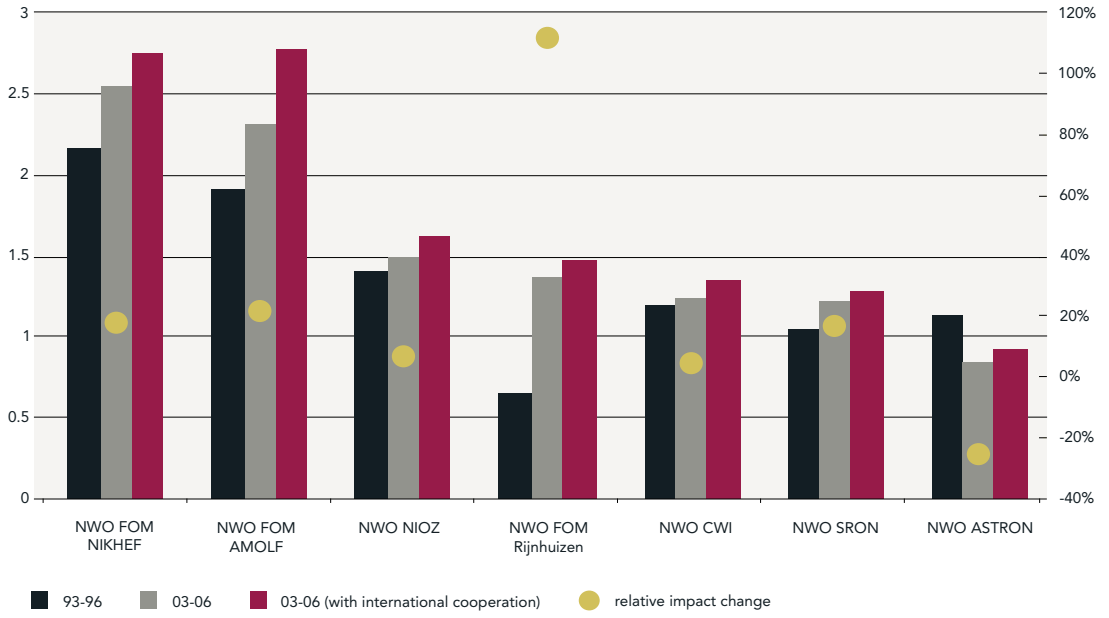
Source: NWO Year Books / Annual Reports from 2003

Rathenau Instituut

A major portion of the scientific publications by NWO institutes that is included in the Thomson Scientific Web of Science is the result of international academic cooperation. This ranges from 48 to 88 percent. International cooperation leads to higher citation scores compared to publications that are not the result of academic cooperation. The 2003-2006 citation impact of the NWO institutes was above the world average, except for ASTRON. This is also the only institute where the impact declined from 1993-1996. The citation cores of NIKHEF and AMOLF were high in the period 1993-1996, but they increased further in later years (Figure 7).

The NWO institutes, just as universities or research groups, are subject to a periodic external evaluation in accordance with the 'Standard Evaluation Protocol 2003-2009', which was established together with VSNU and the KNAW. Seven of the nine institutes (ASTRON, CWI, ING, NIOZ, NCSR, SRON and FOM-NIKHEF) were evaluated in the 2005-2007 period. The institutes received a rating from 'very good' to 'excellent'. In the case of NIKHEF this led to an additional injection of funding, both from FOM (structural funding of € 450,000) and from NWO (€ 450,000 for the period 2008-2010). Further information on the evaluations can be found on the NWO website (http://www.nwo.nl/nwohome.nsf/pages/NWOP_5SMHD3).

Figure 7 Citation impact of NWO institutes[15]



Source: NOWT 2008; World Average = 1.0 (left Y-axis), growth in percentage (right Y-axis)

Rathenau Instituut

The KNAW and the KNAW institutes

The Royal Netherlands Academy of Arts and Sciences (KNAW) considers itself to be a science forum and the conscience and voice of science in the Netherlands. Its mission is to improve the quality of science and to be an advocate for the interests of the scientific community. The KNAW endeavours to raise the standard of science in the Netherlands to achieve an optimal contribution to the cultural, social and economic development of society. The KNAW is an association of scientists in which current members choose new members. It is also an umbrella organization of 17 institutes in the field of the humanities, social sciences, life sciences and 'science and technology assessment'. The institutes conduct scientific research. They also collect and maintain scientific collections and make them available for use by others. The institutes provide services to the world of science and to society in general.

The institutes are divided into two clusters: the Humanities and Social Sciences cluster (HSS) and the Life Sciences cluster (LS). The focus of the HSS institutes lies in the field of history, social history, language and culture. The language, culture and history of the Netherlands are part of this focus, but the cluster also has an international orientation.

In addition, there are institutes that provide support to research activities in the field of the humanities and social sciences. These institutes form a bridge between science and society. The LS institutes focus on biological, biomedical and ecological sciences.

The KNAW and its associated institutes operate within a legal framework in accordance with the Higher Education and Research Act of 8 October 1992, with subsequent amendments. The Minister of Education, Culture and Science has responsibility for the KNAW. The minister is, however, not responsible for the nomination or approval of members of the Board. The Minister of Education, Culture and Science takes a stand on the institute's long-term strategy and receives the institute's budget and annual report (including annual accounts). He can impose parameters on the structure of the budget, annual report and accounts. The regulations for the organization and management structure are submitted to the Minister of Education, Culture and Science.

15 This applies to institutes with 100 or more scientific publications between 2003 and 2006.

The funding mechanism of the KNAW institutes

The KNAW institutes are funded as follows: the institutes generally receive the same basic budget as in the previous year within the total budgetary framework of the KNAW. The institutes receive no performance-related contributions from the KNAW. However, the KNAW does have an annual Strategy Fund of over 2 million euros for strategic innovations at the institutes. Both the institute directors and the KNAW Board may take initiatives that make use of Strategy Fund resources. In addition, the institutes acquire some revenue from activities contracted by third parties (both indirect and contract funding).

Table 4 Staff size and expenditures of the KNAW institutes, 2007

KNAW institutes	Field	Staff (FTE)	Budget (M €)
Total		**1,064.5**	**97.2**
Humanities and social sciences		*(425.1)*	*(37.6)*
Data Archiving & Networked Services (DANS)	Data archiving	20.7	3.3
Fryske Akademy	Frisian language, culture and history	45.1	1.6
Huygens Institute	Literature and history of science	30.1	2.5
International Institute of Social History (IISG)	Social and economic history	97.4	7.7
Royal Netherlands Institute of Southeast Asian and Caribbean Studies (KITLV)	Language, culture and history of Southeast Asia, the Pacific and the Caribbean	45.2	4.5
Meertens Institute	Dutch language and culture	51.5	3.5
Netherlands Institute for War Documentation (NIOD)	History of World War II	58.3	4.8
Netherlands Interuniversity Demographic Institute (NIDI)	Demographics	43.8	4.8
Netherlands Institute for Advanced Studies (NIAS)	Facilitator	14.6	2.7
Roosevelt Study Center (RSC)	History and culture of the United States and Dutch-American relations	9.0	0.4
Virtual Knowledge Studio (VKS)	E-science SSH	9.4	1.2
Life sciences		*(604.4)*	*(54.5)*
Fungal Biodiversity Centre (CBS)	Research on fungi, yeasts and bacteria	47.6	4.6
Hubrecht Institute	Developmental Biology and Stem-cell research	140.7	13.3
Interuniversity Cardiology Institute Netherlands (ICIN)	Cardiovascular System	83.1	6.6
Netherlands Institute of Ecology (NIOO)	Ecology and Biodiversity	192.1	15.6
Netherlands Institute for Neuroscience (NIN)	Neuroscience	140.9	14.5
Other		*(35.0)*	*(5.1)*
Rathenau Instituut	Science and Technology Assessment	35.0	5.1

Source: KNAW annual report 2007, and Ministry of Education, Culture and Science The Dutch science system. Institutional survey (June 2008)

Rathenau Instituut

1] Both staff employed by the KNAW and staff employed by external organizations, but working for the KNAW; includes both permanent and temporary staff.
2] Fryske Akademy and Roosevelt Study Center are KNAW-affiliated institutes. The KNAW's portion of their budget is shown here.
3] The Rathenau Instituut receives earmarked funding.
4] The budget reflects the KNAW's contribution and external income.
5] The Wadden Academy is a new institute that joined the Academy in mid-2008. The Wadden Academy is to become a centre of expertise on the Wadden region.

In contrast to NWO, virtually the entire KNAW budget goes to the KNAW institutes. This share was 87 percent in 2007, up from 70 percent in 1990. This increase was caused by the vigorous growth of the institutes' budgets during this period.

The bulk of results of scientific research conducted by the KNAW institutes is published in scientific

journals. The institutes also produce numerous contributions to books, monographs and other professional publications and products. The strong increase in the number of publications in peer-reviewed journals is striking.

Table 5 KNAW institutes output

	2004	2005	2006	2007
publications in refereed journals	660	755	798	1065
publications in other scientific journals	266	240	134	121
contributions to books *	239	427	406	553
Monographs	105	97	83	92
Dissertations	28	34	37	63
Other professional products and publications**	680	433	406	433

Source: KNAW annual reports and information provided by the KNAW office

Rathenau Instituut

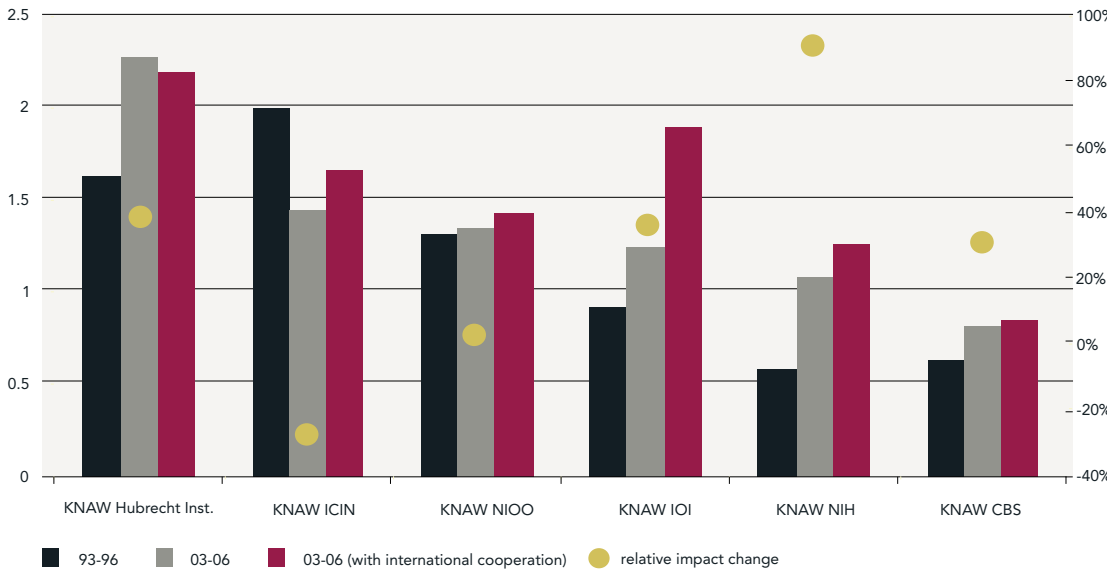
* these totals include edited volumes, conference proceedings and chapters in books, anthologies and proceedings.

** other = specialist publications / professional journals

Figure 8 shows the impact of the publications of the life science institutes.[16] The citation impact score varies per institute, and three of the six institutes score very high (> 1.50). The citation impact of CBS is the only one that is lower than the world average, but it is increasing. Although still high, the citation impact score of ICIN was the only of the KNAW institutes to decline between 1993-1996 and 2003-2006.

The KNAW institutes are also evaluated according to the Standard Evaluation Protocol 2003-2009 (SEP) of VSNU, NWO and the KNAW. The following institutes have been evaluated since 2003: NIDI (2008), Meertens Institute (2007), Huygens Institute (2007), ICIN (2006), NIOO (2006), KITLV (2006), RSC (2005), NIOD (2003) and IISG (2003). All documents relating to the evaluation (the self-evaluation, the evaluation report, comments from the KNAW Board), can be found on KNAW website (see: http://www.knaw.nl/organisatie/evaluatie.html). In general, the institutes and the research they

Figure 8 Citation impact of KNAW institutes[17]



Source: NOWT 2008; World Average = 1.0 (left Y-axis), growth in percent (right Y-axis)

Rathenau Instituut

16 The humanities institutes are not included in the graph because they publish only a small number of scientific articles in peer-reviewed journals and do not meet the threshold of 100 publications.

17 This applies to institutes with 100 or more scientific publications in 2003-2006.

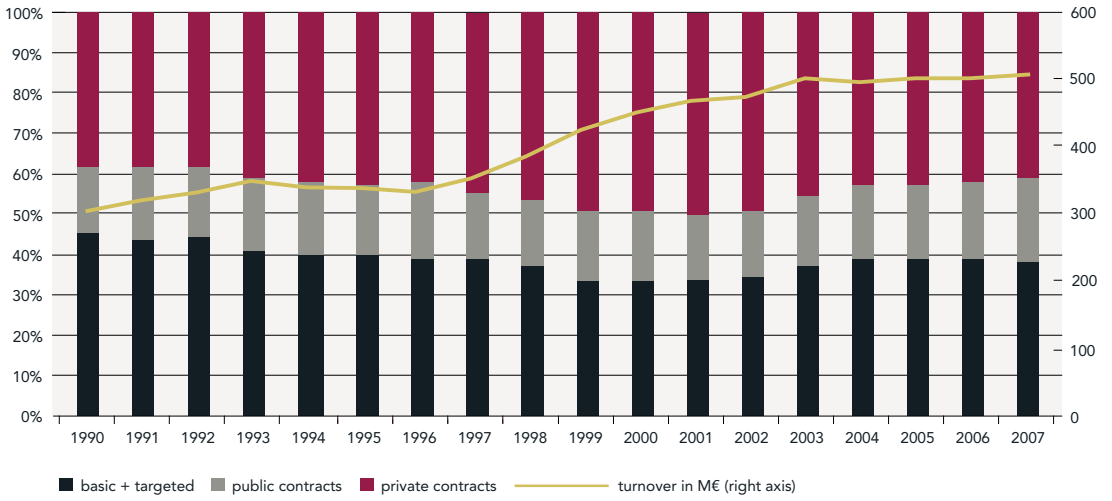
conduct are rated as 'very good' by the evaluation committees, and certain aspects receive a rating of 'excellent'.

TNO

TNO (the Netherlands Organization for Applied Scientific Research) was established in 1932. TNO focuses on the application of scientific knowledge with a view to strengthening the innovative capacity of business and government. Research in five core areas makes up about 75 percent of all TNO activities: quality of life (22.0%), defence and security (24.8%), industry and technology (25.6%), built environment and geosciences (19.6%) and information and communication technology (8.0%).[18]

TNO operates within a legal framework (the TNO Act of 19 December 1985, with subsequent amendments). The ministry responsible for TNO on behalf of the government is the Ministry of Education, Culture and Science. In addition, the Ministries of Defence, Economic Affairs, Housing, Spatial Planning and the Environment, Transport, Public Works and Water Management, Agriculture, Nature and Food Quality, Health, Welfare and Sport and Social Affairs and Employment are involved. The members of the Board of Directors and the Supervisory Board are appointed and dismissed by Royal Decree. This also applies to members of the Council for Defence Research. The position of the Minister of Education, Culture and Science on the defence-related aspects of the strategic plan of TNO must also be approved by the Minister of Defence. Just as in the case of NWO and the KNAW, he can impose parameters on the structure of the budget, annual report and accounts.

Figure 9 TNO revenue by source as a percentage of total and total (in M€)



Source: Ministry of Education, Culture and Science based on TNO data

Rathenau Instituut

Note 1: this data concerns the TNO organization, excluding group companies, with a turnover of around 80 million euros in 2007.

Note 2: starting in 2007 the basic funding has been known as 'knowledge as an asset' and the targeted funding has been known as 'policy and application-specific investments in knowledge'.

The TNO organization previously consisted of a number of institutes that were merged in 2005 into the five core areas as mentioned. Business units and centres of expertise (in 2007 there were 28 and 21, respectively) operate within these core areas. TNO works together with universities and businesses in the centres of expertise. Furthermore, a number of TNO's employees work as part-time professors at a number of universities. There are also TNO lecturers working in higher vocational education. The aim of this kind of collaboration is to strengthen the relationship between TNO and the SME sector, especially where innovation is concerned.

Several ministries contribute to the institutional funding of TNO activities in the form of basic funding

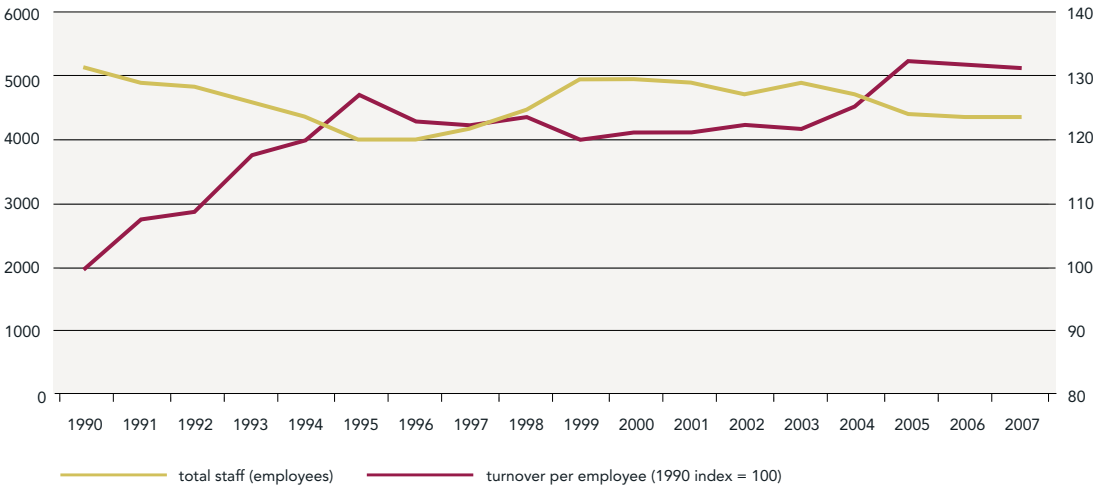
18 The figures in brackets shows the distribution of turnover for these 5 areas.

from the Ministry of Education, Culture and Science and targeted funding from a number of other ministries. In addition, TNO acquires a large share of its funding from the open market, both in the Netherlands and abroad. As a result of the Wijffels Committee report (2004), governmental funding has taken on the character of demand-driven funding and steering. This was formalized in 2007. This is known as 'knowledge as an asset' and 'policy and application-specific investments in knowledge' in TNO terminology. TNO develops research programmes that address overarching societal themes that are both worthwhile and relevant from policy point of view.

The mechanism of demand-driven funding and steering at TNO and the GTIs

Demand-driven steering means that government, business enterprises and civil society indicate the societal needs that call for new knowledge. This approach helps to synchronize the development of knowledge and the requirements of society. The demand for knowledge has been grouped into 12 themes and is further expressed in institutional programmes. Long-term knowledge-building is also a factor. A single government department is ultimately responsible for each theme, though a number of departments are involved in each case. There are also a number of research institutes involved in each theme. Starting in 2007 demand-driven funding and steering have gradually been replacing basic and targeted funding. This changeover should be completed in 2010.

Figure 10 TNO staff totals and turnover per employee



Source: Ministry of Education, Culture and Science based on TNO data

Rathenau Instituut

The revenue of TNO gradually began to increase starting in 1990, but stabilized starting in 2003 (thus producing a slight decrease in real terms). TNO's share of contracts increased in relative terms in the second half of the 1990s, only to decrease slightly thereafter. 41 percent of total turnover comes from private-sector contracts. Turnover per employee (Figure 10) increased by 30 percent between 1990 and 2005, particularly in the first half of the 1990s and in the period between 1999 and 2005. TNO applies its in-house expertise by participating in 50 group companies (in which TNO has an interest of more than 50 percent). In 2007, this led to a market turnover of around 80 million euros.

TNO's output of scientific publications is quite high: 1,962 publications in the period 2003-2006. Starting in 1990, the level fluctuated at around 500 publications annually. The impact of these publications is 16 percent above the world average (2003-2006). The impact increased by 9.3 percent compared to the period between 1993 and 1996. TNO regularly conducts so-called knowledge level audits to gain insight into the state of the art in particular areas of technology, such as the IT sector in 2007.

The Large Technological Institutes (GTIs)

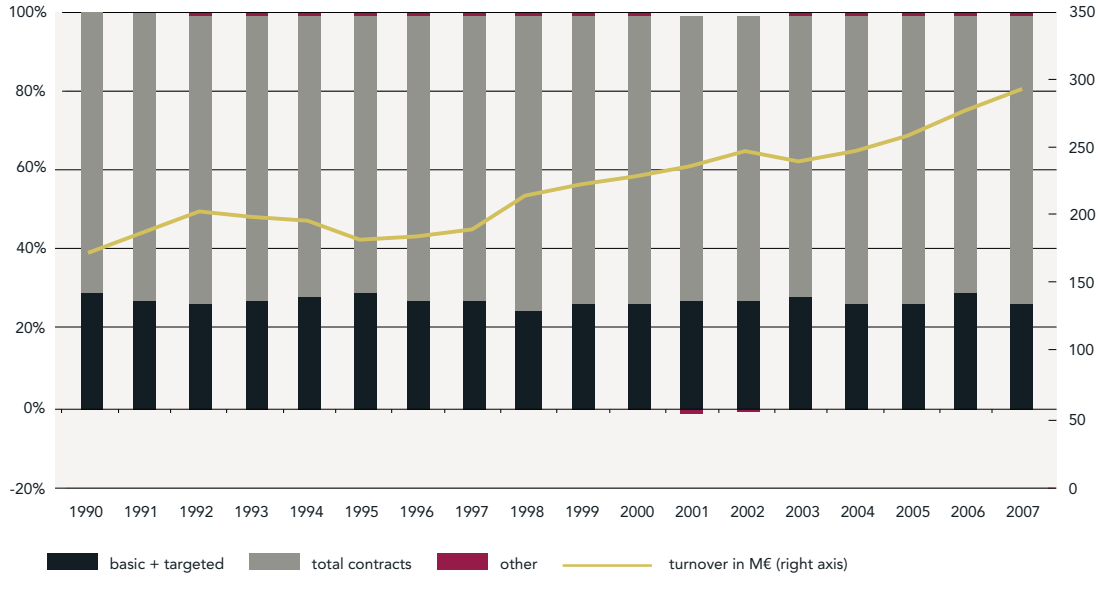
After a merger of a number of organizations in 2008 we now have four Large Technological Institutes (GTIs) in the Netherlands. They carry out applied research and related activities, including advisory tasks. Taken jointly, research accounts for about 60 percent of the budget of the GTIs. The GTIs are centres of technological expertise for companies and the government. They develop technologies that are made available to businesses and the public sector. The four GTIs are:

- *the Energy Research Centre of the Netherlands (ECN)*: conducts research in the field of nuclear energy and other forms of energy. ECN is the largest energy research centre in the Netherlands. It is located in the town of Petten, and has approximately 800 employees. The centre has been known as ECN since 1976. At its inception in 1955, it was called Reactorcentrum Nederland. At the time, it was solely involved in studying the application of nuclear energy.
- *Maritime Research Institute Netherlands (MARIN)*: conducts research into shipbuilding, offshore technology and oceanography. MARIN is one of the largest institutes in the world engaged in this type of research. It is located in Wageningen where it was founded in 1929 as the Nederlands Schip Model Bassin (NSMB).
- *Deltares* was established in January 2008 after a merger between GeoDelft (founded in 1934), WL|Hydraulics (founded in 1933), parts of TNO Built Environment and Geosciences and parts of the Directorate General for Public Works and Water Management (in the field of civil engineering, coastal and marine research and fresh water and waste water treatment). Deltares is a new, independent institute for applied research and specialist advice on water and geosciences.
- *National Aerospace Laboratory (NLR)*: is involved in the field of aerospace. NLR has been a foundation since 1937. It is an independent non-profit organization that provides high quality technological support to the entire aerospace sector. This sector includes industries, users of military and civilian aircraft, operators of airports, air traffic control agencies, governmental and international organizations.

The Ministry of Economic Affairs is responsible for ECN and MARIN. NLR and Deltares fall under the responsibility of the Ministry of Transport, Public Works and Water Management.

Part of the GTIs' revenue is derived from institutional funding by the government, yet a larger part is acquired on the open market (public and private). The share of contracts as part of total turnover is fairly constant and varies between 71 and 75 percent. The GTIs' total revenue increased between 1997 and 2007 in particular. Most of this increase can be ascribed to ECN. The funding structure of the GTIs is the same as that of TNO (see box on page 13).

Figure 11 GTI revenue by source



Source: Ministry of Education, Culture and Science based on data provided by GTIs

ECN has produced quite a few publications, even though this is not one of the primary objectives of the GTIs. These publications are of high quality and have an average citation impact score of 2.58. In other words, ECN publications score 158 percent above the world average.

Agricultural research institutes

The various agricultural research institutes are part of the DLO Foundation. This foundation was once part of the Ministry of Agriculture, Nature and Food Quality, but it was transformed into an independent administrative union in the mid-1990s. It now works together with Wageningen University in the Wageningen University and Research Centre. Van Hall Larenstein College is also part of this association.

The statutes and the grant scheme of the DLO Foundation govern the relationship between DLO and the Ministry of Agriculture, Nature and Food Quality. The Minister of Agriculture, Nature and Food Quality appoints the members and Chair of the Supervisory Board and is expected to approve the appointment of the Chair of the Board of Directors. The minister must also approve DLO's four-yearly strategic plan.

About half of DLO's entire budget is funded by the Ministry of Agriculture, Nature and Food Quality. Funding is directed towards four areas:

- fundamental research, which focuses on the medium-term needs of the Ministry of Agriculture, Nature and Food Quality, non-governmental organizations, other governmental agencies and Wageningen University
- research to support policy-making, focusing on current policy issues
- statutory research tasks, including research aimed at current policy issues and answering the requirements of legal frameworks
- other research projects

The remainder is derived from contract research (excluding the Ministry of Agriculture, Nature and Food Quality) and a limited number of additional sources of revenue. Table 6 provides an overview of revenue by source.

Table 6 DLO Foundation revenue by source

	2007	2006	2005	2004	2003
Total (M €)	**341.2**	**316.2**	**322.1**	**328.8**	**333.7**
Ministry of Agriculture, Nature and Food Quality - in accordance with grant scheme	171.4	162.4	161.1	161.1	162.9
Contract research, source:	112.1	106.9	111.2	119.0	125.2
- EU	18.0	16.3	13.3	12.9	14.8
- Government agencies (including Ministry of Agriculture)	36.4	34.2	34.6	33.6	35.3
- Commodity boards and industry	48.1	45.3	51.4	58.8	59.2
- Other	9.6	11.1	11.8	13.7	15.9
Patents and licences	3.8	4.3	7.6	16.0	10.0
Analyses and consulting	3.8	8.2	11.9	9.8	13.2
Other sources of income	49.9	34.3	30.3	22.8	22.4

Source: Wageningen University and Research Centre annual reports

Rathenau Instituut

The following research institutes are part of DLO:

- AFSG: Agrotechnology & Food Sciences Group
- Alterra: green living environment and its sustainable use
- ASG Livestock: Animal Sciences Group
- LEI: Agricultural Economics Research Institute
- PRI: Plant Research International
- PPO: Applied Plant Research
- Wageningen IMARES: Institute for Marine Resources & Ecosystem Studies
- ID Lelystad: Animal Sciences Group.

Total employment at the DLO institutes amounts to approximately 2,800 FTE.

Governmental Institutes

Some ministries run research institutes as part of the ministry. These institutes are involved in research to varying degrees:

- The Ministry of Justice has its own internal research institute, the Research and Documentation Centre (WODC). The WODC performs internal research in the field of justice and is also responsible for outsourcing research. In addition, the WODC provides advice and disseminates knowledge. The Netherlands Forensics Institute (NFI) is an agency of the Ministry of Justice. In addition to forensic research, the NFI is also involved in R&D and it is a centre of expertise. The research budget for both institutes is estimated at over € 20 million.
- There are a number of cultural institutes that are part of the Ministry of Education, Culture and Science that also conduct research. This includes the National Service for Archaeology, Cultural Landscape and Built Heritage (RACM), the Netherlands Institute for Cultural Heritage (ICN) and the Netherlands Institute for Art History (RKD). The research budget for these institutes is estimated at approximately € 10 million.
- The Ministry of Housing, Spatial Planning and the Environment may call on the Netherlands Environmental Assessment Agency (PBL). This agency is the result of a 2008 merger between the Spatial Planning Agency and the Natural Environment and Planning Agency. Its primary task is to pool relevant knowledge for policy-making and for conducting strategic policy analyses as needed in the areas of ecology, nature and the living environment. Although the agency reports to the Ministry of Housing, Spatial Planning and the Environment, other government departments may ask PBL to conduct research on their behalf. The agency's research budget is between € 30 and € 40 million.
- The Ministry of Transport, Public Works and Water Management has three internal institutes: 1) the Royal Netherlands Meteorological Institute (KNMI), which is a national agency for weather, climate and seismology. Its research budget is between € 10 and € 15 million; 2) four national services that are part of the Directorate General for Public Works and Water Management and that deal with issues of water, traffic & infrastructure, construction and IT & data management; and 3) the Netherlands Institute for Transport Policy Analysis (KiM) with a research budget of approximately € 4 million.
- The Ministry of Economic Affairs has two agencies whose primary task is not research, though they do conduct research for the ministry: Statistics Netherlands (CBS) and the Netherlands Bureau for Economic Policy Analysis (CPB). CPB has a budget of approximately € 13 million, part of which is spent on research. CBS conducts research only to a limited degree.
- Two institutes fall under the responsibility of the Ministry of Health, Welfare and Sport. The first is the National Institute for Public Health and the Environment (RIVM), whose budget is € 200 million. The second is the Social and Cultural Planning Office of the Netherlands (SCP), whose budget is € 8.5 million. Research is a key activity at both institutes.

Leading institutes

A new category of research institutes was developed in the late 1990s: the 'leading institutes'. These institutes are public – private partnerships. The first leading institutes were created in 1997: the Leading Technological Institutes (LTIs). They were established as virtual institutes to promote cooperation and collaboration between research institutes and business enterprises in areas of importance to the economy and society. The primary goals of the LTIs as indicated by the government are to promote scientific excellence in coherent fields of research and to engage companies in the application of new knowledge as it becomes available. An additional objective of the LTIs is to enhance the profile of Dutch R&D in the international context.[19] The Telematica Instituut has developed into a research institute in the classical sense, whereas the others are virtual institutes. The leading institutes also play a role in the distribution of funds among participating organizations.
The initial four leading institutes are active in the fields of nutrition, metals, polymers and telematics. The LTIs were originally funded by the Ministry of Economic Affairs[20], but government funding has become diversified with the addition of new LTIs. Funding for LTIs also comes from companies, universities and public research institutes. The four LTIs were evaluated in 2005 (Technopolis, 2005). The general conclusion was that each LTI had contributed in its own way to achieving the objectives,

19 See the letter from the Minister of Economic Affairs to the Lower House of Parliament dated 30 January 2006 on the Evaluation of the LTIs (OI/I/OI/6003548)

20 The Ministry of Economic Affairs' funding of the LTIs can be regarded as targeted funding: the funding is provided specifically for the implementation of research programmes on behalf of the ministry.

Table 19 Overview of Leading Technological Institutes

	Name	Field	Revenue 2007 (M €)
DPI	Dutch Polymer Institute	An association of a large number of companies and domestic and international research institutes that carries out long-term research into polymeric materials	17.4
M2i[21]	Materials innovation institute	Based on research groups at the universities in Delft, Eindhoven, Twente, Groningen and TNO-industry; carries out applied research to identify and use new opportunities presented by materials technology for business and society	16.0
TI	Telematica Instituut	An international network of companies, social institutions and research institutes; conducts research in the field of communications using the latest developments in the field of IT	19.4
TIFN	TI Food and Nutrition[22]	A partnership between four research institutes and private parties in the field of nutrition and health food	25.2
TI Pharma	Top Institute Pharma	A partnership consisting of academic and industrial research teams focusing on the development of medicines	12.8
CTMM	Center for Translational Molecular Medicine	A public-private partnership of universities, university medical centres, medical technology companies and chemical and pharmaceutical companies in the field of molecular medicine	(established in 2008)
TTIW	LTI Water technology	A group of research institutes and companies that conduct research into sustainable water treatment technologies	Approx. 7
TTI GG	LTI Green Genetics	A network of companies in the field of green genetics and institutes in the field of plant sciences. The central theme of the institute is 'innovative plants for sustainable flowers & food'	Not known
TI BMM	BioMedical Materials	A network of academic institutes (mainly university hospitals), private parties and charities in the field of biomedical materials	Not known

Source: Annual reports of the institutes (for revenue data).
For an overview of the LTIs and their websites, please see http://www.senternovem.nl/TTI/index.asp

Rathenau Instituut

but that they had not yet developed into the 'international centres of excellence' as originally proposed. After the 2005 evaluation, five new LTIs were established in the following fields: pharmacology, translational molecular medicine, green genetics, water technology and biomedical materials.
In addition to the institutes of technology, the Leading Social Institutes were established in 2006. These institutes focus on key social priorities. There are currently three such institutes. The total budget for all leading institutes now exceeds € 100 million.

Table 20 Overview of Leading Social Institutes

NICIS	Netherlands Institute for City Innovation Studies	A partnership of government, civil society organizations and universities in the field of research, knowledge sharing and training on urban research	6.3
NETSPAR	Network for Studies on Pensions, Aging and Retirement	Association of researchers and practitioners in the field of aging and pensions	6.0
HIIL	The Hague Institute for the Internationalization of the Law	Research into internationalization of national legal systems	1.9

Source: Annual reports of the institutes (for revenue data).
For an overview of the Leading Social Institutes and their websites, please see http://www.nwo.nl/nwohome.nsf/pages/NWOA_6ZZARV

Rathenau Instituut

The scientific performance of DPI and TIFN are high, particularly that of DPI which had a citation impact score of 2.0 in the period 2003-2006 (NOWT, 2008). The impact of TIFN is 1.36. The number of

21 Previously known as the Netherlands Institute for Metals Research (NIMR); M2i since February 2008.
22 Originally known as 'Wageningen Centre for Food Sciences' (WCFS).

scientific publications produced by the other institutes is below the threshold of 100 publications or they had not yet produced any scientific publications in the period 2003-2006.

Other institutes

Besides the institutes discussed above, there is yet another category: "other institutes". A number of these conduct research in field of the social and/or medical sciences. Examples include: NIVEL, NIGZ, NKI, the Clingendael Institute, the Verweij-Jonker Institute and the ASC. Please see the KNAW website for a complete overview: http://www.onderzoekinformatie.nl/nl/oi/nod/onderzoeksinstelling/.

Discussions on developments in the research institute sector

Van der Meulen (2008) concludes that the range of research institutes has not changed remarkably in the past 20 years. This conclusion is based on a comparison of the previously mentioned RAWB report on the missions of non-university research institutes in 1988 and the TNO report. However, it is difficult to map the changes in the structure of non-university research, because RAWB (1988) and TNO (Speelman, 2006) use slightly different categories to group the institutes. Furthermore, the RAWB report lists turnover in terms of research capacity, while Speelman reports on the total revenue of the institutes in question. If we examine the reports in greater detail a few things become apparent:

- a new category of institutes has come into existence, the leading technological and social institutes. The LTIs are primarily public-private partnerships;
- the number of DLO institutes has decreased significantly: from 34 institutes (including 9 test stations) to 9 institutes;
- TNO has adjusted its organizational structure by changing the institutes into business units and centres of expertise, which has served to enhance collaborative efforts and strengthen the relationship with universities and companies;
- the number of institutes that fell directly under the responsibility of ministries has declined since 1988. Some of these institutions now operate as NWO or KNAW institutes or have been transferred to a university.

The research institute sector is not only characterized by change but also by heterogeneity. It is not really appropriate to speak of 'the institutes' or their 'quality', because there are major differences between them in terms of tasks, objectives, organizational structure, organizational context and evaluation criteria.

- Some of the institutes are engaged in research activities that resemble university research. Unlike the universities they do not provide education, but they often have a significant secondary activity, such as conserving research collections or managing research infrastructure. The NWO and KNAW institutes fall into this category. Evaluations show that scientific quality is generally high.
  The distribution of roles and tasks among this group of institutes and universities is an interesting topic for discussion – even in an international context.
- Furthermore, there are the GTIs, TNO and DLO. These institutes fulfil an intermediary role between science, government and industry. The relative position of this group has strengthened in recent years. The key policy issues in this respect are the relationship with private investment in research and the internationalization of research and innovation. The TNO report on the public research infrastructure (Speelman, 2006) was meant to encourage administrative and organizational innovation. The reason behind it was that public research institutes, together with companies, are "the main engine for economic and social value creation and thus for the continuation and further development of prosperity and welfare for Dutch society" (p 17). On the other hand, they seem to have only a relatively limited impact on economic and social value creation. It seems that change is needed (once again). The data presented here reveal that Dutch institutes receive a much larger portion of their research funds from contract funding when compared to their fellow institutes in other countries. In this regard, they seem to play their innovative role with more finesse than has been suggested.
- A wide variety of governmental institutes conduct research to varying degrees. Their scientific performance and policy-related benefits are not always systematically evaluated.
- Finally, the leading institutes have been established in and among these groups. Their objectives are both purely scientific and aimed at valorization, and they are meant to promote cooperation and collaboration. They typically operate as a virtual research institutes and they are partly responsible for distributing research funds among the participating institutions.

Sources used

- CBS, Statline (http://statline.cbs.nl/statweb/)
- CBS (2005), *Kennis en economie. R&D-inspanningen in Nederland*, 2003, Voorburg/Heerlen
- CBS (2006), *Kennis en economie 2006. Onderzoek en innovatie in Nederland*, Voorburg/Heerlen
- KNAW, annual reports
- Meulen, Barend van der (2008), *Ecologie of infrastructuur. Positie en rol van para-universitaire onderzoeksinstituten in Nederland*. Achtergrondstudie voor de AWT, Twente
- NOWT (2008), *Wetenschaps- en Technologie- Indicatoren 2008*, NOWT, CWTS report (Leiden University) and UNU-MERIT for the Ministry of Education, Culture and Science
- NWO, annual reports
- Ministry of Education, Culture and Science (2008), *Het Nederlandse wetenschapssysteem. Institutioneel overzicht*
- OECD (2008), *Main Science and Technology Indicators (2008/2)*, Paris
- RAWB (1988), *Advies over het missiepatroon van de niet-universitaire onderzoekinstituten*, with appendix, The Hague
- Speelman, H. en S. Angelino (2006), *Vernieuwing van de publieke kennisinfrastructuur van Nederland. Eindrapportage inzake de niet-universitaire kennisinfrastructuur*, TNO
- Wikipedia for general information TNO and the GTIs (http://nl.wikipedia.org/wiki/Hoofdpagina)
- Veen, G. van der. e.a. (2005), Evaluation Leading Technological Institutes, Technopolis report for the Ministry of Economic Affairs Ministerie

Statistics Netherland definition of the research institute categories

Research institutes (R&D turnover 2006: M € 1,016)
These are primarily public and semi-public institutes with a governance relationship with various ministries. These institutes are engaged almost exclusively in research activities (e.g. TNO and the GTIs).

National services (R&D turnover 2006: M € 104)
These are the (specialized) services of ministries which conduct research as a major secondary activity.

Institutions for healthcare and welfare (R&D turnover 2006: M € 104)
These are institutes that carry out research in the field of healthcare and welfare as a (sometimes major) secondary activity.

Other institutes (R&D turnover 2006: M € 36)
These are institutes in the areas of culture and public administration on the one hand, and advisory bodies, umbrella organizations and foundations on the other. R&D of the various sub-categories of this Group is too small to merit separate study by Statistics Netherlands.

About this publication

This is the second issue of Facts and Figures, compiled by the Science System Assessment Department, Rathenau Instituut. The Science System Assessment Department is a national center for science studies and science policy studies.
This issue contains information on the wide variety of public research institutes in the Netherlands, focusing on the research activities carried out by these institutes. Other activities, such as general services and consulting, are not included in this report. The data, which are primarily quantitative, are presented in an international context wherever possible.
It is our hope that this information will be useful to anyone involved in research policy, administration or management.
For further information on this publication, please contact the author Jan van Steen (j.vansteen@rathenau.nl), or head of department professor Peter van den Besselaar (p.vandenbesselaar@rathenau.nl).

Rathenau Instituut
Postbus 93566
2509 CJ Den Haag
The Netherlands

This publication should be cited as follows:
Steen, J. van (2008), *Science System Assessment Facts and Figures 2: The public research institutes.*
The Hague, Rathenau Instituut.

Translation: Paul Rueckert