ICT, knowledge and the economy
2011
Explanation of symbols

. data not available
* provisional figure
** revised provisional figure
x publication prohibited (confidential figure)
– nil
– (between two figures) inclusive
0 (0.0) less than half of unit employed
a blank category not applicable
2010–2011 2010 to 2011 inclusive
2010/2011 average for the years 2010 up to and including 2011
2010/’11 cropyear, financial year, book year, school year etc., beginning in 2010
and terminating in 2011
2008/’09 book year etc., 2008/’09 up to and including 2010/’11
2010/’11 book year etc., 2010/’11
Detailed items in tables do not necessarily add to totals because of rounding.
Revised figures are not marked as such.

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For a knowledge economy like the Netherlands, research and education are determinative elements. ICT is an indispensable enabling factor in this regard. Investing in research and development (R&D) makes it possible to realise new products and processes and thereby achieve a competitive advantage over competing economies. National and international policymakers recognise the importance of knowledge. This is evidenced by, among other things, the “Europe 2020 strategy” of the European Commission and the “National Reform Programme” of the current Dutch government.

This book, *ICT, knowledge and the economy*, is a continuation of *The digital economy* and the *Kennis en economie* (*Knowledge and the economy*, not published in English) publication series, until recently both published separately every year by Statistics Netherlands. In this new publication series, Statistics Netherlands describes the Dutch knowledge economy through a focus on the pillars of R&D, innovation and ICT. This book casts light on ICT use by households and companies, telecommunications and R&D. In addition, education is discussed, in respect of which the focus is mainly on higher and technical education. The concluding part consists of special-subject contributions that deal in greater depth with matters addressed elsewhere in this publication.

The Netherlands continues to perform well with respect to ICT use. Broadband internet is common in Dutch companies and households. Seventy-two percent of large Dutch companies even used mobile broadband internet connections in 2009. The preconditions for an intensive knowledge economy are in place in this regard. The R&D expenditure of Dutch companies is under the EU average, however. In 2009, it amounted to 0.86 percent of GDP, whereas the EU average was 1.25 percent.

Cooperation with the Netherlands Organisation for Applied Scientific Research and financial support from the Ministry of Economic Affairs, Agriculture and Innovation has made it possible for this publication to provide information about the telecommunications infrastructure and make numerous international comparisons. During preparation, use was also made of information available from other organisations or research agencies. In addition to that provided by this publication, a great deal of information is available on the Statistics Netherlands website (www.cbs.nl/ICT-knowledge-economy).

G. van der Veen,
Director General of Statistics
Summary and conclusions

This publication contains an introductory chapter, five chapters based on statistical data and a concluding chapter that discusses a number of special subjects in greater depth. Based on the order of the chapters, this summary specifies the publication’s key findings in each subject area.

Introduction

In a knowledge economy, knowledge is invested in through research and education. By enabling the development of new products or processes, innovation makes it possible to secure a competitive advantage over other market players. Dutch government policy is strongly oriented towards achieving a competitive knowledge economy and making the Netherlands one of the leading European countries in this regard. This aim must be achieved by translating knowledge into new products and services on a larger scale. The rate of increase of R&D expenditure and ICT investments lagged behind economic growth in the past decade, however. The national target is for R&D expenditure to amount to 2.5 percent of GDP by 2020. Within the framework of the Europe 2020 strategy, the European Commission’s target is 3 percent of GDP in the EU. Key spearheads of Dutch knowledge policy are a focus on the innovative capacity of economically leading sectors and the further development of the broadband network.

This publication is based on a model in which knowledge development, flows and products are central. This model describes the roles of ICT, R&D, innovation and knowledge, as well as the roles of parties that are active in these areas, in the economy and society. Developments in the Netherlands are frequently compared with those in other countries. The publication series consists of an annually recurring core section on ICT and a rotating section on R&D and innovation. The chapters in this first edition deal with, respectively, the supply and use of telecommunications, ICT users (companies and households), R&D and people’s knowledge potential. The closing chapter discusses a number of specific subjects in greater depth. The publication also describes the interrelationships between the various domains discussed.

Telecommunications

The Netherlands has the highest penetration of high-speed internet connections in Europe. However, the number of optical fibre connections remains low in comparison
with the leading countries in this field of technology. The volume of internet traffic in the Netherlands is continuing to increase strongly. Smartphones and tablets are driving a tremendous increase in mobile data traffic. Mobile data traffic in the Netherlands increased tenfold in the first two quarters of 2010 relative to the same period in 2008.

The number of fixed IP telephony (VoIP) connections again increased strongly. At the beginning of 2010, the total number of IP telephony connections exceeded the combined total of ISDN and regular analogue (PSTN) telephone connections for the first time. Compared with other countries, the Netherlands has a high number of mobile telephone connections.

The number of digital television connections is continuing to increase. Digital television connections in the Netherlands totalled 5.3 million at the end of 2010, 16 percent more than a year earlier. The cable is the most common way of receiving digital television. Digital radio broadcast over the air is being encouraged by the Dutch government, since it provides the same advantages as digital television, namely a higher quality signal and the possibility of transmitting a greater number of broadcasters within the limited frequency spectrum.

To an increasing extent, television, telephony and internet services are being purchased as combined packages from the same provider and through a single network. The distinction between these services is becoming less pronounced, since television and telephony data, like other data, can be transmitted through the internet.

**ICT use by companies**

The intensity with which Dutch companies use ICT is continuing to increase. Over 90 percent of companies had a broadband internet connection in 2009. The corresponding figure for 2003 was 54 percent. Mobile broadband internet was used by over a quarter of Dutch companies. ICT diffusion did not occur very rapidly in the Netherlands, however. In general, this process was much faster in, for example, the Scandinavian countries. Nevertheless, the Netherlands has made tremendous advances in this regard and is now (2011) one of the countries with the best ICT infrastructure.

In 2009, 61 percent of employed individuals used a computer with internet access at work. The figure for the group of largest companies even exceeded 90 percent. This increase is more or less a doubling relative to 2002. The figure for the Netherlands in this regard is substantially higher than the EU average.

An intranet is relatively common among companies active in the area of “information and communications”. An intranet application was most common among companies in the “insurance” (79 percent), “telecommunications” (76 percent) and “IT and information services” (67 percent) sectors. An extranet is less common. Eighteen percent of companies had an extranet in 2009.
Over half of companies had software to record or process sales orders in 2009. Software to record purchase orders was used by 43 percent of companies. Twenty-one percent of all companies used ERP software. The manufacturing sector in particular made extensive use of ERP applications. CRM software is widely used in services sectors, since marketing is a key activity in these branches of industry. Twenty-five percent of companies used open source software in 2009, an average level relative to other European countries. Open source software in operating systems or on servers was used by 14 percent of Dutch companies.

One in five companies used an open source variant for office and business applications. Automated data exchange provides advantages in terms of efficiency and the standardisation of services and products. Almost all large companies apply this working method (92 percent). Although automated data exchange is used to a substantial extent by all branches of industry, its application depends on the specific characteristics of the branch of industry concerned.

The extent to which electronic sales occur depends very much on the sector in question. There are major differences between individual branches of industry. The percentage of sales achieved through electronic networks is highest in the “transport and storage” sector (22 percent), which also includes airlines. The “accommodation, food and beverages” sector achieved 15 percent of its sales by electronic means. Consumers have been booking accommodation and trips through the internet to an increasing extent in recent years. Electronic purchasing is more common among companies than electronic selling. Lower investment costs are a possible factor in this regard. Although the percentage of companies that engaged in electronic purchasing in the Netherlands in 2004 was lower than the EU average, the corresponding figure for 2009 was slightly higher than this average. The Netherlands was one of the leading countries in 2009 in terms of companies that engaged in electronic selling.

Dutch companies were affected by ICT security incidents relatively frequently in 2009 compared with companies in other European countries. Large companies are affected by ICT security incidents more frequently than small ones. Sectors that make extensive and advanced use of ICT, such as “information and communications” and “financial institutions” are also frequently affected by problems in the area of ICT security.

**ICT use by households and individuals**

ICT is now an integral part of life for virtually everyone in the Netherlands. Modern means of information and communication are becoming increasingly common in households and are also being used more and more intensively. Ninety-two percent of households had a desktop or laptop in 2010. In addition, there are virtually no households with a PC that is not connected to the internet. At 84 percent, the proportion of Dutch households with broadband internet in 2010 was the highest of all European countries. Internet use by means of mobile telephones is also increasing. Over one third of users (36 percent) had
access to the internet by means of mobile equipment in 2010. This constitutes a considerable increase relative to 2007, when the proportion was one fifth. A growing proportion of internet users are performing more internet activities in terms of number and variety. These activities are performed both at home and, to an increasing extent, outside the home. Eighty-four percent of users accessed the internet every day or almost every day in 2010. Communicating has been the most important internet activity of individuals for many years already. This remained the case in 2010. Virtually every user communicated through the internet in one way or another. Almost half of Dutch internet users made use of “active” social media like Facebook, Twitter and Hyves in 2010. Compared with their peers in other EU countries, young people in the Netherlands aged 16 up to and including 24 are among the most frequent users of social media. Over nine in ten young internet users actively engaged in social media. The internet is also extensively used to search for information and download games, music and images. Telebanking is one of the internet services that very quickly became an integral part of life. Over eight in ten internet users engaged in telebanking in 2010. In addition, 58 percent of all internet users visited government websites in 2010. This percentage has not changed significantly since 2006, however. Online shopping has become an important part of internet activities for many Dutch people. The proportion of frequent e-shoppers increased from 51 percent in 2009 to 55 percent in 2010. The Netherlands is one of the countries with the most e-shoppers in relative terms. Almost six in ten e-shoppers booked trips and holidays online in 2010. Other goods and services frequently purchased through the internet were clothing items, tickets for events and literature.

The increasing use of ICT also entails risks. Unwanted e-mail messages and viruses affect many internet users. Compared with other countries, computer viruses are rare in the Netherlands. Spam, on the other hand, is common. Many Dutch people are concerned about the abuse of personal data or other forms of privacy breach. On the whole, Dutch people are well aware of the dangers on the internet. Security software to protect PCs and personal data is very widely used in the Netherlands.

Research and development (R&D)

In 2009, 10.4 billion euros were spent on R&D in the Netherlands, slightly less than a year earlier. Viewed over a longer period of time, however, R&D expenditure is on an upward trend. Nevertheless, with an R&D intensity of 1.82 percent, the Netherlands is not a leading country in international terms. The Dutch government’s aim is to increase this intensity to 2.5 percent of GDP by 2020.

The business sector performed almost half of all R&D in the Netherlands in 2009 (47 percent). Institutions of higher education jointly accounted for 40 percent of R&D. The remaining proportion of R&D was performed by public research institutes. The
higher education sector is performing an increasing proportion of Dutch R&D. Eleven percent of Dutch R&D is financed from abroad. This percentage has not changed much in the past ten years. In 2009, 88,000 working years were spent on R&D in the Netherlands. Also in this case, almost half of the individuals engaged in this activity were company employees. The number of working years spent by companies on R&D decreased in 2008 and 2009, whereas the number of working years spent by the higher education sector on R&D continued to increase during this period. The number of working years spent on R&D in the Netherlands is average compared with other countries.

Following a period in which it was on an upward trend, R&D expenditure at companies fell by 10 percent in the period 2008–2009. The manufacturing sector’s share in R&D expenditure has decreased somewhat in recent years, whereas that of the services sector has increased. As was the case in 2008, the chemical, pharmaceutical, and electrical equipment industries and the machine and equipment industry accounted for the highest R&D expenditure in absolute terms. In 2009, large companies accounted for 72 percent of R&D expenditure, while this group of large companies constitutes only 13 percent of all R&D companies. In comparison with other countries, expenditure on R&D by companies in the Netherlands is relatively low. The R&D intensity of companies in the Netherlands was 0.86 percent in 2009, substantially lower than the EU average of 1.25 percent. Companies in the province of North Brabant accounted for the highest expenditure on R&D in 2009. Together, they spent 1.6 billion euros, approximately one third of the total R&D expenditure of companies in the Netherlands. This level of expenditure was nevertheless lower than two years earlier, when North Brabant accounted for 40 percent of R&D expenditure. The ICT sector’s R&D expenditure amounted to 629 million euros in 2009, which meant that this sector accounted for 12.8 percent of the total R&D expenditure of Dutch companies. The ICT services sector accounted for slightly over half of R&D expenditure, namely 361 million euros, in the ICT sector as a whole.

The public sector spent 5.5 billion euros on R&D in 2009. This amount is increasing each year. The public sector’s R&D expenditure exceeded that of the private sector in 2009 for the first time since 1993. Research institutes accounted for almost a quarter of total public R&D expenditure in 2009. At 76 percent, the higher education sector’s share in R&D expenditure was the largest. The number of R&D staff working in the public sector is also on an upward trend. In 2009, 45,500 FTEs were spent on R&D. The majority of these FTEs were spent by the higher education sector (75 percent) and a quarter by research institutes. At 333 euros per inhabitant, the Netherlands is one of the countries with the highest level of public expenditure on R&D in relative terms. On average, 175 euros per inhabitant were spent on R&D by EU countries in 2009.

In international terms, Dutch parties apply for a high number of patents. In 2006, Dutch parties applied for 375 patents from the European Patent Office (EPO) per billion euros spent on R&D. The EU-27 average was 261. A relatively small group of large companies
account for a large proportion of Dutch patent applications. The number of Dutch patent applications in the high-tech industry has fallen sharply since 2001, however.

Knowledge potential

The participation rate of young people in education has increased considerably since the 1990s. The number of senior general secondary education (havo) and pre-university education (vwo) graduates increased from 64,000 in 2003/'04 to 75,000 in 2008/'09. In addition, a relatively greater number of young people are successfully completing these highest forms of secondary education. Each year since 2003/'04, more examinations have been successfully completed in a natural science subject cluster than in a society one in both senior general secondary education and pre-university education.

With less than 6,000 graduates in 2009/'10, "ICT" is a less popular choice of study in senior secondary vocational education (mbo). In addition to “education”, “ICT” was the only field of study in senior secondary vocational education in which the number of graduates dropped. There were almost 1,000 more senior secondary vocational education ICT graduates in 2005/'06 than there were in 2009/'10. The decrease occurred mainly at the highest level of senior secondary vocational education.

The number of students enrolled in higher professional education programmes (hbo) has increased each year since 1995/'96. Approximately 417,000 students were enrolled in higher professional education programmes in 2010/'11. The corresponding figure for 1995/'96 was 271,000. The proportion of women increased in this period from 49 percent to 52 percent. Approximately 13 percent of higher professional education students are completing programmes in a natural science subject; almost 6 percent in the natural science subject cluster and almost 8 percent in the engineering subject cluster. The proportion of students in the natural science subject cluster has been increasing almost continuously. Following a drop, the number of higher professional education students is also on the rise again within the field of ICT.

The number of individuals enrolled in university education programmes (wo) has increased by 36 percent since the 1995/'96 academic year, from 178,000 to 242,000 in 2010/'11. An increase in the number of women attending university education accounts for most of this growth. The number of individuals enrolled in the “natural science, mathematics and computing” and “engineering, manufacturing and construction” subject clusters increased to 40,000 in 2010/'11. The number of ICT students within these clusters increased sharply until 2004/'05, after which it decreased for a number of years before stabilising at just over 6,000 from 2008/'09. In the coming years, the number of graduates will probably increase in the “engineering, manufacturing and construction” and “natural science and mathematics” (excluding ICT/computer science) subject clusters. Many people continue to participate in education after they have completed their initial study programme. The European Commission's aim for 2020 in this regard is to ensure
that 15 percent of the population aged 25 to 65 is participating in some form of education or training. The Dutch government is aiming to achieve a participation rate of 20 percent. With a participation rate of 17 percent in 2009, the Netherlands is just behind Europe’s leading countries.

There were over 33,000 mobile students in the Netherlands in 2008/09 (students who completed their prior education in another country). These mobile students, almost three quarters of whom were foreign, accounted for over 5 percent of all higher education students in the Netherlands in the academic year referred to. Approximately 14,000 Dutch people were enrolled at a foreign institution of higher education in the 2007/08 academic year.

The Dutch population’s average level of education has increased across the board in recent years. The proportion of individuals without a basic qualification (senior general secondary education/pre-university education or level 2 or higher of senior secondary vocational education) decreased in the period 2003–2010, while the proportion of individuals who had completed a higher education programme increased from 29 percent in 2003 to 35 percent in 2010. The Netherlands is just behind the leading countries in international terms with respect to the proportion of highly educated individuals. In comparison with other countries, the proportion of individuals who have graduated in a science subject is small in the Netherlands. There are more women than men in Dutch higher education and women also complete their respective study programmes more quickly.

The proportion of individuals in the Netherlands aged 25 to 65 with a paid job, irrespective of the number of hours worked, is fairly high in comparison with other EU countries. At 79 percent, the Netherlands had the second highest labour participation rate in 2009 according to the definition given in the preceding sentence. The average for the 27 EU countries was 71 percent.

The average proportion of human resources in science and technology (HRST) in the EU’s active labour force was 40 percent in 2009. The Netherlands had the third highest proportion, namely 51 percent. Thirty-seven percent of male members of the active labour force in the 27 EU countries were HRST. The corresponding figure for female members of the labour force was 44 percent. The difference between men and women was somewhat smaller in the Netherlands (49 percent and 54 percent respectively).

Almost 40 percent of Dutch computer users had many computer skills in 2010. Relative to 2006, the number of individuals who had average or many computer skills increased slightly from 69 percent to 74 percent. The Dutch population’s internet skills increased more strongly. In 2010, 60 percent of internet users had average or many internet skills, whereas the corresponding figure for 2006 was 46 percent. Age exhibits a strong correlation with internet skills. Eighty-five percent of individuals aged 12 to 25 had average or many internet skills in 2010. The contrast with individuals aged 65 to 74 is pronounced. Two thirds of this latter group had only a few or no internet skills and only 4 percent had many internet skills.
### Key indicators national, 2005–2010

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
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<td>Fixed telephone connections: PSTN</td>
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<td>Digital television connections: satellite</td>
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<td>0.8</td>
<td>0.9</td>
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<td>Digital television connections: cable</td>
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<td>1.0</td>
<td>1.6</td>
<td>2.0</td>
<td>2.5</td>
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<td>0.7</td>
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<td>1.6</td>
<td>2.4</td>
<td>2.9</td>
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<td><strong>% of companies</strong></td>
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<td>Companies with an internal network</td>
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<td>86</td>
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<td>Companies with access to the internet</td>
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<td>Electronic ordering of goods and services</td>
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<td>Electronic receipt of orders</td>
<td>27</td>
<td>28</td>
<td>31</td>
<td>25</td>
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<tr>
<td>PC ownership of households</td>
<td>83</td>
<td>84</td>
<td>86</td>
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<td>91</td>
<td>92</td>
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<tr>
<td>Internet access of households</td>
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<td>80</td>
<td>83</td>
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<td>Broadband access of households</td>
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<td>66</td>
<td>74</td>
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<td>Electronic shopping by individuals</td>
<td>55</td>
<td>61</td>
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<td>67</td>
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<td>R&amp;D expenditure</td>
<td>9,772</td>
<td>10,175</td>
<td>10,342</td>
<td>10,502</td>
<td>10,408</td>
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<td><strong>% of GDP</strong></td>
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<tr>
<td>R&amp;D intensity</td>
<td>1.90</td>
<td>1.88</td>
<td>1.81</td>
<td>1.76</td>
<td>1.82</td>
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<td><strong>x 1,000</strong></td>
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<td>Knowledge potential</td>
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<tr>
<td>Enrolled in higher professional education (hbo)</td>
<td>357</td>
<td>367</td>
<td>375</td>
<td>384</td>
<td>403</td>
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<td>Enrolled in university education (wo)</td>
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<td>Graduates of bachelor’s programmes in higher professional education (hbo)</td>
<td>59.5</td>
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<td>Graduates of master’s programmes at universities (wo)</td>
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<td>30.7</td>
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### Key indicators national, 2005–2010

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<th>2007</th>
<th>2008</th>
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<tr>
<td>Proportion of natural science subject students in first-year higher education⁸</td>
<td>15.1</td>
<td>14.9</td>
<td>14.9</td>
<td>15.2</td>
<td>15.3</td>
<td>15.2</td>
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<td>Proportion of ICT students in first-year higher education⁹</td>
<td>4.9</td>
<td>4.7</td>
<td>4.1</td>
<td>4.2</td>
<td>4.6</td>
<td>4.4</td>
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<td>Proportion of HRST in the labour force (aged 25–64)</td>
<td>49.3</td>
<td>48.1</td>
<td>49.8</td>
<td>50.5</td>
<td>50.9</td>
<td>.</td>
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</tbody>
</table>

Source: Statistics Netherlands; Netherlands Organisation for Applied Scientific Research (TNO) for the telecommunications infrastructure.

1) Number of ISDN connections. An ISDN connection can consist of two or more lines.
2) Companies with 10 or more employees.
3) Due to a change in method, the 2008 and 2009 figures are difficult to compare with those of previous years.
4) Private households consisting of at least one individual aged 12–74.
5) Of individuals with an internet connection.
6) R&D performed by a company’s or institution’s own staff.
7) R&D expenditure divided by GDP.
8) ISCED fields “science, mathematics and computing” (4) and “engineering, manufacturing and construction” (5).
9) ISCED 48: Computing.

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Source: Eurostat for European ICT patents applied for, highly educated individuals in the population, increase in the number of highly educated individuals and proportion of mobile students; Netherlands Organisation for Applied Scientific Research (TNO) for the telecommunications infrastructure; OECD for the proportion of science subject and ICT graduates in higher education and the proportion of HRST in the labour force.

1) Including ISDN and VoIP connections.
2) Excluding mobile connections.
3) Companies with 10 or more employees.
4) Electronic sales accounting for 1 percent or more of a company’s total sales (turnover).
5) Electronic purchases accounting for 1 percent or more of a company’s total purchases.
6) Individuals aged 16–74 who shopped online in the three months prior to the survey.
8) 2008 instead of 2009 for the EU-27.
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1.1 ICT, R&D and innovation policy framework
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1.2 Purpose of the publication

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   • ICT foundation, rotating section on R&D and innovation
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   • Knowledge and innovation model
The Dutch government is aiming to ensure that the Netherlands is among the top five most competitive knowledge economies by 2020. By that time, the Netherlands must be a European leader in terms of sales generated by companies through innovation. This aim is based on the idea that a competitive advantage over other market players can be secured through innovative capacity rather than price competition. Over the past decade, however, R&D expenditure and ICT investments lagged behind GDP growth in the Netherlands. The national target is for R&D expenditure to be 2.5 percent of GDP by 2020. This is lower than the EU target of 3 percent of GDP set within the framework of the Europe 2020 strategy.

This first edition of the ICT, knowledge and the economy publication series provides an overview of the developments and applications of knowledge in the Netherlands. Among other things, this chapter describes a model in which knowledge development, knowledge flows and knowledge products are central.

1.1 ICT, R&D and innovation policy framework

For affluent countries, knowledge is an important means to ensure continued economic growth. Gaining market share in existing markets through price competition is not a sustainable strategy. Innovation makes it possible to develop new products or processes and thereby secure a competitive advantage over other market players. Successful innovation has a higher chance of advancing in a properly functioning network of companies and knowledge institutes that invest in research and development (R&D) and are willing to cooperate to make innovations a reality (Statistics Netherlands, 2010a). In a knowledge economy, investments in knowledge are made through research and education. In addition, national and international companies, knowledge institutes, government authorities and intermediaries trade in knowledge. In part, this occurs directly through the purchase and sale of knowledge in the form of outsourcing R&D or investing in ICT, for example. It also takes place through the recruitment of what are referred to as “knowledge workers”, i.e. individuals who possess the required knowledge and skills. Furthermore, knowledge itself can be sold, for example through the granting of patents.

Knowledge flows that cannot be expressed in monetary terms and are therefore not directly measurable in that sense also occur. Examples in this regard include cross-border knowledge flows within multinational companies and the exchange of knowledge that takes place in cooperation projects. To continue achieving economic growth, the
knowledge available must ultimately be allocated in an optimal way. The following step is to translate this knowledge into innovations; that is, into new applications that can be marketed.

Innovations introduced into the market by entrepreneurs can lead to new branches of industry (Bos and Stam, 2011). New entrepreneurs can explore the potential of unprecedented economic activities through experimentation. Although the success of such experimentation is unpredictable, it can help to define the future economic structure, such as the emergence of internet providers in a technological sense and, in a non-technological one, low-cost air carriers in commercial aviation. In a process of creative destruction (Schumpeter, 1942), innovative newcomers give rise to new branches of industry that supplant old ones. From this perspective, new companies are of particular importance, as are, to a lesser extent, established large companies and independent workers without employees.

Towards open innovation

In the past decades, a step-by-step change occurred in the organisation of knowledge development. A shift took place in the allocation of tasks between large and small companies and between private and public organisations. This is also referred to as the “socialisation” of knowledge development. Large companies have, to an extent, hived off their R&D departments, which means that R&D is being taken over by suppliers or knowledge institutes. Innovation is increasingly taking place in networks of private and public parties. This “open innovation” is becoming increasingly integrated as an organisational form. Performing R&D activity in formal and informal networks creates a system for knowledge development and innovation that transcends the boundaries of companies and research institutes. If companies try to survive the recession by adjusting priorities, cutting costs and, in that context, reorganising R&D, this will have an impact on a sectoral, regional or national system for knowledge development (AWT, 2009).

The ICT, knowledge and the economy publication provides an overview of the development and application of knowledge in the Netherlands. Descriptions are based on subjects like people’s knowledge potential, the modernisation of knowledge (R&D), the application of technology (such as ICT) and innovation. The present introduction outlines the interrelationships between these subjects and therefore serves as a reader’s guide to the publication.

European policy: Europe 2020 strategy

The position of the Netherlands in the world as a knowledge economy cannot be determined unequivocally. For many years already, the Netherlands has been among the
top countries in a broad range of international “ICT league tables”, especially with respect to ICT infrastructure. At the same time, however, the Netherlands is lagging behind a number of other countries both within and outside Europe in terms of R&D and innovation. In 2010 almost 35 percent of the working labour force was highly qualified but, from an international perspective, growth in the number of students pursuing qualifications in science subjects remained limited. This section briefly summarises the government’s key knowledge-related targets on European and national levels.

The European Commission launched the “Europe 2020 strategy” in March 2010 (European Commission, 2010). According to this strategy, the European Union (EU) must, in addition to being a political and economic union, also be an innovative one by 2020. The European Commission believes that innovation will increase Europe’s competitiveness. The 2020 target is for 3 percent of the EU’s GDP to be invested in R&D. The purpose of the “innovation union” is to improve preconditions and access to funding for research and innovation so that innovative ideas are converted more quickly into products and services that drive growth and create jobs. To this end, the European Commission is working to improve links between systems for research and innovation within the EU, foster top universities of international repute, lower thresholds for entrepreneurs and intensify cooperation between science and the business sector.

National policy

Prime Minister Mark Rutte’s Cabinet formulated national-level commitments concerning the main objectives of the Europe 2020 strategy in its National Reform Programme. The Dutch government wants more knowledge to be converted into new products and services. Although the European Commission’s target is 3 percent for Europe, the Dutch government’s target is for 2.5 percent of the nation’s GDP to be invested in R&D by 2020 (Ministry of Economic Affairs, Agriculture and Innovation, 2011a). The government is calling on universities and research institutes to provide greater encouragement to researchers to undertake valorisation-related work and reward them for such work. Valorisation is the process through which knowledge is converted into commercially feasible products, processes or services. By means of a “top sector approach”, the Dutch government will work together with companies and knowledge institutes to strengthen economic activities that are currently or potentially competitive. A common knowledge and research agenda is being prepared for each “top sector”, such as energy, high-tech materials and systems, the agro-food industry, the creative industries and life sciences (Ministry of Economic Affairs, Agriculture and Innovation, 2011b).

As regards ICT, the central government considers the supply of a fixed and mobile telecom network with sufficient capacity and an adequate ICT knowledge infrastructure as being of importance to a good business environment. The government will auction additional
mobile frequencies in 2012 to accommodate the increasing use of mobile internet. Special space will be reserved during this auction for new market players. The current frequencies for mobile phones will also be re-auctioned in 2013.

**Government: R&D expenditure**

2.5 percent of GDP by 2020

The central government drew up the “Knowledge Investment Agenda 2006-2016” (KIA) at an earlier stage (Innovation Platform 2006; Dutch House of Representatives, 2009; Ministry of Education, Culture and Science, 2009). According to this agenda, the knowledge and creativity of people in the Netherlands will determine the country’s future. In addition to an investment plan, which will mean up to as much as an additional 12 billion euro of public and private structural knowledge investments each year, the agenda also sets out three targets:

- To have a labour force that is as highly educated as possible. It must be possible for everyone to discover, develop and use their individual talents;
- To become and remain a world leader in a number of key scientific areas and to make better use of knowledge;
- To ensure that the Netherlands is among the top five of the world’s most competitive knowledge economies and a European leader in terms of sales generated by companies through innovation.

Based on an assessment, it was concluded in 2010 that the targets specified in the Knowledge Investment Agenda were probably not feasible in practice. Not enough is being invested in education, research and innovation for the purpose. Existing companies do not innovate enough and an insufficient number of new, innovative companies are being formed (KIA, 2010a). In a revised version of the Knowledge Investment Agenda, the government makes the target of becoming one of the five best performing knowledge and innovation countries measurable. By 2020, Dutch public expenditure on knowledge and innovation must be such that it amounts to between 4.5 and 6 billion euro of structural, additional investments each year in real terms and in addition to the growth already anticipated (2010 price level). In that period, private investments must structurally have increased by between 2.5 and 4.5 billion euro (KIA, 2010b).

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1) According to the Knowledge Investment Agenda 2006–2016, the Netherlands is characterised by low public and private investments in knowledge. Depending on the calculations used, the Netherlands invests approximately 12 billion euro a year less than Europe’s top three investors.
Increase in R&D and ICT expenditure lagged behind GDP growth

The recent economic crisis adversely affected many facets of the Dutch economy. The steady growth of the preceding ten years ended in 2009. In that year, GDP fell by around 4 percent relative to 2008, and a sharp drop occurred in investments, while inflation gradually increased. To enable a proper assessment of trends in R&D expenditure and ICT investments in the past decade, the development of these knowledge indicators are compared with a few core economic variables in figure 1.1.1.

1.1.1 R&D expenditure and ICT investment in an economic perspective, 2000–2009

Over the last three years (2007–2009), the increase in total R&D expenditure clearly lagged behind GDP growth. The business sector’s R&D expenditure increased by an average of 2.5 percent a year in the period 2000–2009, whereas GDP grew by an average of 3.5 percent a year. This partly explains the decrease in R&D intensity. Both GDP in particular and R&D expenditure dropped in 2009 relative to 2008. ICT investments peaked around 2000, though contraction set in quickly following the end of the internet hype on the financial markets. These investments have been on the rise since 2004, however. In 2007 they exceeded the level of 2000 for the first time since hitting the low point. This growth was driven by substantially increased investments in software (Statistics Netherlands, 2009).
The fact that R&D expenditure and ICT investments lagged behind GDP growth from 2000 until and including 2009 is somewhat worrying, since both are variables that, as an indication of business confidence, partly determine future economic growth. It is also important, however, for the growth rate of R&D expenditure and investments to at least exceed the rate of inflation and, with the exception of 2002, this was indeed the case with respect to R&D expenditure. Investments respond to economic growth with a delay. Investments only exceeded the rate of inflation from 2006 until and including 2008, a period in which the economy had been manifesting an upward trend for some time already.

A qualification must be made with respect to interpreting figure 1.1.1, however. Although R&D expenditure and ICT investments do indeed tell us something about the quantity of R&D performed and the importance of ICT as a factor of production, they do not in themselves provide a good indication regarding the quality of the knowledge infrastructure, since this infrastructure depends on many factors, such as, for example, the degree to and way in which the business sector, government, institutes and universities cooperate. Greater R&D or ICT activity does not automatically mean more innovation.
1.2 Purpose of the publication

This publication describes the roles of ICT, R&D, innovation and knowledge in the economy and society. Developments in the Netherlands are frequently compared with those in other countries. This publication is the product of the merger of *The digital economy* and *Kennis en economie* (*Knowledge and the economy*, only published in Dutch) publication series. As the first edition of an annual series, the present publication was prepared in cooperation with the Netherlands Organisation for Applied Scientific Research (TNO) and with support from the Ministry of Economic Affairs, Agriculture and Innovation.

*ICT, knowledge and the economy* is descriptive in nature. As regards its structure, the guideline for this publication is the availability of official statistics, retention of the main themes of the aforementioned original publication series and description of the interfaces between ICT, R&D and innovation. This publication provides background information, knowledge and assessment frameworks for a broad target group of policymakers, researchers and those engaged in the business sector. For this reason, the publication aims to present a broad overview of available figures and show the interrelationships between the subjects described.

The terms and statistical data contained in this publication are largely determined in consultation with other statistical agencies in the European Union. Eurostat, the statistical office of the European Commission, plays a harmonising role in this regard, which makes it possible to accurately gauge Dutch performance relative to other European countries. This comparison is therefore frequently made.

In addition, the publication remains in keeping with definitions and classifications of the Organisation for Economic Cooperation and Development (OECD), which also makes it possible to compare figures concerning the Netherlands with those of non-European countries.

A section of the Statistics Netherlands website (www.cbs.nl/ict-knowledge-economy) contains a number of publications that augment this one. One of these documents is a statistical annex that, arranged according to chapter, contains a few tables that provide more detailed information. The website also contains a number of additional articles that deal with specific aspects of ICT and R&D.

1.3 Structure of the publication

The importance of ICT in the world economy is increasing at a rapid rate, while innovation is a key factor in the development of new economic activities. To be able to continue
applying the latest technologies – or, put more broadly, compete with other economies on
the basis of knowledge – the Netherlands must meet requirements applicable to the
knowledge and skills of its labour force. A current picture of the Dutch knowledge
economy is crucial in this regard. This new publication comprises a core section on ICT
that remains a feature each year and a rotating section on R&D and innovation.

**ICT foundation, rotating section on R&D and innovation**

The themes “ICT use by companies”, “ICT use by households and individuals” and
“telecommunication” constitute the core of the ICT subject in this publication. Figures on
ICT use by households and companies are taken from official, European harmonised
annual statistics. Telecommunication concerns a cooperative arrangement with TNO. The
ICT infrastructure described in the chapter on telecommunication is a necessary condition
for ICT use. These ICT-related subjects will feature each year in this publication series.
The section of the publication that deals with R&D and innovation will change each year
in connection with the availability of statistics. In terms of content, this new publication
series therefore follows a two-yearly cycle. The cycle of the innovation survey is particularly
determinative in this regard. Every two years, the Community Innovation Survey (CIS) is
carried out in a harmonised way in all EU Member States. The results of this survey will be
presented in this publication as soon as they become available. This means that, starting
from 2012, the subject of innovation will be comprehensively discussed in this publication
series in even years, whereas in odd years, starting from this first edition, R&D will be at
the forefront due to the availability of the R&D survey results. Since the R&D survey is
carried out each year, the subject will also be briefly discussed in even years so that it
remains an annual feature.

In addition to the subjects referred to, attention will also be paid each year to the level of
knowledge potential in the Netherlands, as was the case in the former Kennis en economie
publication series. The rotation of subjects described will result in a publication series in
which the emphasis will be on knowledge and knowledge development in odd years and
on technology and application in even years.

**Interrelatedness of ICT, R&D and innovation**

The new publication series will not be restricted to mere descriptions of themes previously
discussed in the former, separate ones. Rather, it will also explain the interrelationships
between these domains. The interfaces between ICT, R&D and innovation will feature
prominently. This will manifest itself in a specific focus on ICT in sections dealing with
patents and R&D on the one hand and, on the other, on the ICT use of R&D-intensive sectors
within the ICT theme. The contents of the chapters are briefly described in the following.
Chapter 2 discusses supply, use and trends with respect to telecommunication. Sections 2.1 up to and including 2.3 focus on the most important services of the telecom sector, namely internet, telephony, radio and television. The end of this chapter describes the integration of various services and the effects of this phenomenon on both telecom companies and consumers.

Chapters 3 and 4 describe the use of ICT. Chapter 3 focuses on ICT use by companies. Figures organised according to company size and sector (Standard Industrial Classification 2008) are frequently used in this regard. Following an overview of ICT infrastructure at companies given in section 3.1, internal data communication is discussed in section 3.2. The focus then shifts to external data communication. An application of such communication is the linking of a company's ICT systems, for example its order processing systems, with those of customers or suppliers. The chapter continues with the theme of e-commerce and concludes with a description of ICT security at companies. This closing section describes the degree to which companies equip themselves to deal with ICT security incidents and also the degree to which companies are affected by problems in this area.

Chapter 4 discusses ICT use by households and individuals. Following a survey of ICT facilities in section 4.1, the focus shifts to ICT use. Section 4.2 provides an overview of the most important internet activities of Dutch internet users. The section also discusses the diversity of internet activities, including online shopping. Like the one on ICT use by companies, this chapter concludes with a section about internet security. The focus in this instance, however, is on the problems experienced by households and individuals in this area.

Chapter 5 stresses the importance of R&D in science, ICT and technology more generally. Following a definition of the term R&D, the results of the 2009 R&D survey at companies are discussed. In addition, special attention is devoted to R&D expenditure in the ICT sector and in the public sector (results of the R&D survey at government institutes and figures on R&D in higher education). The concluding section focuses on patents.

Chapter 6 deals primarily with people's knowledge potential. The opening section outlines the educational context. This aspect concerns developments relating to participation in education and the percentage of those who successfully complete secondary and higher education. The chapter also focuses on developments concerning the subjects of study chosen by students. In addition, developments in research-oriented higher education in the Netherlands, in particular with respect to science subjects and ICT study programmes, are discussed in detail. Considerations on the importance of further education and training following the completion of an initial study programme are also provided. The chapter's concluding section describes the Dutch population's ICT skills.
The ICT sector and SIC 2008

Standard Industrial Classification (SIC) is used by Statistics Netherlands to classify companies according to their main activity. The SIC instrument is similar to NACE, the statistical classification of economic activities in the European Community. The NACE classification system is based on the International Standard Industrial Classification of All Economic Activities (ISIC) of the United Nations used throughout the world. NACE has been revised several times. A new version entered into effect in 2008. The purpose of this revision was to remain in step with developments and structural changes in the economy (Regulation (EC) No. 1893/2006). This means that changes in companies’ activities or in the nature of their activities are taken into account. Emerging new activities in the ICT sector are an example in this regard. Statistics Netherlands adheres to this NACE version.

Breakdown of the ICT sector according to SIC 2008

<table>
<thead>
<tr>
<th>SIC 2008</th>
<th>Description of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>261</td>
<td>Manufacture of electronic components and circuit boards</td>
</tr>
<tr>
<td>262</td>
<td>Manufacture of computers and peripherals</td>
</tr>
<tr>
<td>263</td>
<td>Manufacture of communication equipment</td>
</tr>
<tr>
<td>264</td>
<td>Manufacture of consumer electronics</td>
</tr>
<tr>
<td>268</td>
<td>Manufacture of information media</td>
</tr>
<tr>
<td>465</td>
<td>Wholesale of ICT equipment</td>
</tr>
<tr>
<td>582</td>
<td>Publishing of software</td>
</tr>
<tr>
<td>61</td>
<td>Telecommunications</td>
</tr>
<tr>
<td>6201</td>
<td>Development, production and publishing of software</td>
</tr>
<tr>
<td>6202</td>
<td>Advice on information technology</td>
</tr>
<tr>
<td>6209</td>
<td>Other service activities in the field of information technology</td>
</tr>
<tr>
<td>631</td>
<td>Data processing, hosting and related activities, web portals</td>
</tr>
<tr>
<td>951</td>
<td>Repair of computers and communication equipment</td>
</tr>
</tbody>
</table>

Source: OECD/Statistics Netherlands.

The overview above shows the internationally applicable classification for the ICT sector in terms of SIC 2008 categories. Where available, figures that are in conformity with SIC 2008 are used in the present publication. However, comparable figures that are in conformity with the new classification system are not always available in the case of time series. For this reason, SIC 1993 is used where necessary.

The final chapter of this publication presents special subjects in the form of contributions that deal in greater depth with matters discussed elsewhere in the present work.

Knowledge and innovation model

This publication assumes a model in which knowledge and cooperation are central. This model is based on the National Innovation System (NIS). The NIS describes the cooperation and knowledge flows between government authorities, universities, research institutes and companies, as well as between companies themselves and knowledge exchange with foreign countries. The NIS concept was used for the first time by Freeman in an analysis of the Japanese model for technological innovation (Freeman, 1988). This concept acquired recognised status in spite of never having been conclusively and unambiguously defined. This was principally due to the further elaboration of the innovation process by the OECD,
which uses the NIS as an overarching term for theoretical insights into a country’s innovation processes (OECD, 2005; OECD, 2009a). Partly because of this, common indicators have been formulated. These indicators make it possible to evaluate various aspects of the NIS more accurately in international terms.

Figure 1.3.1 shows the building blocks used to describe the knowledge economy, including aspects that are dealt with in greater detail in the following of this publication.

1.3.1 National Innovation System

Knowledge development:  
Research and Development, patents  
People’s knowledge potential (education)  
ICT-infrastructure

Knowledge flows:  
exchange of knowledge and people

Knowledge products:  
Innovation  
ICT-products

Knowledge development

Research and Development, patents  
People’s knowledge potential (education)  
ICT-infrastructure

Knowledge flows:

Universities  
Research institutes  
Intermediaries

Relationship between R&D, ICT and innovation

Use of knowledge

Customers, users and partners

Source: TNO, Statistics Netherlands.

The NIS has been modified. The top block (R&D, knowledge potential, ICT infrastructure) is the input and has a direct relationship with the output (innovation and ICT products). The middle block is the throughput (knowledge flows), of which two types are specified in the bottom block. Knowledge products relate to output.

The model consists of four parts that are explained below. A dynamic system ideally focuses on all parts. Applied research is a key condition in ensuring the sustained dynamism of an innovation system and the continuous modernisation and improvement of companies and institutes. The quality and quantity of research, the market orientation of research and the commercialisation of knowledge ensure continued advances, which keeps the system dynamic (Nauta and Gielen, 2009).

Knowledge development

The first part (top left) consists of research and development, knowledge potential and ICT infrastructure. These are inputs for the ultimate realisation of an innovation. The
The scope and quality of research, as well as the number and quality of research staff, in higher education, public research institutes and R&D departments of companies constitute the knowledge foundation for product development. The scope of R&D activities indicates a country’s or sector’s level of ambition with respect to investing in knowledge itself rather than merely using knowledge developed elsewhere. The description of R&D in different countries has been harmonised within an OECD context. The terms and definitions used in this regard are set out in the Frascati Manual (OECD, 2002). Patents are usually viewed as an important outcome of a country’s R&D activities. The filing of many patent applications indicates a knowledge-intensive economy. In practice, knowledge potential often concerns individuals in employment who are graduates of higher education. Although all studies in higher education (universities and universities of applied sciences) are important within a knowledge economy, greater value is usually attached to studies in natural sciences and engineering and technology. Graduates in these subjects frequently go on to perform R&D work. Knowledge potential also concerns lifelong learning; that is, the continuous development of skills and knowledge through the completion of education programmes and training courses both in work-related and leisure contexts.

ICT: innovation and enabling technology

ICT infrastructure concerns investments and services on which an information society relies. ICT can in itself be an innovation. More than this, however, it is also what is known as an “enabling technology”: ICT makes other innovations possible. Moreover, knowledge can be disseminated more easily and made available at virtually all times and places through internet and broadband networks.

Knowledge products
Innovations can be viewed as being knowledge products. ICT has been the most important technology of the past decades. The spread of the internet through television, mobile phones and navigation systems illustrates how ubiquitous this technology has now become. In addition, due to its many manifestations, ICT can also be classified as a “general purpose technology” that creates the infrastructure through which companies can innovate on an extensive scale (Statistics Netherlands, 2010b). Innovations are an expression of a society’s capacity to reinvent and revitalise itself. This capacity is generally viewed as a crucial factor for economic growth. Innovation is the development of new or significantly improved products (product innovation) or the
introduction of new or significantly improved production processes (process innovation). Roughly speaking, innovation can be divided into two main types, namely technological and non-technological innovation. The focus with respect to innovation has traditionally been on its technological aspect; on what a company produces (product innovation) and on how the company produces it (process innovation). Non-technological innovation concerns organisational innovation and marketing innovation. These four innovation concepts are described in the Oslo Manual, an internationally used document prepared in cooperation between the EU and the OECD that contains guidelines for measuring innovation at company level (OECD, 2005).

Until the 1990s, the linear view that innovation proceeds from science predominated. From this perspective, increasing scientific input leads directly to more technological innovations. Investments in R&D infrastructure (laboratories and other research facilities) and personnel reflect this approach. The traditional perception of innovation at companies, which is based on the view that high-tech R&D departments produce inventions or technological innovations in virtual isolation from the outside world, is outdated. A new perspective that focused primarily on the system characteristics of innovation emerged at the end of the 1980s (OECD, 1997). Innovation system theory views innovation as an interactive process that requires intensive communication and exchange between a range of actors. Users of knowledge, such as companies, government authorities and knowledge institutes like universities and universities of applied sciences, constitute the innovation system through mutual relationships of exchange. The innovation system is seen as the infrastructure that enables the kind of economic modernisation through which a country or region can remain internationally competitive.

Knowledge flows
Knowledge can be developed and applied through a greater or lesser degree of cooperation. There is increasing awareness that cooperation can accelerate and improve the development and exchange of knowledge. Every successful economic system has intensive, interactive networks between companies, knowledge institutes and government authorities. These connections ensure a continuous flow of knowledge exchange, resources and talent. The mutual benefit of cooperation is rooted in the fact that new combinations of the existing knowledge of both partners are created and, moreover, the partners jointly produce knowledge (Statistics Netherlands, 2010b).

International cooperation in particular has become increasingly relevant over the past decades due to globalisation. This aspect concerns both trade with companies in other countries and the relocation or outsourcing of a company’s business activities abroad. R&D is also relocated or outsourced to other countries. Cooperation is a key factor in both cases.

Use of knowledge
Companies and knowledge institutes enter into cooperative relationships with other actors, such as customers, suppliers, competitors and partner companies. Not only the
presence of high-quality customers, but also the availability of venture capital play a role in this part of the model (Nauta and Gielen, 2009). A good network of customers and users of an innovation constitutes the sales market and is also essential to the development and further development of innovations and the generation of ideas for new products or processes. In addition to their existing networks, companies and knowledge institutes must continuously develop new relationships that tap into new knowledge and sources of finance. A network with proven successes holds a certain attraction for foreign companies, new and potential entrepreneurs and scientists.
Telecom
Telecom

2.1 Internet
- The Netherlands is world leader in 50+ Mbps broadband coverage
- The Netherlands just behind leaders in terms of internet speed
- Price of broadband connection average in international terms
- Volume of data traffic through mobile internet up almost tenfold in two years

2.2 Telephony
- Fixed telephony stabilising
- High number of mobile telephone connections

2.3 Television and radio
- Shortage of frequencies for analogue radio and television
- Digital television requires less bandwidth
- Digital television through terrestrial broadcasting
- Digital television through satellite
- Digital television through cable
- Digital television through the internet (IPTV)
- Digital television through cable most popular
- Digital radio through terrestrial broadcasting encouraged
- Many broadcasters provide digital radio through the internet

2.4 Integration of telecom services
- Distinction between services fading
The Netherlands has the highest broadband penetration in Europe. However, the number of optical fibre connections is still limited relative to the leading countries in this field of technology. The number of fixed IP telephony (VoIP) connections is continuing to exhibit strong growth and, in comparison with other countries, the Netherlands has a high number of mobile telephone connections. Furthermore, the number of digital television connections is still increasing. Cable is the means most used to receive digital television. Television, telephone and internet services are increasingly being purchased as combined packages from the same provider and through a single network. The distinction between these services is becoming progressively less pronounced because television and telephony data can, just like other forms of data, be sent through the internet.

2.1 Internet

This section describes telecom sector services in relation to the internet. Services pertaining to telephony, radio and television are discussed in subsequent sections. It is not always possible to make unequivocal distinctions between different telecom services. An example in this regard is IP telephony. While a user may view this as a telephone service, in technical terms it could be defined as an internet application. In preparing this chapter, the decision was made to classify services according to end product rather than underlying method and technology. In other words, IP telephony is discussed in the section on telephony, even though the underlying technology is based on the internet.

Internet traffic will continue to increase strongly through HDTV and 3DTV

The volume of internet traffic has risen sharply. This is an important indication of both an increase in the number of internet users and the traffic generated by ‘heavier applications’.
Figure 2.1.1 shows monthly internet traffic for two Dutch internet exchanges. An internet exchange is a national hub where the lines of various domestic internet providers as well as lines to other countries meet. The Amsterdam Internet Exchange (AMS-IX) is one of the largest in the world.

The quantity of data that passes through AMS-IX provides an indication of the total quantity of data sent in the Netherlands through the internet. Over 250,000 terabytes (on average, this is 21 times the contents of a normal DVD per second) of traffic were registered at AMS-IX in December 2010. This constitutes an increase of over 40 percent relative to December 2009, when almost 180,000 terabytes were registered, and is in keeping with the increase in internet traffic throughout the world. AMS-IX is the world’s second largest internet hub after DE-CIX, the internet exchange in Frankfurt, Germany. In December 2008, the traffic registered in Frankfurt exceeded the amount registered at AMS-IX by approximately 38 percent (University of Minnesota, 2009). More recent figures are not yet available.

### 2.1.1 Volume of internet traffic through AMS-IX and NL-IX, 2000–2010

![Graph showing internet traffic through AMS-IX and NL-IX, 2000–2010](image)

Source: AMS-IX; NL-IX.

1) In December of the year concerned.

The continuing strong growth in internet traffic is being driven primarily by the increase in video traffic (both quantity and quality of videos), the use of cloud services (e.g. online back-up and remote file storage) and online gaming. The expectation is that internet traffic will increase very substantially in the coming years due to the advent of HDTV and 3DTV (CISCO, 2010).
Overview of internet connection types

This overview is not intended to be exhaustive. Rather, this box provides information about terms and abbreviations that occur in the text.

Fixed connections

Dial-in connection (max. 1.28 Kbps). Contact with an internet provider is established through a telephone connection by means of an analogue or ISDN modem.

Asymmetric digital subscriber line, ADSL (max. 8 Mbps download, 1 Mbps upload). In the case of ADSL, internet traffic is transported to the local exchange by a telephone line, after which further transportation takes place by optical fibre. The ADSL signal is placed in a separate frequency band while in the telephone line so that telephone and internet can be used simultaneously. The term ‘asymmetric’ refers to the difference in upload and download speed. A problem with using the telephone line in this way is that the maximum speed achievable decreases with the length of copper wire used, which means that internet speed depends on the distance to the local exchange.

ADSL2, ADSL2+ (max. 24 Mbps download, 3.3 Mbps upload). This is a modernised form of ADSL that primarily provides higher download speeds.

Very high bit rate digital subscriber line, VDSL, VDSL2 (max. 52 to 200 Mbps download, 13 Mbps upload). This is the next generation DSL connection. VDSL2 has been commercially available since September 2009. The higher speed is achieved by using the copper telephone line only for the section between the home and the street cabinet, after which the signal is further transported by optical fibre cables.

Cable internet (max. 400 Mbps download, 108 Mbps upload). In this case, internet traffic is transported by the RTV coaxial cable ‘alongside’ the radio and television signals to the local exchange, after which it is further transported by optical fibre. Subscriptions that provide download speeds of 50 to 120 Mbps are already being taken out on a large scale.

Satellite internet (max. 4 Mbps download). In this case, internet traffic is received from a satellite orbiting the Earth by means of a satellite dish. Although this technology is often more expensive than the other internet connection types, it is sometimes the only option in sparsely populated areas with less dense cable networks.

Mobile connections

WiFi (max. 540 Mbps). This type of connection is used as wireless internet in the home or in the vicinity of ‘hot spots’ (antennas placed at busy locations such as stations). Range is limited: with a regular antenna, signals can be received up to approximately 30 metres away.

General Packet Radio Service, GPRS (max. 58 Kbps download, 29 Kbps upload). Internet traffic is transported through the GSM network, the network for mobile telephony. This type of connection is also known as 2G.

Universal Mobile Telecommunications System, UMTS (max. 2 Mbps), also known as 3G (third-generation mobile network). Internet traffic is sent and received through the network of UMTS antennas (see section 2.2).

High-Speed Downlink Packet Access, HSDPA (max. 7.2 Mbps), also known as 3.5G. Internet traffic is likewise sent and received through the network of UMTS antennas. A higher speed is achieved due to the use of newer technologies, however.

Long Term Evolution, LTE (max. 100 Mbps). Although this technology is often referred to as 4G, it does not as yet meet 4G conditions. LTE Advanced, the successor that will probably be released in 2012 and provide a maximum download speed of 1 Gbps, will meet these conditions. A first LTE network went live already in 2010. LTE can to a large extent use existing GSM and UMTS networks.
The Netherlands is world leader in 50+ Mbps broadband coverage

The Ministry of Economic Affairs, Agriculture and Innovation defines broadband as ‘a good-quality, continuously available connection that is suitable for visual and audio applications and for the exchange of large data files’. In its international statistics, the OECD applies a more quantitative definition: broadband connections are internet connections with a total transmission capacity (the sum of the upload and download data transfer rate) of at least 256 Kbps. The definitions of broadband given above include the most modern fixed internet connections, such as ADSL and cable internet. Dialling in through a fixed telephone line is an example of a connection that is not classified as broadband internet access. On the other hand, mobile internet through UMTS, for example, qualifies as broadband internet access according to the definitions given. Nevertheless, the figures on broadband internet presented in the rest of this section do not include mobile connections.

Virtually all households and companies currently (2011) use broadband connections. Figure 2.1.2 shows that at the end of 2009, together with Denmark, the Netherlands had the highest number of broadband connections per 100 inhabitants of OECD countries. Virtually all countries have exhibited slowed growth in recent years.

2.1.2 Number of broadband connections per 100 inhabitants, international, 2005–2009

Source: TNO based on OECD.

1) In December of the year concerned.
2) Excluding mobile connections.
3) The decrease in the number of broadband connections in Finland was caused by a change in methodology.
In technical terms, it was possible for almost all households in the Netherlands to acquire a broadband connection in 2010. ADSL is available to over 99 percent of the population, for example, while cable internet is available to approximately 98 percent of the population. Virtually all cable operators now apply the new EuroDOCSIS 3.0 standard, which makes very-high-speed connections possible through the coaxial network. As a result, high-speed cable internet with download speeds of between 50 Mbps and 120 Mbps already has 95 percent coverage. This means that the Netherlands has the highest coverage of 50+ Mbps broadband connections in Europe and is surpassed only by South Korea, Hong Kong and Singapore (NLkabel, 2011). A minimum speed of 50 Mbps is necessary for the use of new online applications and services that will be introduced in the coming years. In addition, investments are also being made in other infrastructures designed to enable high-speed internet, such as VDSL and the fibre optic infrastructure (Fibre to the Home, FttH).

Figure 2.1.3 presents an international comparison of the access technology used for broadband in June 2010. The figure concerns only fixed connections and does not include mobile connections.

### 2.1.3 Access technology used for broadband internet, international, June 2010

- **Japan**: Optical fibre/LAN (80%), Cable (15%), DSL (1%), Other (4%
- **South Korea**: Optical fibre/LAN (90%), Cable (8.5%), DSL (1.5%), Other
- **Denmark**: Optical fibre/LAN (70%), Cable (25%), DSL (3%), Other (2%)
- **US**: Optical fibre/LAN (40%), Cable (40%), DSL (20%), Other (0%)
- **Netherlands**: Optical fibre/LAN (70%), Cable (25%), DSL (2%), Other (3%)
- **Finland**: Optical fibre/LAN (80%), Cable (15%), DSL (5%), Other
- **Germany**: Optical fibre/LAN (50%), Cable (40%), DSL (10%), Other
- **France**: Optical fibre/LAN (60%), Cable (30%), DSL (10%), Other
- **UK**: Optical fibre/LAN (60%), Cable (30%), DSL (10%), Other
- **Canada**: Optical fibre/LAN (50%), Cable (40%), DSL (10%), Other

**Source**: OECD.

1) Mobile connections not included.

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1) Some households cannot be connected for technical reasons, such as the distance separating them from the local exchange.
mobile broadband access. In the middle of 2010, the internet was used in the Netherlands primarily by means of ADSL (58 percent of internet connections) and RTV cable (39 percent of internet connections). There are major international differences in this regard. The Netherlands has traditionally had a well-developed cable network. A large proportion of households are connected to television and radio services by cable, which means that the percentage of households that have access to broadband in the Netherlands is also relatively high. In countries with less dense cable networks, such as France and Germany, this form of broadband access is less common. High-speed optical fibre connections are already widely used in Japan and South Korea, where over 50 percent of households have access to broadband through fibre optics technology. At over 2 percent, the corresponding figure for the Netherlands is much lower.

No international figures are as yet available regarding the situation at the end of 2010. At that time, there were 6.2 million broadband connections in the Netherlands, of which 55 percent were DSL, over 41 percent cable and slightly less than 4 percent optical fibre (Telecompaper, 2011). The share of DSL in the total number of broadband connections has therefore decreased by a few percentage points, primarily due to an increase in cable and optical fibre connections.

### 2.1.4 Number of optical fibre connections, 2004–2010

![Connections per 100 inhabitants](image)

**Source:** Point-Topic.

i) 2010 = end of Q2.
Figure 2.1.4 shows the increase in the number of optical fibre connections. This includes all connections in which optical fibres are used until at least the street cabinet. The final section may be a different kind of infrastructure. The increase in the number of optical fibre connections that occurred in the Netherlands in 2006 and 2007 did not continue in the subsequent two years. A clear increase (over 15 percent) occurred again in the first two quarters of 2010. In international terms, South Korea and Japan, with over 18 and 14 connections per 100 inhabitants respectively, have a strong lead over all other countries.

The Netherlands just behind leaders in terms of internet speed

In the European Union, 29 percent of fixed broadband connections have a speed of 10 Mbps or higher. The corresponding figure for the Netherlands is 57 percent. At 89 percent, Greece has the highest percentage of connections with a speed of 10 Mbps or more, but the total number of fixed broadband connections is relatively low there. In Germany, the United Kingdom and Finland the percentage of all fixed broadband connections with a speed of 10 Mbps or more is relatively low.

2.1.5 Speed of broadband internet connections, international, Q2 2010

![Bar chart showing the percentage of broadband connections with different speeds across various countries, including Greece, Bulgaria, Romania, Portugal, Netherlands, Belgium, Sweden, Denmark, Czech Republic, Germany, Great Britain, and Finland. The chart indicates the percentage of connections with speeds of 10 Mbps and higher, 2 Mbps to 10 Mbps, and 144 Kbps to 2 Mbps. Source: European Commission.](chart-image-url)
In September 2010, subscribers with access to internet speeds of between 10 Mbps and 30 Mbps constituted the largest group in the Netherlands, accounting for 2.8 million connections. In addition, there were approximately 384,000 connections that provided access to speeds of higher than 30 Mbps, primarily through cable (OPTA, 2010).

**Price of broadband connection average in international terms**

Figure 2.1.6 provides an overview of the monthly rates for a DSL broadband starter package and a cable broadband internet starter package in the Netherlands and a number of benchmark countries. The rates have been converted into US dollars to enable comparison. Furthermore, although the figure concerns starter packages, the contents of such packages may differ per country in terms of speed, download limit, additional services and so on. In the Netherlands, broadband subscriptions have been upgraded several times in recent years. These upgrades give consumers a higher speed for the same price. It is also possible to downgrade and pay a lower rate for an old, lower speed.

2.1.6 Rates for a DSL and a cable broadband internet starter package, international, Q1 2010

![Bar chart showing monthly rates for DSL and cable broadband internet in international terms.](chart)

Bron: Point-Topic.

1) The countries are ranked according to lowest available rate for DSL or cable internet.

2) Rates for DSL and cable were almost the same in the US.
The price of a cable broadband internet starter package in the Netherlands is average. However, the price of a DSL starter package in the Netherlands is rather high in international terms.

**Volume of data traffic through mobile internet up almost tenfold in two years**

Smartphones are driving tremendous growth in mobile data traffic. Figure 2.1.7 shows that the total volume of mobile data traffic in the Netherlands was 359,000 gigabytes in the first two quarters of 2008. In the same period of 2010, this volume had already increased to 3,207,000 gigabytes. It must be noted that this figure accounts for only a few tenths of a percent of the total volume of data traffic registered at AMS-IX during the same period.

### 2.1.7 Mobile internet data volume, 2008 - first half of 2010

A global survey of data use through mobile internet based on a combined total of 210 million subscribers revealed that, at 35 percent, video streaming accounted for the most data used, followed by web browsing at 29 percent (Allot Mobile Trends, 2011).
2.2 Telephony

The telephony market is still undergoing change. The number of traditional analogue telephone connections to the fixed network is further decreasing as alternatives like mobile telephony and IP telephony are coming increasingly to the fore. This section will first present figures on fixed telephone connections, including IP telephony, and subsequently discuss mobile telephony.

Fixed telephony stabilising

In technical terms, practically all households in the Netherlands can be connected to the fixed telephone network. The fixed network is very extensive and provides national coverage. In around the year 2000, there were almost 10 million telephone connections to the fixed network, including ISDN connections. Following a long period of steady growth, the number of fixed telephone connections started to fall after 2000. IP telephony (VoIP, broadband telephony) was introduced in 2005.

2.2.1 Number of fixed telephone connections by technology, 2004–Q2 2010

![Graph showing number of fixed telephone connections by technology from 2004 to 2010.]

Source: TNO, Electronic Communications Market Report

1) 2004 = end of Q4 2003.
Figure 2.2.1 shows the emergence of IP telephony. This form of telephony underwent strong growth again in 2009 and accounted for 3.4 million connections by the end of that year. At the beginning of 2010, the total number of IP telephony connections exceeded the combined total of ISDN and regular analogue (PSTN) telephone connections for the first time. Until the end of 2007, a proportion of households continued to cancel their fixed telephone connections and use only mobile telephone services. However, the total number of fixed telephone connections has remained more or less the same since 2008 (6.8 million). The cancellation of traditional telephone connections therefore appears to coincide with the activation of IP telephony connections.

Figure 2.2.2 shows the number of fixed telephone connections per 100 inhabitants in the Netherlands and a number of benchmark countries. In 2009, there were 44 fixed connections per 100 inhabitants in the Netherlands, the same number as in the preceding year. In 2000, by contrast, there were 62 fixed connections per 100 inhabitants in the Netherlands. Similar decreases occurred in most of the benchmark countries and can be explained by the fact that a proportion of households opted to use only mobile telephone services.

2.2.2 Number of fixed telephone connections per 100 inhabitants, international, 2000, 2005 en 2009¹

Source: TNO.

¹ Including ISDN and VoIP connections.
High number of mobile telephone connections

At the end of 2010 there were 19.1 million mobile telephone connections (both prepaid and subscriptions), a drop of 3 percent relative to the end of 2009 caused by updating of prepaid customer bases on the part of a number of mobile telephony providers. Nevertheless, the number of mobile telephone connections still exceeds the number of inhabitants in the Netherlands. Some people have two or more mobile telephones, for example one for work and one for private use. In addition, this figure includes other devices that have a SIM card, such as a laptop with UMTS mobile broadband internet, for example. The increasing use of this kind of mobile internet through laptops may lead to a further rise in the number of mobile connections. In the future, this may result in the replacement of both fixed telephony and internet access through the fixed network in view of the increase in the mobile connection speed.

In international terms, the Netherlands has a relatively high number of mobile telephone connections. Figure 2.2.3 shows the number of connections per 100 inhabitants for the Netherlands and a number of benchmark countries. In 2009, there were 128 mobile connections per 100 inhabitants in the Netherlands. At 130, the corresponding figure for the United Kingdom was the highest. This figure increased in all the benchmark countries.
The mobile telephone network in the Netherlands almost provides national coverage. At the end of December 2010, there were 13,197 antennas for GSM services, the most widely used mobile telephony standard, throughout the country. This is 176 more than in December 2009 (Antennebureau, 2011). The number of antennas for UMTS services, the successor of the GSM standard, increased in the same period by 336 to 10,110. The number of both GSM and UMTS antennas further increased in the first quarter of 2011.

2.3 Television and radio

In the Netherlands, the first analogue television broadcasts took place in 1951. At the time, with the aid of large antennas attached to the roofs of homes, all television programmes reached viewers through terrestrial broadcasting. RTV cables were first connected to households in the 1960s. Cable provided better visual and audio quality than terrestrial broadcasting and also made it possible to receive more channels. The cable currently remains the most common way to receive television. In 2010, it was possible for 98 percent of Dutch households to take out a subscription for cable radio and television. This means that the Netherlands has one of the densest cable networks in the world.

Shortage of frequencies for analogue radio and television

Although the reception of analogue television through terrestrial broadcasting is a thing of the past (analogue broadcasts ended on 11 December 2006), analogue radio through terrestrial broadcasting remains very popular. Many car radios still use this technology, for example, as do mobile telephones with built-in radio receivers. A scarcity of frequencies is a major problem for current FM terrestrial broadcasters. The demand for terrestrial frequencies for radio broadcasting exceeds the available supply. For this reason, the government manages analogue terrestrial radio licences. Using Terrestrial Digital Audio Broadcasting (T-DAB) would be one way of overcoming this scarcity.

Together with analogue television signals, various analogue radio signals are also generally transmitted through the RTV cable. Although cable broadcasting provides more space for radio channels than terrestrial broadcasting, scarcity likewise applies. There are a number of drawbacks to using analogue signals. Disruptions in the signal quickly become evident in the form of unwanted noise, ‘snow’ or spectral images, for example. This is particularly a problem with respect to analogue signals broadcast terrestrially but can also cause loss of quality in analogue cable television.
A second problem is the fact that the space available for channels is limited. Only a few frequencies, actually frequency bands, can be used for the transmission of radio or television signals in terrestrial broadcasting. An RTV cable can likewise transmit only a limited number of channels. These problems are present to a lesser extent in digital television and radio. Partly for this reason, almost 68 percent of all active connections at the end of 2010 were already for digital television (Telecompaper, 2011). Digital television and radio, as well as the different ways in which they can be received, are discussed in greater detail below.

**Digital television requires less bandwidth**

In the case of digital television, audiovisual information constituting the different television channels is transmitted in the form of discrete data packets rather than as a continuous analogue signal. Less bandwidth is required for each channel because, among other reasons, the digital data can be compressed. This makes it possible to transmit more digital than analogue channels through the same transportation medium. The bandwidth used for a single analogue channel can usually be used to transmit six to eight digital channels with the same audiovisual quality. It is also possible to transmit a signal with a higher resolution, such as HDTV, instead of several channels.

**Nearly seven in ten television connections are digital**

| 32% | 68% |
The standard used in Europe for all forms of digital television signals is referred to as Digital Video Broadcasting (DVB). This internationally accepted standard is also used in, among other regions, Russia, parts of Africa, Southeast Asia and Australia. Alternative standards are used in other parts of the world. For terrestrial digital television, ATSC standards are used in North America, the ISDB standard is used in Japan and South America and DMB technology is used in China, for example.

The price of a digital subscription is usually about the same as that for analogue television. In most cases, an additional payment must be made for more channels or channels in HDTV. In addition, a special digital receiver (also referred to as a decoder, tuner or set-top box) with a smart card is required for each television set. This receiver is often hired out or made available by the provider to convert the digital signals into a format suitable to a regular television set. Many television sets also have an in-built tuner. To enable use of this feature, the smart card must be inserted into the television set by means of a plug-in card (Conditional Access Module). An additional remote control and a separate decoder are in this case no longer required.

There are different ways of receiving digital television: through the traditional RTV cable, through terrestrial broadcasting, through satellite or through internet (DSL/optical fibre). The following sections briefly discuss the possibilities of and the differences between the various methods. In addition, figures concerning use are provided where possible.

**Digital television through terrestrial broadcasting**

Digital television through terrestrial broadcasting, also known by the abbreviation DVB-T (Digital Video Broadcasting – Terrestrial), is the modern version of television viewing by means of a traditional analogue television antenna. This modern form of reception is possible virtually throughout the Netherlands. Whereas in the past a large antenna attached to the roof was necessary for proper reception, a small antenna of approximately 20 centimetres in height that can often be placed inside the home is sufficient for terrestrially broadcast digital television. Although image quality is better than had been possible through the use of an analogue antenna, it is nevertheless not as good as that of other forms of digital television because of the higher degree of compression. The digital versions of television channels Nederland 1, 2 and 3, as well as those of regional broadcasters, became freely available through terrestrial broadcasting following the discontinuation of analogue signals. A digital decoder and a suitable antenna are required to view these channels, however.

At present (2011), 23 channels can be received by means of digital television through terrestrial broadcasting. Although new compression techniques have made it possible to broadcast in high definition, this option is not yet offered in the Netherlands. Interactive television is not possible with this form of broadcasting.
At the end of 2010, there were 900,000 subscribers of terrestrially broadcast digital television in the Netherlands. The corresponding figure for the preceding year was 878,000. Following the sharp increases of previous years, the growth of this form of digital television therefore appears to be stagnating.

Digital television through satellite

In addition to terrestrial broadcasting, it is also possible to receive digital television through satellite. This method provides access to over 400 channels and the most extensive range of HDTV. Image quality is also better than is the case with terrestrially broadcast digital television. A disadvantage, however, is that a satellite dish must be attached to the outside of the home, which is not always possible or permitted. This satellite dish must also have a direct ‘line of sight’ with the satellite and, moreover, interactive television is likewise not possible with this form of broadcasting.

All Dutch satellite broadcasters have broadcast their programmes exclusively in digital form since the end of 2006. Virtually all foreign satellite broadcasters also transitioned to digital technology in recent years. In terms of the infrastructure required, there is little difference between analogue and digital television reception by means of a satellite dish and accompanying receiver. Consumers who already own a satellite dish can therefore easily switch to digital television. Placing a different receiver is usually sufficient.

Digital television is broadcast by satellite according to the DVB-S (Digital Video Broadcasting – Satellite) standard. The satellites used have an extremely long range and can provide broadcasts for an entire continent. Provided that there is a ‘line of sight’ with the satellite, 100 percent of the population can therefore receive this form of digital television. At the end of 2010, 930,000 households were receiving digital television through satellite. The corresponding figure for 2009 was 885,000.
Digital television through cable

In the case of digital television through cable, signals are received by means of the RTV cable (coaxial cable). Additional antennas or dishes are not required. The standard used to transmit digital television through RTV cable is referred to as DVB-C (Digital Video Broadcasting – Cable). Relative to analogue cable television, more channels and/or channels with better image quality can be transmitted. Television sets not equipped with an additional digital receiver can often still receive the regular analogue cable signal, which continues to be transmitted together with the digital signal. Image quality is comparable to that of digital television through satellite. Access to dozens of channels is provided, including ones in high definition. Interactive services like Video on Demand (VOD) and voting through the remote control are possible. The number of households with digital television through cable rose in 2010 to 3 million. At the end of 2009, the corresponding figure was 2.5 million. This form of digital television therefore again achieved the largest absolute increase in the number of subscribers also in 2010. This has been the case since 2005.

Cable increasingly becoming most popular way of receiving digital television

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Digital television through the internet (IPTV)

A fourth way of receiving digital television is through the internet, something also referred to as IPTV (Internet Protocol television). A complete television channel can be transmitted in high quality through a DSL connection with sufficient capacity or an optical fibre.
connection. An advantage of this form of digital television is that only the channel opted for by the user is transmitted. In most of the other forms of broadcasting, all channels are transmitted simultaneously and one is filtered out by the television set or decoder. A scarcity of frequencies therefore does not apply to this technology and an infinite number of channels is theoretically possible.

A prohibitive factor with respect to this form of broadcasting is that the internet connection must be fast enough. ADSL2 is often recommended. Not every household in the Netherlands can have such a connection activated, however. Furthermore, although HDTV channels are provided, quality is as yet not optimal due to a high degree of compression. As is the case with digital television through cable, interactive television is possible with IPTV. It is important to note that this form of digital television must not be confused with watching television on a PC by means of a special television card and in respect of which the signal is still received through, for example, an RTV cable, or with downloading or streaming movies or programmes from the internet.

There were 495,000 subscribers at the end of 2010, whereas there had been 350,000 at the end of 2009. Although it remains the least used form of digital television, its growth in percentage terms was the highest of all forms of digital television in 2010.

Connected TV

The integration of the internet and television sets is a new development that is referred to as 'Connected TV' or 'Smart TV'. An important new service that this development has given rise to is over-the-top (OTT) streaming. Streams of video and audio are delivered through the broadband connection to the device, such as a television set, PC, mobile telephone or tablet, that connects a user to the internet. This makes it possible for a user to access content at any time of his or her choosing. An extensive range of content is available, including movies and television series. This content can also be offered in a personalised way, for example on the basis of friends' suggestions. The costs for a user are far lower than is currently the case with respect to subscriptions taken out with providers of standard television.

Unlike IPTV, no separate network

In the case of regular IPTV, an operator broadcasts through a separate network. The operator has complete control of the network and can adjust the bandwidth to guarantee high quality, for example. By contrast, a separate infrastructure is not required in the case of Connected TV. Content of good audiovisual quality can be viewed through the internet by means of OTT streaming. This applies to both live broadcasts and Video on Demand. A television channel can transmit its broadcasts to a viewer directly or through other parties.

Connected TV is an alternative to cable, satellite and IP television. Nevertheless, providers of these technologies also have an array of new options: They can use OTT streaming to expand the services package and offer content to subscribers of other providers. The expectation is that, worldwide, there will be 380 million OTT television viewers as against 163 million IPTV viewers in 2015 (Informa Telecoms & Media, 2011).

Devices required already fairly common

A television set that can be connected to the internet is required for Connected TV. Such a connection can also be effected by means of a connected Blu-ray player or video game console. Virtually all manufacturers now sell television sets that can be connected to the internet, though they continue to adhere to their own standards. Approximately 420,000 connected televisions were sold in the Netherlands in 2010 (GfK, 2011). This number is expected to double in 2011. Sales of connected Blu-ray players are also set to increase sharply. In addition, approximately 5 million video game consoles with online capability have already been sold. This means that many households that have a television set without an internet connection can already make use of the new services. The number of content providers is still limited in the Netherlands. Major providers that are granted full network access by network operators are already a feature particularly in the United States.
Digital television through cable most popular

At the end of 2010, there were a total of 5.3 million digital television connections, 16 percent more than there had been one year earlier. Figure 2.3.1 shows the trend in the use of digital television according to reception method, i.e. through cable, satellite, terrestrial broadcasting or DSL/optical fibre connection. Until and including 2005, satellite television accounted for the largest share of digital connections. The RTV cable has held the lead since 2006. At the end of 2010, cable television had a market share of over 56 percent. The corresponding figure for digital satellite television was 17 percent. The number of viewers of terrestrially broadcast digital television rose sharply between 2005 and 2009. At over 20,000, the increase in this number was markedly less in 2010, however. The market share of terrestrial broadcasting has fallen to 17 percent due to the increase in the total number of digital television connections. The emergence of HDTV is perhaps the cause in this regard, since it is as yet not provided through terrestrial broadcasting. The market share of digital television through the internet (IPTV) has continuously increased since 2006 and amounted to over 9 percent at the end of 2010.

2.3.1 Number of digital television connections by reception method, 2004–2010

![Chart showing the number of digital television connections by reception method from 2004 to 2010.](image)

Source: TNO

Statistics Netherlands
Digital radio through terrestrial broadcasting encouraged

Digital Audio Broadcasting (DAB) is a standard for digital radio that is used in many countries. The improved standard is referred to as DAB+. Terrestrial Digital Audio Broadcasting (T-DAB) can be viewed as the successor of FM technology. In the Netherlands, T-DAB broadcasts reached approximately 70 percent of the population in 2010, mainly in the Randstad conurbation and in the provinces of North Brabant and Gelderland. In addition to terrestrial transmission of the analogue signal, public service broadcasting in the Netherlands has included the T-DAB signal since 2007. To stimulate the introduction of T-DAB, commercial radio broadcasters with an FM licence are obliged by the government to broadcast through T-DAB as well. Digital radio through T-DAB must be receivable in 80 percent of the Netherlands by September 2015.

In addition to DAB, it is also possible to receive radio broadcasts through DVB-T, DVB-S and DVB-C. In the case of these technologies, the radio broadcasts are transmitted with the television signals. Commercial stations are also already available in this way. Figures concerning the reach and use of these technologies are provided in the section on digital television.

As is the case with digital television, the signal in digital radio is transmitted in the form of digital data packets. The same advantages as those of digital television apply: a higher-quality signal, particularly as compared to terrestrially broadcast analogue radio, and the possibility of broadcasting more stations within the limited frequency spectrum. Additional information can also be transmitted with the signal. This makes it possible to, for example, update a car’s navigation system with information on traffic jams and, to a limited extent, transmit images. A digital radio receiver is required to listen to digital radio.
Digital Radio Mondiale (DRM)\(^3\) is a separate standard that can be seen as the digital equivalent of shortwave radio. The advantage of shortwave is that a broadcaster’s range is far greater than that of an FM broadcaster. Disadvantages of shortwave are that unwanted noise and poorer sound quality occur. Such unwanted noise can be limited by transmitting digital signals, which makes it possible to achieve broadcasts of reasonable sound quality that have a range in excess of 1,000 kilometres. At present (2011), only Radio Netherlands Worldwide (RNW) broadcasts from the Netherlands according to the DRM standard.

**Many broadcasters provide digital radio through the internet**

A range of ‘streams’ (data streams) can be listened to through the internet, both ‘live streams’ (the immediate transmissions of radio stations that also broadcast terrestrially or through cable) and a large number of broadcasts that are only available online. Due to the internet’s global nature, it provides access to stations throughout the world, not only those in the Netherlands. A scarcity of frequencies does not apply to this technology, since only the broadcaster selected is transmitted.

In addition, recordings of programmes can be retrieved and listened to through the internet at any time convenient to the user. Although a very high-speed internet connection is necessary to receive good-quality television through the medium, the same does not apply to online digital radio. A broadband starter package is usually sufficient.

2.4 **Integration of telecom services**

In the past, each telecom service had a unique method of transmission. A single agency or company held a monopoly on the service in question. Communications by telephone and fax took place through a telephone line and cable television was the preserve of the local cable company. Two important changes have taken place in this regard. First, there is no longer a state-owned company that holds a monopoly on telephony. Other companies can now use the telephone cable infrastructure as well. Second, important new technologies like mobile telephony and the internet are now available. The emergence of the internet in particular has made new services possible. It became possible, for example,

\(^3\) Not to be confused with Digital Rights Management, which refers to technologies used to manage digital rights, such as copyrights in digital music files, for example.
to transmit previously separate services as a combined package through the Internet Protocol (IP) and do so within a single infrastructure. This capability has contributed to the convergence of services.

Many telecom companies now use a single distribution method to provide combined services. This is also referred to as ‘multiplay’ and entails the provision of television, internet and telephone services by a single company through, for example, an RTV cable. These services are sometimes offered as a single package but provided by different distribution methods.

The main reason that households opt for a combined package is the convenience of a single helpdesk and invoice (Telecompaper, 2011). Price advantages are also specified as a reason. A drawback of a combined package is the fact that all services become unavailable if the connection fails. This can be a problem for companies in particular. A temporary loss of e-mail capability alone is less serious for a company than being simultaneously cut off from telephone and internet services.

Combined packages are advantageous to telecom companies because they make it possible for such companies to offer a broader range of products and possibly also lower rates due to economies of scale. Traditional cable companies that previously provided only television and radio services now provide telephone services as well, for example, while, in their turn, telephone companies have likewise expanded their services to include television.

A single helpdesk and invoice the main reason for a combined package

A range of measures designed to make it easier to switch to a different provider are now in force. Partly as a result of regulation by the Independent Post and Telecom Authority of the Netherlands (OPTA), for example that pertaining to telephone number retention, switching to a different provider of fixed and mobile telephone services had already been made easier. Switching to a different internet or radio and television provider has also become more common and is gradually becoming easier to do. In the past, switching to a different internet provider could take several weeks, during which time the customer had no access to the internet. Providers must now ensure that such access is in place within one day.

Figure 2.4.1 shows the range of services purchased from a single provider. Many market players now focus on this kind of service provision. Following an increase in the number of multiplay contracts by over 10 percent in 2009, the number stabilised in 2010. By contrast,
2.4.1 Multiplay use, 2007–2010

A sharp increase of 20 percent, which translates into 2.3 million subscribers, occurred with respect to the tripleplay package comprising a connection for fixed telephony, television and broadband internet. This is therefore by far the most common form of multiplay. Another package that attracted more subscribers in 2010 was that for fixed telephony, television, broadband internet and mobile telephony. Consumers are therefore increasingly opting for an all-in-one package.

Distinction between services fading

In addition to the fact that different services are distributed through different channels, the distinction between services is now fading. As discussed in section 2.3, television can now be transmitted through broadband internet as well (Connected TV), and telephony through broadband internet is already even more common. Indeed, there is in fact no longer a technical difference between television, telephony and other forms of data. The extent and depth of these developments are likely to increase in the future, and it is therefore reasonable to expect that, in time, a broadband internet subscription is all that will be needed to have access to the full range of telecom services.

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1) The term fixed refers in this case to telephony through a fixed line (including VoIP), while mobile refers to a mobile telephone connection. Broadband refers to a fixed or wireless broadband internet connection.
ICT use by companies
ICT use by companies

3.1 ICT infrastructure and use
- Virtually all companies have an internet connection
- Mobile broadband is becoming common at companies
- Over eight in ten companies have a website
- Internet used extensively at work

3.2 Internal data communication
- Intranet usually in larger companies
- Extranet not common
- Number of companies with teleworkers doubled
- Over half of companies have software for recording or processing sales orders
- ERP at one fifth of companies
- ERP use by Dutch companies equal to EU average
- One in four companies uses open source software
- Use of open source operating software at Dutch companies average

3.3 External data communication
- Intensity of ICT use is increasing
- Application of automated data exchange related to company characteristics

3.4 E-commerce
- Importance of electronic sales is increasing
- Electronic purchasing more common than electronic selling
- E-commerce sales are increasing
- Substantial electronic sales in transport, manufacturing and trade
- Electronic purchasing and selling: catching up in international terms
- Strong correlation between electronic purchasing and selling

3.5 ICT security
- Dutch companies at European average in terms of formal ICT security policy
- Few Dutch companies make employees aware of ICT security duties
- ICT security incidents mainly at large companies
- More ICT, more incidents
- A high number of incidents compared with neighbouring countries
Dutch companies are making increasingly intensive use of ICT. Over 90 percent of companies had a broadband internet connection in 2009. Mobile broadband internet was used by over a quarter of Dutch companies, and over half of all companies provided telework facilities to their employees. In the ‘largest companies’ category, over 90 percent did so. Almost three-quarters of all companies applied some form of automated data exchange, the most common being the electronic receipt of invoices. The proportion of Dutch companies that engage in e-commerce is relatively high in comparison with other EU countries. The share of total sales volume generated by e-commerce does not exceed the EU average, however. Furthermore, in comparison with those in neighbouring countries, Dutch companies were relatively frequently affected by ICT security incidents.

3.1 ICT infrastructure and use

Information and communications technology (ICT) has become a major factor in business over the past decades. In the 1980s and at the beginning of the 1990s it was still possible for companies to distinguish themselves through the use of ICT. Now, virtually every company uses a form of ICT and the matter is increasingly about the way in which ICT is applied. ICT is viewed as a technology that is ‘enabling’ in nature; that is, it enables companies in various sectors to develop new products, services and processes or optimise existing versions of the foregoing (European Commission, 2009). The degree to which ICT is ultimately used is not necessarily the same for all companies and remains a decision made on economic grounds. For a company with only a limited number of suppliers, for example, it may be rational not to implement a system through which suppliers can communicate in electronic form with the company network. Conversely, such a system may increase the efficiency of business operations for a company that has many suppliers. The process of making increasingly advanced use of ICT starts with the spreading of the ICT required and development of accompanying infrastructure both within and outside the business sector. The spreading of ICT did not occur very rapidly in the Netherlands. In Scandinavian countries, for example, this process was generally much faster. However, the Netherlands undertook major efforts to close the gap and is now one of the countries with the best ICT infrastructures (Economist Intelligence Unit, 2010). It is important for developers of ICT applications to be able to reach as many potential users as possible. For them, this is one of the factors that determine whether or not investing in the development of ICT systems is economically worthwhile. Similarly, for users, the benefit of applying ICT or doing so at some point in the future depends on the number of other actual and potential users. This number is now so large that it no longer constitutes a barrier to the development and use of ICT applications.
Virtually all companies have an internet connection

At the end of 2009 virtually all companies, irrespective of size or sector, were connected to the internet (98 percent). Over 90 percent of all companies had a broadband internet connection (Figure 3.1.1). A broadband internet connection is in this case understood to mean a fixed, high-quality internet connection like cable internet, ADSL and optical fibre connections.

Although small companies make relatively intensive use of broadband internet, they do not do so to the same degree as large ones. Of the companies with 10 to 20 employees,

3.1.1 Trend in ICT use by companies, 1995–2009\(^1\)
88 percent had a broadband internet connection, whereas virtually all companies with 250 or more employees had one (99 percent). Broadband internet is the standard in virtually all sectors. Its use ranged from 82 percent of companies in ‘food and beverage service activities’ to virtually all companies active in the ‘research and development’ and ‘travel agencies’ sectors. Advanced internet applications and services on a large scale are possible because many companies have access to broadband internet. These can be provided both to other companies and to private individuals, not least because an increasing number of private individuals have access to broadband internet. Seventy-seven percent of households had a broadband internet connection in 2010. Although the percentage of companies with broadband has remained fairly stable in recent years, it has increased considerably relative to 2003. In 2003 only 54 percent of Dutch companies had access to the internet through a broadband connection. At the time, Danish, Spanish and Belgian companies were already making far greater use of broadband internet than Dutch ones (Figure 3.1.2). However, Dutch companies made tremendous

3.1.2 Companies with a fixed broadband connection, 2003–2009

![Graph showing broadband connection percentages from 2003 to 2009 for different countries.]

Source: Eurostat.

1) Companies with 10 or more employees, excluding the financial sector.

In comparisons with other countries in this chapter, a number of business categories, including financial institutions and the human health and social work activities sector, are not taken into account in the Eurostat figures because they are not observed in all countries. This may lead to small deviations with the StatLine-publications on ICT use of companies where these sectors are taken into account.
strides in the period 2004–2006. Of the benchmark countries, only Spain was ahead of the Netherlands in 2009. Surprisingly, Denmark, which had the highest percentage of companies using broadband internet in 2003, had the lowest percentage in 2009 of the benchmark countries presented in figure 3.1. The EU average in 2009 was 85 percent.

**Mobile broadband is becoming common at companies**

Mobile broadband has in recent years become a major factor in the consumer market (see also section 4.1). The technology is also used in the business sector through tablets, laptops and smartphones. Over 28 percent of all companies used a mobile broadband connection in 2009. Large companies are currently making the greatest use of mobile broadband connections in their business operations. Of companies with 500 or more employees, almost three quarters had a mobile broadband connection (72 percent), whereas just under one fifth of companies with 10 to 20 employees had such a connection (19 percent). The use of mobile broadband also differs according to sector. Relatively extensive use was made of the technology in the ‘telecommunications’ and ‘research and development’ sectors (63 percent and 62 percent of companies respectively). Mobile broadband connections were least used in the ‘food and beverage service activities’ sector (14 percent).

**Over eight in ten companies have a website**

At the end of 2009, 82 percent of Dutch companies had a website. However, the rate of increase in the percentage of companies that have websites on which they profile themselves is slowing due to a certain degree of saturation. It may be noted in this regard that 79 percent of companies already had a website in 2005. Websites are more common among larger companies than they are among smaller ones. Of the companies with 10 to 20 employees, 77 percent had a website, whereas virtually all companies with 500 or more employees had one (98 percent). Websites were fewest in the ‘retail trade’ sector. Over one in three companies in this sector had no website. The figure for the ‘financial consulting’ sector was also relatively low (69 percent). The figure was highest for the ‘travel agencies’ sector (96 percent). Companies in the ‘research and development’ and ‘refineries and chemistry’ sectors also tended to have their own websites (95 percent for both). Whether or not a company has a website is determined, among other things, by the nature of the company and its position in the production and distribution chain. Furthermore, the facilities provided by a website are determined primarily by the demand of users. Among consumers, for example, demand for facilities that enable the online booking of trips, holidays and accommodation is high. Over half of internet users booked trips and holidays online in 2010, and this level of demand is
The “Digital economy” rankings 2010

The Economist Intelligence Unit (EIU), part of The Economist Group, carries out an annual study entitled the “Digital economy” rankings (previously titled the “E-readiness” rankings) in cooperation with the IBM Institute for Business Value. The study assesses the quality of a country’s ICT infrastructure and the ability of its consumers, companies and government authorities to use ICT for their benefit. The rankings are based on over 100 criteria divided into six categories. These concern both purely technical aspects, such as the number of computer users or broadband connections, and data that reflects a country’s general economic and political environments. The six categories are: connectivity and technology infrastructure (weight in overall score: 20 percent), business environment (weight in overall score: 15 percent), social and cultural environment (weight in overall score: 15 percent), legal environment (weight in overall score: 10 percent), government policy and vision (weight in overall score: 15 percent) and consumer and business adoption (weight in overall score: 25 percent). To ensure that the study kept pace with developments in the digital world, a few new criteria were added in 2010 which resulted in adaptation of ICT becoming more important in the overall score. The rankings of 2010 and 2009 are therefore not directly comparable.

The top 15 of the Digital economy rankings 2010

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The Netherlands is fifth in the 2010 rankings, which include a total of 70 countries, and fell by two places relative to old E-readiness rankings of 2009. Sweden is top in 2010. Of the non-European countries, the United States (third), Singapore (eighth) and Australia (ninth) have relatively high scores.

The Netherlands is relatively less successful on business and socio-cultural environment. On the dimension of use of digital channels by companies and individuals the Netherlands has the highest score of all countries in 2010. The EIU’s study also reveals that the differences between countries’ scores have become smaller. This is mainly because, in their search for growth during the current period of economic recovery, multinationals are focusing on rapidly developing emerging markets. This focus has led to increasing levels of investment and prosperity in those countries, factors that affect a country’s digital environment.

Source: Economist Intelligence Unit (2010).

reflected by the fact that travel agencies and providers of accommodation frequently make it possible to book online (85 percent and 74 percent of companies respectively). This in turn illustrates the fact that the usefulness of ICT applications is to a large extent determined by the number of actual and potential users.

Figures on a detailed level concerning internet use, type of internet connection and the presence or absence of a website are contained in the statistical annex (Table 3.1) to this publication. The annex can be consulted online at www.cbs.nl/ict-knowledge-economy.
Internet used extensively at work

Sixty-one percent of employees used a computer with internet access at work in 2009. This is approximately a doubling relative to 2002 and indicates that the internet is increasingly coming to be seen as an important source of information or tool in the performance of daily work.

Almost all bank, insurance and travel agency employees use internet at work

Virtually all employees in the ‘banking’ sector used a computer with internet access (97 percent). The percentage was also high in the ‘travel agencies’, ‘insurance’ and ‘IT- and information services’ sectors. In each of these sectors, 95 percent of employees used a computer with internet access in 2009. Eighty-seven percent of employees in the ‘research and development’ sector used the internet in the performance of their work. With only 28 percent of employees in each sector making use of the technology, computers with internet access were used least in the ‘other industries and repairs’ and ‘food and beverage service activities’ sectors. Also in this case, the nature of the work largely explains the relatively low percentages.

The differences between small and large companies are only slight in this regard. At small companies (10 to 20 employees), 56 percent of employees had internet access at the workplace, whereas the corresponding figure for large companies (250 or more employees) was 63 percent.

The Netherlands is substantially above the EU average as regards the proportion of employees who use a computer with internet access at work. The EU average in 2009 was 43 percent, whereas in the Netherlands the corresponding figure was 58 percent. Of the benchmark countries included in Figure 3.1.3, Denmark had the highest percentage of employees who had a computer with internet access at their disposal (64 percent). The percentages applicable to the other Scandinavian countries were likewise high, as had been the case in 2005. In Belgium, Germany, the United Kingdom and France, the proportion was lower than in the Netherlands. Italy had the lowest percentage of the benchmark countries (33 percent).
3.2 Internal data communication

Internal data communication is a widely used ICT application in the business sector. In 2009, 83 percent of companies in the Netherlands used a fixed internal computer network, such as a local area network (LAN) consisting of at least two computers (Figure 3.2.1). Penetration was far higher among large companies: within this group, 98 percent had a fixed internal computer network.

Large companies evidently consider this application to be indispensable. As regards small companies with 10 to 20 employees, 76 percent had a fixed internal computer network. Companies active in the 'insurance' sector made the most use of fixed internal computer networks (97 percent). The use of such networks was likewise prevalent in the 'travel agencies' and 'refineries and chemistry' sectors (96 percent for both).

Companies are also making increasing use of wireless applications. Over one third of all companies had a wireless internal computer network in 2009 (37 percent). Wireless networks often exist alongside the fixed internal computer network. The flexibility and mobility provided by this technology often make it attractive for companies to invest in a
wireless local area network (WLAN). Continuous technological advances are making wireless networks increasingly fast and reliable, as a result of which differences with fixed networks have largely disappeared in this particular respect. Wireless networks are common primarily in the 'IT- and information services' sector. Over three quarters of companies in this sector had a wireless network at their disposal (76 percent). In the ‘research and development’ sector, 59 percent of companies had a wireless internal computer network.

Intranet usually in larger companies

An intranet is a way of providing information within a company and communicating with employees, and, although based on internet technology, it can only be accessed by the company's employees. One third of all companies had an intranet in 2009. To ensure that it remains a meaningful application, an intranet’s contents must be kept up to date. An intranet therefore requires more maintenance than a 'mere' internal network. An intranet makes it possible to reach many employees with relative ease and is therefore often used within large companies. Over 87 percent of companies with 500 employees or more had an intranet in 2009. Less than a quarter of the smallest companies, those with 10 to 20 employees, had an intranet (23 percent). Communicating and sharing information
through other channels is easier at a small company than it is at a large one. In addition, small companies generally have less resources to invest in the implementation and maintenance of an intranet.

An intranet is relatively common among companies primarily active in the area of ‘information and communications’. Examples in this regard include those that operate in the ‘telecommunications’ and ‘IT- and information services’ sectors, of which 76 percent and 67 percent respectively had an intranet. However, companies in the ‘insurance’ sector accounted for the highest percentage (79 percent). Broadly speaking, it can be concluded that companies active in services sectors make greater use of intranet technology than those in other sectors. Intranet use also exceeded the average among companies in the ‘research and development’ sector (58 percent).

**Extranet not common**

An extranet is related to an intranet. It is a part of an intranet that has been made accessible to parties external to the organisation in question, such as customers or suppliers. An extranet is not common among Dutch companies. Eighteen percent of companies had an extranet in 2009, and large companies make greater use of extranet technology than small ones. Thirteen percent of small companies (10 to 20 employees) had an extranet, whereas the corresponding figure for companies with 500 or more employees was 48 percent. Given that an extranet is related to an intranet, it is naturally prevalent in sectors that make extensive use of intranet technology, such as ‘telecommunications’, ‘insurance’ and ‘IT- and information services’. Fifty-eight percent of companies in the ‘telecommunications’ and ‘insurance’ sectors had an extranet, while for those in the ‘IT- and information services’ sector the corresponding figure was 47 percent. At 45 percent, the figure was again likewise high for companies in the ‘research and development’ sector.

**Number of companies with teleworkers doubled**

Internet makes it possible for both companies’ computers to communicate with each other and employees’ computers to communicate with those of the company, and this in turn makes teleworking possible. Teleworking is in this case understood to mean that an employee retains access to the company’s ICT systems while not on company premises. Fifty-six percent of companies provided telework facilities to its employees in 2009. This is a doubling relative to 2003, when 28 percent of companies provided telework facilities. Companies in the ‘IT- and information services’ sector provide the most facilities for teleworking. Eighty-nine percent of all companies in this sector provided the option of teleworking. Telework facilities were also made widely available in the ‘telecommunications’ sector.
and ‘travel agencies’ sectors (88 percent and 85 percent respectively). Companies in the ‘research and development’ sector made it possible for employees to work from home in 82 percent of the cases studied.

Teleworking is most common at large companies. Ninety-three percent of companies with more than 500 employees provided telework facilities, whereas the corresponding figure for companies with 10 to 20 employees was 44 percent.

Of all employed persons, 19 percent regularly worked off company premises while retaining access to the company’s operational systems. This is a slight increase relative to preceding years. The corresponding figures with respect to all employees in the Netherlands were 16 percent in 2007 and 18 percent in 2008. Working off company premises while retaining access to operational systems occurred most in the ‘IT- and information services’ sector (62 percent of employees in this sector). Twenty-nine percent of employees in the ‘research and development’ sector regularly teleworked.

### Percentage of companies with teleworkers doubled between 2003 and 2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>28%</td>
</tr>
<tr>
<td>2009</td>
<td>56%</td>
</tr>
</tbody>
</table>

Detailed information about the use of internal networks, intranet, extranet and teleworking is contained in the statistical annex to this publication. In Table 3.2 the figures are given according to sector and company size, while in Table 3.3 they are placed in an international context. The statistical annex can be consulted online at www.cbs.nl/ict-knowledge-economy.
Over half of companies have software for recording or processing sales orders

The continuously improving ICT infrastructure in companies has made, in addition to basic ICT facilities, more complex applications possible, such as the interlinking of a company’s different automation systems. In 2009, for example, over half of companies had software that recorded or processed sales orders (53 percent of all companies). Although software for the recording of purchase orders was less common, 43 percent of companies nevertheless had it. Companies with a sales order processing system had in most cases linked it to an invoicing or accounting system (72 percent). Purchase order processing systems were also linked to an accounting system in most cases (70 percent). In general, large companies make greater use of software to record sales and purchase orders than small ones. Of the companies with 500 or more employees, 64 percent had a sales order processing system and 72 percent had a purchase order processing system. The corresponding figures for small companies with 10 to 20 employees were 45 percent and 35 percent respectively. There are also considerable differences between large and small companies in terms of the linking of sales and purchase order processing systems. Over two thirds of companies with 500 or more employees had established a link to the logistics system, whereas approximately a quarter of companies with 10 to 20 employees had done so (Figure 3.2.2). The complexity of the business process is probably a determining factor in this regard.

Companies in the manufacturing sector headed the list in terms of having software in place for the processing of sales orders (73 percent). The same applied with respect to software through which purchase orders could be recorded (61 percent). Seventy-four percent of companies in the manufacturing sector with a sales order processing system had established an automatic link between the application and the invoicing and accounting system. Linked sales order processing systems are also prevalent in other sectors in which the timely delivery or availability of goods is of the essence. Seventy-nine percent of trading companies had established a link to an invoicing system and 68 percent had established a link to a system for the management of inventory levels, for example. Purchase order processing systems linked to a payments and accounting system were most prevalent among companies active in the ‘renting, buying and selling of real estate’ (81 percent). The corresponding figure for business service companies was likewise high (76 percent). Purchase order processing systems linked to stock management systems were most prevalent among wholesale and retail companies. Almost three quarters of the companies active in these sectors had such a system (74 percent).

ERP at one fifth of companies

Enterprise resource planning (ERP) comprises software that systematically integrates data from different business units, such as purchasing, planning, logistics and production. ERP’s purpose is to increase the productivity of organisations. Because links can be
established between, for example, purchasing, stock and sales, the business process can be better managed. Customer relationship management (CRM) is an additional functionality of ERP aimed at the company-wide collection of customer data and the dissemination of this data to increase sales opportunities. ERP therefore focuses more on the input side of the production chain, whereas CRM focuses on sales and marketing and has to do more with the output side of the chain. For this reason, there are considerable differences between sectors regarding the use of ERP and CRM (Figure 3.2.3).

### 3.2.2 Companies with order processing systems linked to other internal automation systems, 2009\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>Sales order processing system linked to an invoicing and accounting system</th>
<th>Sales order processing system linked to a stock management system</th>
<th>Sales order processing system linked to production systems</th>
<th>Sales order processing system linked to logistics systems</th>
<th>Purchase order processing system linked to a payments and accounting system</th>
<th>Purchase order processing system linked to a stock management system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>72</td>
<td>43</td>
<td>30</td>
<td>38</td>
<td>70</td>
<td>51</td>
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<td>Sector</td>
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<td>53</td>
<td>53</td>
<td>49</td>
<td>67</td>
<td>57</td>
</tr>
<tr>
<td>Electricity and gas supply, water supply, waste management</td>
<td>74</td>
<td>39</td>
<td>37</td>
<td>53</td>
<td>74</td>
<td>49</td>
</tr>
<tr>
<td>Construction</td>
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<td>Wholesale and retail trade, repair of motor vehicles</td>
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<td>68</td>
<td>27</td>
<td>48</td>
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<td>74</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>76</td>
<td>26</td>
<td>14</td>
<td>50</td>
<td>74</td>
<td>24</td>
</tr>
<tr>
<td>Accommodation and food service activities</td>
<td>41</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>Information and communications</td>
<td>62</td>
<td>35</td>
<td>25</td>
<td>30</td>
<td>60</td>
<td>38</td>
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<td>Financial institutions</td>
<td>68</td>
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<td>40</td>
<td>26</td>
<td>74</td>
<td>23</td>
</tr>
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<td>Renting, buying and selling of real estate</td>
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<td>19</td>
<td>14</td>
<td>81</td>
<td>19</td>
</tr>
<tr>
<td>Consultancy, research and other specialist business services including Research institutes</td>
<td>73</td>
<td>20</td>
<td>27</td>
<td>23</td>
<td>76</td>
<td>27</td>
</tr>
<tr>
<td>Renting and leasing of tangible goods and other business support services</td>
<td>66</td>
<td>38</td>
<td>25</td>
<td>32</td>
<td>71</td>
<td>33</td>
</tr>
<tr>
<td>Human health and social work activities</td>
<td>65</td>
<td>36</td>
<td>22</td>
<td>27</td>
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<td>43</td>
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<td>Company size</td>
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<td></td>
</tr>
<tr>
<td>10–19 employees</td>
<td>69</td>
<td>36</td>
<td>22</td>
<td>27</td>
<td>60</td>
<td>43</td>
</tr>
<tr>
<td>20–49 employees</td>
<td>73</td>
<td>42</td>
<td>29</td>
<td>38</td>
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<td>50</td>
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<td>50–99 employees</td>
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<td>100–249 employees</td>
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<td>61</td>
<td>48</td>
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<td>65</td>
</tr>
<tr>
<td>250–499 employees</td>
<td>83</td>
<td>61</td>
<td>49</td>
<td>58</td>
<td>78</td>
<td>60</td>
</tr>
<tr>
<td>500 or more employees</td>
<td>88</td>
<td>66</td>
<td>59</td>
<td>67</td>
<td>82</td>
<td>67</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT use by enterprises 2009.

\(^1\) Companies with 10 or more employees.
Twenty-one percent of all companies used ERP software in 2009. Use of this software among manufacturing companies was 39 percent and the percentage was also relatively high among companies in ‘electricity and gas supply; water supply; waste management’ and ‘information and communications’ (33 percent and 27 percent respectively). The nature of the business process in ‘accommodation and food service activities’ and ‘human health and social work activities’ accounts for the low percentage of ERP users in these sectors.

3.2.3 Use of ERP and CRM software according to sector, 2009

Given that CRM is aimed at strengthening the output side of the chain, the percentage of companies with CRM software was notably high in services sectors like ‘information and communications’ (57 percent), ‘financial institutions’ (45 percent), and ‘consultancy research and other specialised business’ (31 percent). Marketing is very important in these sectors. A substantial proportion of companies evidently recognise that CRM can play a part in increasing customer satisfaction and customer revenue. Over 90 percent of companies with CRM software stored customer data and 71 percent actually analysed the data as well. Companies in ‘consultancy research and other specialised business services’ made relatively extensive use of CRM but only limited use of ERP. Research companies, which are included in this sector, made above-average use of ERP and CRM. Twenty-five percent of research companies used ERP software and 34 percent used software for CRM.
ERP use by Dutch companies equal to EU average

Relative to companies in other European countries, ERP use by Dutch companies is average. The EU average was 22 percent in 2009, which corresponds with the figure for Dutch companies that used ERP. Companies in Belgium used ERP most (40 percent). At 22 percent, the use of CRM by Dutch companies was a few percentage points below the EU average, which was 27 percent in 2009. CRM applications are used most by Danish and Belgian companies (45 percent and 44 percent respectively).

One in four companies uses open source software

The ‘Open source definition’ provided by the ‘Open Source Initiative’ sets out ten criteria that must be complied with before software can be classified as open source (Open Source Initiative, 2011). In summary, the matter concerns software in respect of which the source code may be read, additions or improvements may be introduced and further distribution is permitted. Although open source software is in general freely available, this is not automatically the case: a provider may ask money for the product. In addition, installing, becoming familiar with and maintaining the software require investments. It is not uncommon for voluntary financial contributions to be made for the development or, as the case may be, further development of open source software. Companies may also opt to have employees participate in the development of open source software, which can also be seen as a form of investment. Linux and OpenBSD are well-known open source operating systems. Office and business applications, such as the OpenOffice suite and Firefox web browser, are also available in open source versions.

The use of open source software is being encouraged by the central government. The aim in this regard is to advance interoperability between companies, government authorities and citizens, increase the independence of suppliers in the purchase and use of ICT and promote both a level playing field and innovation in the software market (Ministry of Economic Affairs, 2010). Using open source software can also have drawbacks. Broad support is not always available for this kind of software, for example.

Twenty-five percent of all companies used open source software in 2009 (Figure 3.2.4). This does not mean, however, that all software within these companies was of an open standard, since the use of open source software could be limited to a single server within a company. Fourteen percent of all companies used open source software in operating systems or on servers. One in five companies used an open source version of office and business applications.

Small companies made less use of open source software than large ones. Twenty-two percent of small companies with 10 to 20 employees had open source software, whereas the corresponding figure for companies with 500 or more employees was 52 percent. The difference is primarily in the use of open source operating systems and server software,
both of which were used far more by large companies than by small ones. Differences between large and small companies in terms of having open source office suites are much less pronounced. Nineteen percent of the smallest companies used such suites. The corresponding figure for companies with 500 or more employees was 25 percent.

The use of open source software is most prevalent among companies in the 'information and communications' sector. Fifty-seven percent of companies in this sector were using an open source application. This indicates that ICT knowledge plays a part in the use of open source software. Use was also relatively prevalent among companies in the 'consultancy research and other specialised business services' and 'renting, buying and selling of real estate' sectors (35 percent and 34 percent respectively). Penetration of open

Source: Statistics Netherlands, ICT use by companies 2009.

1) Companies with 10 or more employees.
source software is lowest among companies active in ‘transport and storage’ (19 percent) and the ‘construction’ sector (16 percent).

A lower level of industrial classification reveals that open source software is used most in ‘telecommunications’ (67 percent) and ‘IT- and information services’ (59 percent). Research companies also make relatively extensive use of open source software. Forty-six percent of all companies in the ‘research and development’ sector used open source software in 2009. Slightly less than one third (32 percent) of research companies used open source operating software and slightly more than one third (36 percent) used open source office applications.

Use of open source operating software at Dutch companies average

At 14 percent, the use of open source software for operating systems or servers by Dutch companies in 2009 was average relative to other European countries. The corresponding figure for Germany, the leading country in this area, was 27 percent, almost twice as high as that of the Netherlands. Use of open source operating software was relatively limited in the United Kingdom and Denmark (9 percent for both). At 8 percent, Norway has the lowest percentage of open source operating software among European countries.

3.3 External data communication

External data communication concerns the ability to communicate with a computer or computers of third parties by means of a company computer. Electronic data communication between companies has been taking place for a number of decades already. However, the way in which this communication occurs has changed profoundly over the years. The first one-to-one or one-to-n networks were created at the beginning of the 1990s. These made it possible for a company to communicate with one or more other companies. Nevertheless, it was by no means always possible for all companies to communicate with each other in one-to-n networks. Internet technology ensured that when an individual user had access to a network, this user could also communicate with other users within that network. In addition, because many companies now have a broadband internet connection, advanced applications can also be used. Examples in this regard include systems for the sending and receiving of orders and invoices and systems to manage the flow of goods and funds in the chain to which a company belongs. The online purchase and sale of goods (e-commerce) is also made easier by the use of broadband.

Companies with ten or more employees, excluding the financial sector.
3.3.1 ICT use by companies according to external data communication applications, 2006 and 2009

![Bar chart showing ICT use by companies in 2006 and 2009](chart.png)

Source: Statistics Netherlands, ICT use by companies 2006 and 2009.

1) Companies with 10 or more employees.

**Intensity of ICT use is increasing**

The intensity of ICT use by companies has continuously increased. Websites are no longer used by companies solely to profile themselves. Their functions now include recruiting personnel (39 percent of company websites in 2009) and displaying product catalogues or price lists (31 percent of company websites in 2009), for example. More advanced applications like accepting online orders (23 percent) and customised pages for regular customers (11 percent) were likewise regularly used. To a lesser extent, the same applies to the options of modifying products (5 percent) and tracking orders (6 percent).

Internet technology is also widely used to communicate with government authorities. Ninety-five percent of companies communicated with the government by means of the internet in 2009 (Figure 3.3.1). This is a considerable increase relative to 2006, when the corresponding figure was 80 percent. Frequent use was made of the internet in 2009 mainly for obtaining and downloading forms (94 percent of companies) and returning them electronically (93 percent). This kind of use primarily concerned VAT and income tax returns and subsidy applications.

The percentage of companies that conduct financial transactions through the internet is still on the rise. Ninety-one percent of companies used the internet for online banking in 2009, for example, whereas the corresponding figure for 2006 was 85 percent. Banks
strongly encourage online banking and the fear of fraud that existed when this form of banking first emerged has largely disappeared.

**Application of automated data exchange related to company characteristics**

Electronic transmission of data is faster and often cheaper than conducting such exchange in written and printed form and therefore makes efficiency gains possible, all the more so when that electronic transmission of data is automated. Whether or not through a website, automated data exchange (ADE) can be applied in different ways. International standards that describe the required format of the messages are often used. Examples of

<table>
<thead>
<tr>
<th>3.3.2 Automated data exchange by companies according to purpose, 2009</th>
<th>Applies some form of ADE</th>
<th>Sends purchase orders to suppliers</th>
<th>Receives e-invoices</th>
<th>Receives orders from customers</th>
<th>Sends e-invoices</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of companies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
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<td>31</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>Sector</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>76</td>
<td>29</td>
<td>28</td>
<td>29</td>
<td>13</td>
</tr>
<tr>
<td>Electricity and gas supply, water supply, waste management</td>
<td>79</td>
<td>22</td>
<td>29</td>
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<tr>
<td>Construction</td>
<td>71</td>
<td>22</td>
<td>25</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Wholesale and retail trade, repair of motor vehicles</td>
<td>71</td>
<td>22</td>
<td>35</td>
<td>25</td>
<td>16</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>79</td>
<td>17</td>
<td>35</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Accommodation and food service activities</td>
<td>67</td>
<td>26</td>
<td>33</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Information and communications</td>
<td>75</td>
<td>27</td>
<td>34</td>
<td>20</td>
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<td>Financial institutions</td>
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<td>33</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>Renting, buying and selling of real estate</td>
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<td>34</td>
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<td>including Research institutes</td>
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<td>Renting and leasing of tangible goods and other business support services</td>
<td>73</td>
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<td>30</td>
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<td>Human health and social work activities</td>
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<tr>
<td>Company size</td>
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<td>10– 19 employees</td>
<td>67</td>
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<td>20– 49 employees</td>
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<td>31</td>
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<td>50– 99 employees</td>
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<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT use by enterprises 2009.

1) Companies with 10 or more employees.
well-known formats are XML and EDIFACT. ADE is used for, among other things, sending and receiving orders, invoices and product information. ADE can also be used to send payment orders to banks and information to the tax authorities.

Seventy-two percent of all companies used some form of ADE in 2009. ADE was most frequently used for receiving e-invoices. Thirty-one percent of companies applied this form of ADE. Companies made far less use of ADE to send e-invoices (12 percent).

Also in this case, large companies make greater use of ADE than small ones. Sixty-seven percent of small companies (10 to 20 employees) used some form of ADE in 2009. At 92 percent, the corresponding figure for large companies (500 or more employees) was much higher. In particular, the difference in the use of ADE to send purchase orders to suppliers is considerable. Forty-eight percent of large companies sent purchase orders using ADE, whereas the corresponding figure for small companies was 23 percent.

Differences between the different sectors in the use of ADE are somewhat less pronounced. Eight in ten companies active in the ‘leasing and trading in immovable property’ used some form of ADE in 2009. At the same time, however, use in the ‘accommodation and food service activities’ sector, the one in which ADE was least prevalent, still amounted to over two thirds of companies. ADE is evidently advantageous in a broad range of sectors.

Differences are greatest with respect to receiving orders. Thirty percent of ‘financial institutions’ and companies active in ‘transport and storage’ used a system that made this possible, whereas only 9 percent of companies in the ‘human health and social work activities’ sector had an automated order processing system. Although ADE is therefore used to a high degree in all sectors, the way in which it is applied depends on the specific characteristics of the sector in question.

3.4 E-commerce

A specific use of electronic networks is the actual online ordering of goods and services. Such transactions were already taking place between companies before the ‘internet era’. At that time, however, they were conducted through networks in which the companies involved had specially invested and that only those companies could use. In technical terms, internet technology has lowered the threshold for everyone regarding the ability to order goods and services online. This also applies to consumers, who had not featured in this context in the past.

A large number of business processes within and between companies can be organised more efficiently by means of ICT. Such efficiency gains can be achieved without the final transaction also being automated, however. In this sense, the transaction is only the end of what is primarily a process of data exchange. Nevertheless, the number of companies
that conclude electronic transactions and the value of these transactions are clear indicators of a sector’s or country’s development in terms of e-commerce.

**Importance of electronic sales is increasing**

List 3.4.1 shows that 23 percent of all companies used the internet or other electronic networks in 2009 to receive orders. The corresponding figure for 2008 was 25 percent. The number of companies that achieved sales through websites is more or less the same as the number of companies that achieved sales through non-public electronic systems. Large companies engage in electronic sales to a greater extent than small ones. Twenty percent of

### 3.4.1 Electronic purchasing and selling by companies, 2009

<table>
<thead>
<tr>
<th>Selling</th>
<th>Purchasing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accounting for 5% or more of total sales</td>
</tr>
<tr>
<td>% of all companies</td>
<td>% of companies that engaged in electronic selling</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
</tr>
</tbody>
</table>

**Sector**

<table>
<thead>
<tr>
<th>Selling</th>
<th>Purchasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of all companies</td>
<td>% of companies that engaged in electronic selling</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>27</td>
</tr>
<tr>
<td>Electricity and gas supply, water supply, waste management</td>
<td>17</td>
</tr>
<tr>
<td>Construction</td>
<td>13</td>
</tr>
<tr>
<td>Wholesale and retail trade, repair of motor vehicles</td>
<td>29</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>31</td>
</tr>
<tr>
<td>Accommodation and food service activities</td>
<td>22</td>
</tr>
<tr>
<td>Information and communications</td>
<td>28</td>
</tr>
<tr>
<td>Financial institutions</td>
<td>37</td>
</tr>
<tr>
<td>Renting, buying and selling of real estate</td>
<td>8</td>
</tr>
<tr>
<td>Consultancy, research and other specialised business services</td>
<td>18</td>
</tr>
<tr>
<td>including Research institutes</td>
<td>34</td>
</tr>
<tr>
<td>Renting and leasing of tangible goods and other business support services</td>
<td>22</td>
</tr>
<tr>
<td>Human health and social work activities</td>
<td>12</td>
</tr>
</tbody>
</table>

**Company size**

<table>
<thead>
<tr>
<th>Selling</th>
<th>Purchasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of all companies</td>
<td>% of companies that engaged in electronic selling</td>
</tr>
<tr>
<td>10– 19 employees</td>
<td>20</td>
</tr>
<tr>
<td>20– 49 employees</td>
<td>23</td>
</tr>
<tr>
<td>50– 99 employees</td>
<td>28</td>
</tr>
<tr>
<td>100–249 employees</td>
<td>31</td>
</tr>
<tr>
<td>250–499 employees</td>
<td>34</td>
</tr>
<tr>
<td>500 or more employees</td>
<td>36</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT use by enterprises 2009.

---

1) Companies with 10 or more employees.
companies with 10 to 20 employees achieved part of their sales by electronic means, whereas the corresponding figure for companies with 500 or more employees is 36 percent. In spite of the slight decrease in the proportion of companies engaged in electronic sales, a sharp increase occurred with respect to the number of companies that achieved at least 5 percent of their total sales by electronic means. This applied to 80 percent of all companies with electronic sales in 2009, whereas the corresponding figure for 2008 was 66 percent. On balance, the importance of electronic sales for Dutch companies has therefore increased considerably.

**Electronic purchasing more common than electronic selling**

Electronic purchasing is used by a higher proportion of companies than electronic selling. Forty-three percent of all companies did at least part of their purchasing electronically in 2009. Particularly for purchasing through the internet, less investment is required than for facilitating electronic sales. The threshold for electronic purchasing is therefore lower. Also in this case, large companies are more active than small ones. Forty-one percent of companies with 10 to 100 employees did part of their purchasing electronically in 2009, whereas the corresponding figure for companies with over 500 employees is 72 percent. This difference can probably be explained by the fact that large companies often purchase on a large scale, have relatively highly developed ICT systems and have large investment budgets relative to small companies.

**E-commerce sales are increasing**

Sales achieved by companies electronically increased from over 3 percent in 1999 to over 14 percent in 2009 (figure 3.4.2). Following the drop in 2008, a new peak was reached in 2009. Assuming that the average value of an order remained more or less the same, this means that more transactions were concluded electronically in 2009, which is in keeping with one of the advantages of using electronic networks, namely the reduction of transaction costs. Sales achieved are an indicator of the growth of e-commerce. The increase in the number of transactions concluded electronically is the determinative factor with respect to the efficiency gain.

**Substantial electronic sales in transport, manufacturing and trade**

Of all sectors, the percentage of sales achieved through electronic networks, namely 22 percent, is highest in ‘transport and storage’ (figure 3.4.3). This sector also includes airlines, which receive a large part of their bookings electronically.
The ‘accommodation and food service activities’ sector achieved 15 percent of its sales by electronic means. This sector consists of two groups on opposite extremes of the electronic sales spectrum. Providers of accommodation have adopted e-commerce on a large scale, whereas bars and restaurants are far less active in this respect.

### High level of e-commerce for hotels, low levels for pubs, cafés and restaurants

The ‘manufacturing’ and ‘wholesale and retail trade’ sectors have been engaged in e-commerce for a long time. Both sectors achieved over 17 percent of their sales by electronic means in 2009. Although they still make relatively frequent use of different, (older) electronic networks, these networks continue to contribute substantially to total sales.
sales, in part because they are used to conclude major transactions. The share of sales achieved by electronic means is somewhat lower in the business services sector. This sector is characterised by a high degree of customised work, as a result of which direct negotiations are frequently preferred prior to the placing of an order. Large companies achieve a considerably greater share of their sales through electronically received orders than small ones. Companies with less than 50 employees are far below the average in this regard. Nevertheless, small companies are catching up. The group with 10 to 20 employees made the greatest advance in percentage terms. It is also striking that companies with 500 or more employees no longer lead the field in this area. Although the share of sales achieved by electronic means did indeed increase for these largest companies relative to 2008, growth was stronger among companies with 100 to 500 employees.

### 3.4.3 E-commerce sales according to sector and company size, 2009

<table>
<thead>
<tr>
<th>Sector</th>
<th>10-19 employees</th>
<th>20-49 employees</th>
<th>50-99 employees</th>
<th>100-249 employees</th>
<th>250-499 employees</th>
<th>500 or more employees</th>
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<tbody>
<tr>
<td>Human health and social work activities</td>
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<tr>
<td>Electricity and gas supply, water supply, waste management</td>
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</tr>
<tr>
<td>Renting, buying and selling of real estate</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultancy, research and other specialised business services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renting and leasing of tangible goods and other business support services</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Information en communications</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Accommodation and food services activities</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Wholesale and retail trade, repair of motor vehicles</td>
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<tr>
<td>Manufacturing</td>
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<td></td>
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<tr>
<td>Transport and storage</td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT use by companies 2009.

1) Companies with 10 or more employees.
2) Excluding financial institutions.
3) ‘Renting, buying and selling of real estate’ and ‘Consultancy, research and other specialised business services’ have been combined.
Electronic purchasing and selling: catching up in international terms

In comparison with other EU countries, companies in the Netherlands performed above average in 2009 with respect to electronic purchasing and selling. As regards the proportion of companies engaged in electronic sales, the Netherlands was slightly above the average in 2004. Nevertheless, at that time, it lagged considerably behind the leaders (the United Kingdom, Norway and Denmark). In 2009, however, the Netherlands was clearly above the EU average (figure 3.4.4). Although Norway (not an EU member) still retains a considerable lead, the Netherlands is now among the top group and was indeed one of the leading countries in 2009 in terms of number of companies engaged in electronic selling.

Although the percentage of companies engaged in electronic purchasing in the Netherlands was lower than the EU average in 2004, it was slightly higher than this average in 2009. The corresponding percentages for Norway, Sweden, Denmark, Germany and Ireland were high in both years. The United Kingdom remains a leader in this regard, though the percentage there has dropped. The sharpest increase over the last five years occurred in Belgium, which is now one of the top three.

3.4.4 Companies engaged in electronic selling, international, 2004 and 2009¹²

Source: Eurostat.

¹) Companies with 10 or more employees, excluding financial institutions.
²) Electronic sales account for at least 1% of total company turnover.
Strong correlation between electronic purchasing and selling

Figure 3.4.6 compares the levels of electronic purchasing and selling by companies in various European countries. Purchasing through electronic networks is more common than electronic selling in all countries. Earlier in this section, it was stated that, in contrast to facilitating electronic sales, electronic purchasing hardly requires investments. There is a fairly strong correlation between electronic purchasing and selling. Countries that have a high percentage of companies that purchase electronically often have a high percentage of companies that sell electronically.

It is striking that Finland is around the EU average when it comes to electronic purchasing and selling activity, whereas it is among European leaders in most of the other areas pertaining to intensive ICT use. By contrast, levels of electronic purchasing and selling activity are high in the other Scandinavian countries and Belgium. In the United Kingdom, for example, electronic networks are used relatively frequently for the purchase of goods and services, whereas in the Netherlands electronic selling is relatively common.

For many years already, turnover achieved by Dutch companies through e-commerce has lagged behind Europe’s leading countries in this area. The percentage of sales achieved by electronic means in the Netherlands was equal to the EU average in 2009, while in 2004, it was somewhat lower than this average. By contrast, Ireland, Norway (not an EU
3.4.6 Companies engaged in electronic purchasing and selling, international, 2009

Source: Eurostat.

1) Companies with 10 or more employees, excluding financial institutions.
2) Cyprus and Slovakia share the same point.
3) Electronic selling/purchasing account for at least 1% of total company turnover/orders.

3.4.7 Sales achieved by companies through the electronic receipt of orders, international, 2004 and 2009

Source: Eurostat.

1) Companies with 10 or more employees, excluding financial institutions.
member), Germany, Finland and Sweden have traditionally performed well in this area. Belgium and the Czech Republic have made tremendous progress in this regard and are now also among the leading countries. Although Denmark and the United Kingdom are still among the leaders, the share of sales achieved by electronic means has hardly risen in those countries. A degree of caution must be exercised with respect to all figures concerning e-commerce sales, since companies often find it very difficult to accurately identify the percentage of their total sales achieved through electronic selling.

3.5 ICT security

Most companies store important and often also confidential information in digital form. In contrast to paper documents, digital documents do not take up any physical storage space. Moreover, they can be retrieved easily and rapidly from every workplace and can be accessed by several users simultaneously. It is also easy to make backups so that information is not lost in the event of, for example, a fire or water damage. Digital documents come with their own set of problems, however. They can be destroyed or corrupted by breakdowns or malfunctions, for example. Furthermore, in this era in which virtually all companies are connected to the internet, there is the risk of confidential documents being accessed by parties with malicious intent, for instance for the purpose of gaining access to bank balances or securing a gain through other means at the cost of the company or its customers or suppliers. Various measures are available to prevent such breaches. Virus scanners and firewalls were already present at most companies a few years ago.3 Other more modern security measures include the identification of users and their personal access rights by means of hardware tokens or biometric methods. Companies can also reduce the risk of security incidents by making employees aware of their duties in relation to ICT security.

Dutch companies at European average in terms of formal ICT security policy

The formal adoption and regular review of an ICT security policy is an important indication that a company recognises the importance of ICT security. An ICT security policy encompasses, among other things, the configuration of servers and networks, remote

access, the internet and e-mail use of employees, rules and procedures governing passwords and raising awareness of the dangers among employees. Figure 3.5.1 shows that 29 percent of companies in the Netherlands have formally adopted and regularly review an ICT security policy. This is slightly higher than the EU average of 27 percent. France is below this average (22 percent). It is also striking that no country has a figure in excess of 50 percent. ICT security policies are far more common among companies with 250 or more employees than they are among SMEs. Sixty-eight percent of the largest companies in the Netherlands have an ICT security policy. This percentage is close to the European average. Large companies in the Netherlands do somewhat better in this regard than large companies in Germany and France, but the difference is pronounced vis-à-vis the Scandinavian countries in particular, all of which have corresponding figures in excess of 80 percent.

3.5.1 Companies with a formally adopted ICT security policy, international, 2009

Figures for companies in the financial sector, which often work with information that is confidential and susceptible to fraud, were not included in those on which Figure 3.5.1 is based. Fifty-one percent of Dutch companies in this sector have a formally adopted ICT security policy. This is the lowest percentage of all European countries. The EU average is 79 percent. The corresponding figures for Norway (not an EU member), Sweden and Germany exceed 90 percent.
Few Dutch companies make employees aware of ICT security duties

Companies can reduce ICT security risks by making employees aware of their duties in relation to ICT security. This can be done by, for example, making training courses available to employees, having ICT-related duties included in employment or additional contracts or providing information to employees through the intranet, newsletters or paper documents. Thirty-three percent of Dutch companies used such a method in 2009. This is far below the European average of 48 percent. With a corresponding figure of 29 percent, France is even lower than the Netherlands in this regard, whereas, by contrast, the corresponding figure for Finland is 80 percent. Three quarters of Finnish companies provide voluntary training courses or make ICT-related duties known through generally available information. Compulsory training courses are most common in Italy, namely at 39 percent of companies. The corresponding figure for the Netherlands is 10 percent, while the European average is 20 percent.

3.5.2 Method by which companies make employees aware of duties in relation to ICT security, international, 2009

Source: Eurostat.

% of companies

Companies with 10 or more employees, excluding financial institutions.
**ICT security incidents mainly at large companies**

There are different kinds of ICT-related security incidents. ICT services may become unavailable or data may be corrupted as a result of breakdowns or malfunctions in hardware or software, for example. ICT services may also become unavailable as a result of an external attack. Such instances include, among others, the unavailability of a website due to the server being loaded with many requests simultaneously. In addition, data can be corrupted or destroyed by viruses or by unauthorised access, or confidential data may be disclosed as a result of pharming or phishing. 4) Finally, a company’s own

<table>
<thead>
<tr>
<th>3.5.3 Security incidents at companies, 20091)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unavailability of services due to breakdown or malfunction</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td><strong>Sector</strong></td>
</tr>
<tr>
<td>Manufacturing</td>
</tr>
<tr>
<td>Electricity and gas supply, water supply, wastewater management</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Wholesale and retail trade, repair of motor vehicles</td>
</tr>
<tr>
<td>Transport and storage</td>
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<tr>
<td>Accommodation and food service activities</td>
</tr>
<tr>
<td>Information and communications</td>
</tr>
<tr>
<td>Financial institutions</td>
</tr>
<tr>
<td>Renting, buying and selling of real estate</td>
</tr>
<tr>
<td>Consultancy, research and other specialised business services</td>
</tr>
<tr>
<td>Including Research institutes</td>
</tr>
<tr>
<td>Renting and leasing of tangible goods and other business support services</td>
</tr>
<tr>
<td>Human health and social work activities</td>
</tr>
<tr>
<td><strong>Company size</strong></td>
</tr>
<tr>
<td>10–19 employees</td>
</tr>
<tr>
<td>20–49 employees</td>
</tr>
<tr>
<td>50–99 employees</td>
</tr>
<tr>
<td>100–249 employees</td>
</tr>
<tr>
<td>250–499 employees</td>
</tr>
<tr>
<td>500 or more employees</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT use by enterprises 2009.

1) Companies with 10 or more employees.

4) ’Pharming’ and ’phishing’ are described in the Glossary at the end of this publication.
employees may intentionally or unintentionally disclose confidential company information. Such incidents can seriously damage a company in both tangible and intangible senses. ICT security incidents occur relatively frequently at large companies (List 3.5.3). Sectors that make extensive and advanced use of ICT, such as ‘information and communications’ and ‘financial institutions’, are likewise frequently affected by ICT security incidents. Moreover, financial institutions are often attractive targets for criminals.

More ICT, more incidents

ICT security incidents occur more frequently at companies that make relatively extensive and advanced use of ICT than at those that use ICT less. This is reflected by the fact that large companies are more frequently affected by ICT incidents than small ones, since large companies use ICT more intensively than small ones. ICT-intensive sectors are likewise affected more frequently by ICT security incidents than less ICT-intensive ones. Figure 3.5.4 shows that, in terms of sectors, there is a fairly clear correlation between the use of broadband internet and the occurrence of ICT security incidents.

3.5.4 Correlation between broadband internet and ICT incidents, 2009

![Diagram showing the correlation between broadband internet and ICT incidents, 2009.](image)


1) Companies with 10 or more employees.
A high number of incidents compared with neighbouring countries

At least one type of ICT incident occurred at 22 percent of Dutch companies in 2009 (Figure 3.5.5). The European average was 15 percent. The situation in this regard was clearly more favourable in Germany (11 percent) and the United Kingdom (6 percent). With a corresponding figure of 40 percent, Portugal had the highest percentage of companies that were affected by ICT security incidents.

In all countries, these incidents occurred more frequently at companies with 250 or more employees than at smaller ones. Forty-three percent of companies in the Netherlands of this larger size were affected by incidents. The EU average was 25 percent. The proportion of large companies affected by ICT security incidents.

Large Dutch companies frequently affected by ICT security incidents

<table>
<thead>
<tr>
<th>Netherlands</th>
<th>EU average</th>
</tr>
</thead>
<tbody>
<tr>
<td>43%</td>
<td>25%</td>
</tr>
</tbody>
</table>

\[^5\] This composite variable does not include figures on the disclosure of information by a company’s own employees.
incidents in the Netherlands was also high relative to its neighbours. The corresponding figure for Germany was 22 percent, for Belgium 24 percent and for the United Kingdom only 10 percent. The situation in this regard was least favourable in Finland, where 47 percent of large companies were affected by security incidents. Together with Denmark, Norway (not an EU member) and Portugal, the Netherlands belongs to the group of countries with the most problems in this area.

Figure 3.5.5 does not show a clear correlation between intensive ICT use and level of ICT security incidents. Companies in Scandinavian countries and in the Netherlands, where ICT use is fairly intensive, are frequently affected by ICT security incidents. The same applies to Portugal, however, which is not among Europe’s most advanced countries in terms of ICT. In addition, very few companies in Germany and the United Kingdom are affected by ICT security incidents, even though the level of ICT use in these countries is high. Cultural differences between countries may also play a part in the willingness of companies to report ICT security incidents.

3.5.5 Companies affected by ICT security incidents, international, 2009

Source: Eurostat.

1) Companies with 10 or more employees, excluding financial institutions.
2) This bar graph does not include figures concerning the disclosure of information by a company’s own employees.
ICT use by households and individuals
ICT use by households and individuals

4.1 ICT facilities in households
• PC ownership a matter of course
• Netherlands leading in terms of internet access
• Internet access: laptop and mobile phone gradually replacing desktop
• Large rise in mobile internet access
• Lack of interest main reason for no internet use
• Over eight in ten people use the internet daily
• Internet used most at home

4.2 Activities and services on the internet
• Communication main internet activity
• Internet also extensively used as a source of information
• More diversity in internet activities
• Online banking an integral part of life
• Almost half of young people search online for information about education and training
• Level of visits to government websites stable
• Instant messaging most popular form of social media
• Social media use by Dutch young people almost highest in the EU
• Number of e-shoppers up again in 2010
• Netherlands among top e-shopping countries
• Typical Dutch e-shopper: male, 25–44 years, higher education
• Travel, holidays and accommodation often booked online
• Internet banking most commonly used payment option
• Preference for traditional shopping main reason for not shopping online

4.3 Internet and security
• Two-thirds of internet users concerned about misuse of personal data
• Spam and viruses affect many users
• Older people experience fewer security problems
• Fewer computer viruses, but more spam in the Netherlands
• Security concerns mainly limit the use of social media
• Making backups becoming more common
• Almost all internet users have security software
• Netherlands top in EU in use of security software
ICT has acquired an important place in the life of virtually every individual in the Netherlands. Modern means of information and communication are becoming increasingly common in households and are being used more intensively. A growing proportion of users are engaging in an expanding range of internet activities both inside and outside the home. ICT is therefore becoming strongly intertwined with the daily lives of Dutch people. The increasing use of ICT also entails risks, however. Many internet users receive unwanted e-mails and are affected by viruses. A high proportion of them are also concerned about the abuse of personal data or other forms of privacy breaches. As evidenced by the very extensive use of security software to protect PCs and personal data, Dutch people are keenly aware of the dangers associated with internet use.

4.1 ICT facilities in households

Many people can no longer imagine a life without computers, the internet and mobile telephones. Applications that could previously be used only through a fixed internet connection are now also available on mobile platforms. The increasing digitisation of society is also affecting the individual's private domain, namely the household.

PC ownership a matter of course

The PC has become a standard part of Dutch households, 92 percent of which had a desktop or laptop in 2010 (Figure 4.1.1). This amounts to 6 million households comprising 12.3 million individuals. Although the proportion of households with a PC has increased continuously over the past years, the rate of growth slowed more recently. The percentage of households with a desktop or laptop in 2010 was only one percentage point higher than in 2009. The saturation point has to all intents and purposes therefore been reached.

Ninety-one percent of households had access to the internet in 2010. This is practically the same as the percentage of households with a PC. In other words, virtually all households with a PC are connected to the internet. As was the case with the percentage of PC owners, the proportion of households with internet access also increased sharply in the period 2002–2010.

The rate of growth likewise slowed more recently relative to the beginning of this period. By way of illustration, the proportion of households with internet access in 2010 was almost 30 percentage points higher than in 2002, whereas it increased by only one percentage point relative to 2009.
Broadband internet is also becoming increasingly embedded in Dutch households, 84 percent of which had access to the internet through a broadband connection in 2010. The corresponding figure for 2002 was a mere 15 percent.

Netherlands leading in terms of internet access

Of the benchmark countries specified in Figure 4.1.2, the Netherlands had the highest percentage of households with internet access in 2010. Over nine in ten Dutch households were connected. This proportion was likewise high among Norwegian, Swedish and

4.1.1 ICT facilities of households and individuals, 2002–2010

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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</thead>
<tbody>
<tr>
<td><strong>Households</strong></td>
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<tr>
<td>% of households</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC (desktop/laptop)</td>
<td>76</td>
<td>76</td>
<td>80</td>
<td>83</td>
<td>84</td>
<td>86</td>
<td>88</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>5.7</td>
<td>5.7</td>
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<td>6.0</td>
<td></td>
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<tr>
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<td>71</td>
<td>78</td>
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<td>83</td>
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<tr>
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<td>22</td>
<td>34</td>
<td>54</td>
<td>66</td>
<td>74</td>
<td>77</td>
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<td><strong>Individuals</strong></td>
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<td></td>
<td></td>
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<td>% of individuals</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PC (desktop/laptop)</td>
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<td>87</td>
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<tr>
<td></td>
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</tr>
<tr>
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<td>78</td>
<td>79</td>
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<td>10.3</td>
<td>11.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


1) Private households with at least one individual aged 12 to 74.
2) Individuals aged 12 to 74 in private households.

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Danish households. It was lowest in Italy, Spain and Portugal. Of all households in the EU, seven in ten had internet access in 2010. At 84 percent, the proportion of Dutch households with broadband internet was also the highest of all European countries in 2010. In addition to the Netherlands, Sweden, Norway and Denmark likewise have a high proportion of households with broadband internet. Of all households in the EU, 61 percent had a broadband connection. As with internet access in general, broadband penetration was lowest in Italy, Portugal and Spain.

**Internet access: laptop and mobile phone gradually replacing desktop**

Progressively fewer Dutch households are using a desktop to access the internet. Whereas this proportion was 93 percent in 2005, it had dropped to three quarters in 2010 (Figure 4.1.3).

**4.1.2 Households with internet access and broadband internet, international 2010**

![Households with Internet Access and Broadband Internet](chart)

Source: Eurostat.

1) Individuals aged 16 to 74 in private households.

Other devices are increasingly being used to access the internet. In 2010, for example, a laptop was used for this purpose by over two-thirds of households; more than double the share in 2005. Internet use by means of mobile telephones is also on the rise. At least one...
person accessed the internet through a mobile telephone in 35 percent of households. This is almost a tripling relative to 2005. Increasing use is also being made of other devices to access the internet. Internet use through television sets with set-top boxes and video game consoles was virtually non-existent in 2005, for example, whereas in 2010 one in ten households had a television set with an internet connection and 16 percent accessed the internet through a video game console. In spite of the increasing use of these kinds of devices, however, the desktop remained the most common means of accessing the internet in 2010.

### 4.1.3 Devices that can access the internet in households

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop computer</td>
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<td>91</td>
<td>89</td>
<td>84</td>
<td>83</td>
<td>78</td>
</tr>
<tr>
<td>Laptop computer</td>
<td>27</td>
<td>32</td>
<td>42</td>
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<td>62</td>
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</tr>
<tr>
<td>Mobile telephone</td>
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<td>13</td>
<td>19</td>
<td>22</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Palmtop computer</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Video game console</td>
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<td>1</td>
<td>4</td>
<td>7</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>TV with set-top box</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>


1) Private households with at least one individual aged 12 to 74; more than one answer possible.
Large rise in mobile internet access

The use of mobile devices to access the internet further increased in the Netherlands. In 2010 over one third of users (36 percent) had access to the internet through mobile equipment. This is considerably more than in 2007, when the corresponding proportion of users was one fifth (Figure 4.1.4). Internet use through mobile telephones and laptops with wireless connections increased more strongly than use by means of other mobile devices. Twenty percent of internet users had a laptop with a wireless connection in 2010 as against 13 percent in 2007. Over one in five users (21 percent) had internet access through a mobile telephone in 2010 as against 8 percent in 2007. Increasing use of Universal Mobile Telecommunications System (UMTS) connections is the principal factor behind the growing proportion of users who access the internet through a mobile telephone. Use of this type of connection rose to over 16 percent of all internet users in 2010, a quadrupling relative to 2007. Increases in the use of connection types other than UMTS for internet access by mobile telephone, such as General Packet Radio Service (GPRS) for example, were far more moderate. Six percent of internet users occasionally used a connection type other than UMTS in 2010. The corresponding figure for 2007 was 4 percent. So, the use of palmtop computers has barely increased since 2007.

The percentage of internet users with a mobile connection was higher among men (27 percent) than among women (15 percent) in 2010. The difference in use of a UMTS connection by men and women is particularly pronounced. Almost a quarter of male users accessed the internet by means of a mobile telephone with a UMTS connection, whereas the corresponding proportion for women was one tenth. Differences between men and women in the use of other devices for mobile internet were much smaller, though the percentage for each mobile device remained higher among men.

Almost half of young people use mobile internet

Devices for mobile internet were most commonly used by those aged 12 to 24. Almost one in two individuals in this age group used mobile internet in 2010 (48 percent). The proportion of individuals who used mobile internet was also high among those aged 25 to 44 (40 percent). Older internet users made far less use of mobile internet connections than young people. In 2010, among those aged 65 to 74, 16 percent used a mobile device with an internet connection and 14 percent used a laptop with a wireless connection. This is approximately half of the proportion of internet users in the 12 to 24 age group, 28 percent of whom used a laptop with a wireless connection.
The difference between young and old people is even greater with respect to the use of mobile telephones that allow access to the internet. Thirty percent of those aged 12 to 24 occasionally accessed the internet by means of a mobile telephone as against 2 percent of those aged 65 or over.

The use of mobile equipment to access the internet was more common among higher educated individuals than it was among the less educated. The proportion of internet users with a mobile connection was 44 percent among people with higher education, 36 percent among those with secondary qualifications and 27 percent among the lower educated. Mobile telephones in particular were used more commonly by the higher educated than the less educated to access the internet. Among people with lower education levels, 10 percent used a mobile telephone to access the internet, whereas the corresponding proportion among the higher educated was over twice as high (22 percent).

**Lack of interest main reason for no internet use**

Over three-quarters of individuals who do not have internet access at home cited not wanting such access, not being interested in such access or not considering such access useful as the reason (Figure 4.1.5). Other reasons given with relative frequency were
insufficient knowledge and skills (21 percent), the ability to use the internet elsewhere (13 percent) and financial considerations (11 percent).

Although women cited a lack of interest as the reason for not using the internet more frequently than men, the difference is small. There were considerable differences with respect to the other reasons for not doing so, however. Women without access to the internet specified insufficient knowledge and skills as the reason far more often than men, for example (27 percent of women without internet access as against 11 percent of men). Women likewise cited financial considerations as the reason more often than men (14 percent of women without internet access as against only 6 percent of men).

Individuals aged 65 to 74 without internet access usually stated that they did not consider it useful or that they had no interest in it. This applied to over eight in ten of the individuals in this age group. A lack of interest was also the most frequently cited reason for not using the internet among those aged 45 to 64 (74 percent). The corresponding proportion for individuals aged 12 to 24 without internet access was 18 percent. Insufficient skills was the most frequently cited reason among young people without internet access. Over one in two individuals aged 12 to 24 without internet access gave this as the reason (56 percent). Eighty percent of lower educated individuals without internet access specified a lack of interest. Those with secondary qualifications and higher education also gave this reason relatively often. In addition, over one third of people with a high level of education without an internet connection at home indicated that they could use the internet elsewhere. This
option was far less common among lower educated individuals (9 percent). In contrast to the higher educated, the financial aspect was also a factor in having no internet access at home among those with secondary qualifications and lower educated individuals. With respect to these latter two groups, it was given as the reason by 14 percent and 11 percent of individuals respectively. In addition, it is striking that concerns about privacy was cited as a reason for not having internet access at home almost exclusively by lower educated individuals.

**Over eight in ten people use the internet daily**

Eighty-four percent of individuals used the internet every day or almost every day in 2010 (Figure 4.1.6). Fourteen percent did so at least once a week but not every day. Other internet users went online at least once a month but not every week (2 percent). The proportion of individuals who use the internet on a daily basis has increased considerably from 2005, when only 68 percent of individuals did so. The Dutch population is therefore making increasing use of the internet.

### 4.1.6 Frequency and location of internet use, 2005 en 2010

<table>
<thead>
<tr>
<th>Location of internet use</th>
<th>Frequency of internet use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elsewhere</td>
<td>Don't know</td>
</tr>
<tr>
<td>At an educational institution</td>
<td>Less than once a month</td>
</tr>
<tr>
<td>At someone else's home</td>
<td>At least once a month but not weekly</td>
</tr>
<tr>
<td>At work</td>
<td>At least once a month but not daily</td>
</tr>
<tr>
<td>At home</td>
<td>Daily or almost daily</td>
</tr>
</tbody>
</table>


1) More than one answer possible.
2) Individuals aged 12–74 who used the internet in the previous three months.
Internet used most at home

Virtually all internet users had an internet connection at home in 2010 (over 98 percent). The workplace was also a principal location of use. Almost half of all users accessed the internet at work (49 percent). Approximately one in five individuals used the internet at an educational institution and over one fifth also did so at someone else’s home. The increase in the proportion of users who accessed the internet at someone else’s home is striking, given that it was a comparatively modest 15 percent in 2005. One fifth of individuals who used the internet outside the home did so at public libraries. Internet cafés were also relatively favoured locations, visited by 14 percent of individuals who did not have internet access at home, work, an educational institution or someone else’s home. Public libraries and internet cafés were used less frequently to access the internet in 2010 than in 2005. The increase in the proportion of internet users that go online elsewhere is probably due first and foremost to the advent of internet access by means of the mobile telephone, which makes it possible to use the internet at virtually any location desired.

4.2 Activities and services on the internet

For many Dutch people, the internet is now (2011) a very valuable means of communication and source of information. Online shopping has also become an important activity for many Dutch internet users. Indeed, the internet is being used ever more intensively and a growing proportion of Dutch internet users are engaging in an expanding range of internet activities.

Communication main internet activity

Communicating has been the most important internet activity of individuals for many years. This was also the case in 2010. Virtually every user communicated in one form or another through the internet, most using e-mail to do so (96 percent). A significant proportion of internet users, namely 28 percent, also chatted online (Figure 4.2.1). Nevertheless, the proportion of users who chat online has decreased markedly relative to 2005, when 40 percent did so. “Chatting” in this case is understood to mean, in addition
to typing text messages to other individual users, participating in newsgroups or other discussion forums. Users are increasingly communicating by telephone through the internet (IP telephony; see also Chapter 2). Six percent of internet users communicated by means of IP telephony in 2005. This figure increased to 19 percent in 2010.

4.2.1 Activities of internet users; communication, 2005–2010*1

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mailing</td>
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<td>93</td>
<td>94</td>
<td>94</td>
<td>95</td>
<td>96</td>
</tr>
<tr>
<td>Using IP Telephony*2</td>
<td>6</td>
<td>12</td>
<td>13</td>
<td>15</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Other, e.g. chatting</td>
<td>40</td>
<td>40</td>
<td>35</td>
<td>27</td>
<td>29</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT use by households and individuals, 2005-2010.
*1 Individuals aged 12–74 who used the internet in the previous three months; more than one answer possible.
*2 The formulation of the question was changed after 2007. The results for 2008, 2009 and 2010 can therefore be compared with each other, but to a lesser extent with the results for the preceding period.

In terms of e-mailing, chatting and using IP telephony, men communicated as much as women through the internet in 2010. However, while gender is therefore not a major factor with respect to the method used to communicate through the internet, the internet user’s age is. Over half of young people chatted (55 percent), whereas the proportion of older people who did so was much lower. Only 14 percent of internet users aged 65 to 74 chatted in 2010, for example. Differences between the different age groups regarding the use of e-mail and IP telephony are less pronounced.

Internet also extensively used as a source of information

In addition to communicating, the internet is also extensively used as a source of information. Nine in ten individuals used the internet in 2010 to search for information on goods and services (Figure 4.2.2). The internet was also extensively used to download games, images or music (56 percent). Using the online services provided by the travel industry was likewise a frequent internet activity (55 percent). Following a slight drop in 2009, the 2010 percentage returned to the levels of 2007 and 2008.

The online services provided by the travel industry were used most frequently by individuals aged 45 to 64. Almost six in ten users in this age group booked a trip through the internet (58 percent). Differences with internet users in other age groups were relatively small, however. Differences between the various age groups were greater
with respect to downloading games, images or music. Eighty-six percent of internet users aged 12 to 24 did so, whereas the corresponding figure for those aged 65 or over was 31 percent.

4.2.2 Activities of internet users; information and entertainment, 2005–2010\(^1\)

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>Searching for information about goods and services</td>
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<td>89</td>
<td>86</td>
<td>87</td>
<td>90</td>
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<td>35</td>
<td>42</td>
<td>52</td>
<td>57</td>
<td>58</td>
</tr>
<tr>
<td>Playing and/or downloading games, images or music</td>
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<td>55</td>
<td>56</td>
<td>65</td>
<td>57</td>
<td>56</td>
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<tr>
<td>Using services in the travel industry</td>
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<td>50</td>
<td>54</td>
<td>55</td>
<td>51</td>
<td>55</td>
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<tr>
<td>Downloading or reading newspapers and/or news magazines</td>
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<td>45</td>
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<td>49</td>
<td>53</td>
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<td>Downloading software</td>
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<td>34</td>
<td>37</td>
<td>34</td>
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<tr>
<td>Applying and/or looking for a job</td>
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<td>22</td>
<td>21</td>
<td>18</td>
<td>19</td>
<td>21</td>
</tr>
</tbody>
</table>


\(^1\) Individuals aged 12–74 who used the internet in the previous three months; more than one answer possible.

The number of individuals who download or read newspapers and/or news magazines by means of the internet is still on the rise. In 2010, over half of internet users (53 percent) consulted newspapers and/or news magazines in digital form, a considerable increase relative to 2005, when the corresponding proportion was one third (35 percent). Although this increase applies to internet users of all ages, it is particularly strong among individuals aged 25 to 44. A growing number of publishers have for a number of years been offering “digital subscriptions”. These give subscribers access to the digital version of the newspaper as well. Digital newspaper subscriptions are usually offered in combination with a subscription, weekend or otherwise, to the printed version of the newspaper. A growing number of individuals are using the internet to listen to the radio and watch television. Fifty-eight percent of internet users listened to the radio or watched television online in 2010, a doubling relative to 2005, when the corresponding proportion was 26 percent. Young internet users in particular made use of this service. Almost three quarters of those aged 12 to 24 listened to the radio or watched television online. At 41 percent, the proportion of those aged 65 or over who did so was substantially lower. The proportion of users who look for work or submit job applications through the internet has barely changed in recent years. One fifth of users looked for work and/or submitted job applications through the internet in 2010. A slightly higher proportion of women than men used the internet to apply for a job (22 percent and 20 percent respectively). These figures are of course influenced by the degree to which men and women are actually looking for work, but this factor was not included in the survey.
More diversity in internet activities

A growing proportion of the 12.2 million individuals who had internet access in 2010 (see section 4.1) are engaging in a broad range of internet activities. The group of users who engage in only a few internet activities is slowly decreasing in number. Statistics Netherlands refers to increasing diversity of internet use when the number of different internet activities engaged in by individuals rises. In 2010, 4.9 million users engaged in at least eight of the ten different internet activities specified below as against 4.6 million in 2009 (Figure 4.2.3). The number of internet users who engaged in eight or more of these activities in 2006 was 2.6 million. Figure 4.2.3 also shows that the proportion of internet users who engage in only a few internet activities decreased in the period 2006–2010. In 2006, for example, 41 percent of users engaged in five or fewer of the different internet activities. This proportion had fallen to a quarter of all internet users by 2010. The average age of internet users who engage in many different activities is lower than that of users who engage in only a few activities. The average age of internet users who engaged in only one or two internet activities in 2010 was 47 and 41 respectively. The average age of internet users who engaged in all of the ten different internet activities was 34.

4.2.3 Diversity of internet activities, 2005–2010 1)

<table>
<thead>
<tr>
<th>Number of different internet activities</th>
<th>Number of internet users</th>
<th>Proportion of internet users</th>
<th>Average age of internet users</th>
</tr>
</thead>
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<td>absolute (million) cumulative % years</td>
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<td>years</td>
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<tr>
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</tr>
<tr>
<td>10</td>
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<tr>
<td>Total</td>
<td>10.4</td>
<td>10.9</td>
<td>11.2</td>
</tr>
</tbody>
</table>


1) Individuals aged 12–74 who used the internet for one or more of the 10 specified activities in the previous three months.

2) Some internet users did not use the internet for any of the 10 specified activities: 0.2 million of internet users in 2010.
Online banking an integral part of life

Advances in internet applications are making it increasingly possible for individuals to conduct a broad range of transactions, financial and otherwise, from the home. Online banking is one of the internet services that very rapidly became an integral part of life. In 2010 over eight in ten internet users engaged in online banking (Figure 4.2.4). This proportion is 3 percentage points higher than in 2009 and 23 percentage points higher than in 2005. Over nine in ten internet users aged 25 to 44 engaged in online banking. Those in the 12 to 24 age group made least use of online banking services (63 percent). The greatest increase relative to 2005 occurred in the number of young internet users who engaged in online banking. The number of internet users aged 65 or over who engaged in online banking also increased considerably.
In addition to online banking, individuals can also conduct other kinds of financial transactions through the internet, such as purchasing shares or selling goods and services. Nine percent of internet users performed such activities in 2010. A relatively high number of men effected financial services through the internet; 12 percent as against 5 percent of female internet users. Individuals aged 65 or over also made frequent use of the internet to effect financial services.

Almost half of young people search online for information about education and training

A growing number of training institutes provide information about the range of training programmes and courses on offer. Some training programmes and courses can also be attended online. The internet therefore plays an important part in educational attendance and the provision of information about education. In 2010, almost 35 percent of users performed internet activities concerning education. In this context, the internet is used primarily to search for information and undertake independent learning (Figure 4.2.5). In 2010, 21 percent of internet users undertook independent learning through the internet. Young people aged 12 to 24 were particularly active in searching online for information about education and training (49 percent). However, actually attending courses through the internet is less common among the general public. Just over 5 percent of internet users attended an online course in 2010. The proportion among young people was 4 percent.

Level of visits to government websites stable

Government services are increasingly becoming available online. In addition to finding information on government websites, citizens can also download forms and send these electronically. These manifestations of e-government provide a range of conveniences to users, not least because the service provided is available at any given time and users are therefore not bound by the opening times of the government institution concerned. Moreover, users do not have to physically visit the government institution. Fifty-eight percent of all internet users visited government websites in 2010. This percentage has not changed significantly since 2006 (Figure 4.2.6). More men than women visited a government website (64 percent and 51 percent respectively). People with high education levels visited government websites more frequently than those with lower education; 77 and 34 percent respectively in 2010. These percentages have also not changed significantly from 2006.

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1) Education and ICT in education are comprehensively discussed in section 6.1 of this book.
4.2.5 Internet activities in connection with training programmes and courses or learning, 2010\(^1\)

\[\text{Attending an online course} \quad \text{Independent learning} \quad \text{Searching for information about training programmes and courses}\]

<table>
<thead>
<tr>
<th>Age 12 to 24 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>


\(^1\) Individuals aged 12–74 who used the internet in the previous three months; more than one answer possible.

4.2.6 Searching for information on government websites, by education level, 2006-2010\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


\(^1\) Individuals aged 12–74 with internet access who visited government websites in the previous three months.
Most internet users who visited government websites did more than simply consult the information provided. Six in ten also used the websites to download documents (Figure 4.2.7). The proportion of visitors who downloaded documents from government websites remained virtually the same in 2010 as in 2009. More men downloaded documents from government websites than women (65 percent and 54 percent respectively). There were also differences between visitors with high and those with lower education levels: 71 and 40 percent respectively in 2010.

As was the case in 2009, 56 percent of visitors to government websites completed or sent forms online in 2010. Again, more men than women visiting government websites completed and sent forms. The level of activity in this context is somewhat lower among young people. Four in ten young people who visited a government website sent completed forms. The corresponding proportion for those aged 25 to 64 who visited government websites was considerably higher (59 percent).

The figures show that the internet is an important medium for the exchange of information between citizens and the government. Virtually no growth has occurred in the use of online government services in recent years, however.

4.2.7 Use of electronic documents by visitors to government websites, 2006–2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Downloading documents</th>
<th>Sending documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>50%</td>
<td>40%</td>
</tr>
<tr>
<td>2007</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td>2008</td>
<td>58%</td>
<td>48%</td>
</tr>
<tr>
<td>2009</td>
<td>59%</td>
<td>49%</td>
</tr>
<tr>
<td>2010</td>
<td>59%</td>
<td>49%</td>
</tr>
</tbody>
</table>


1) Individuals aged 12–74 who used the internet in the previous three months, more than one answer possible.
Instant messaging most popular form of social media

Social media are media for social interaction by means of internet or mobile applications. Social media can be used to share information by, for example, placing messages in an online discussion forum, chat room or newsgroup. Social networks are now a popular form of social media. In order to use a social network, an individual must create a profile that includes a few identifying personal details. Contact can then be established with other participants and messages, personal news items and opinions can be shared. Hyves, Twitter and Facebook are well-known examples of social networks.

Exchanging text messages, also referred to as instant messaging, was the most popular social media application in 2010. Over one third of internet users engaged in instant messaging (37 percent). Many internet users also read web logs or blogs (35 percent). Writing an own web log or blog was less popular (Figure 4.2.8).

Differences between men and women in the use of social media are fairly minor. Men used the different forms of social media somewhat more frequently than women. The single exception in this regard was maintaining an own web log, an area in which female internet users were slightly more active than male ones.

4.2.8 Use of social media, 2010

<table>
<thead>
<tr>
<th></th>
<th>Posting messages in chat rooms or online discussion forums</th>
<th>Exchanging text messages with others (instant messaging)</th>
<th>Reading web logs or blogs</th>
<th>Writing own web log or blog</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>37</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>33</td>
<td>38</td>
<td>37</td>
<td>11</td>
</tr>
<tr>
<td>Women</td>
<td>25</td>
<td>35</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 to 24 yrs</td>
<td>55</td>
<td>78</td>
<td>53</td>
<td>26</td>
</tr>
<tr>
<td>25 to 44 yrs</td>
<td>29</td>
<td>35</td>
<td>38</td>
<td>12</td>
</tr>
<tr>
<td>45 to 64 yrs</td>
<td>16</td>
<td>17</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>65 to 74 yrs</td>
<td>14</td>
<td>11</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary education</td>
<td>35</td>
<td>49</td>
<td>35</td>
<td>17</td>
</tr>
<tr>
<td>Secondary education</td>
<td>28</td>
<td>33</td>
<td>33</td>
<td>10</td>
</tr>
<tr>
<td>Higher education</td>
<td>26</td>
<td>30</td>
<td>38</td>
<td>10</td>
</tr>
</tbody>
</table>


1) Individuals who used the internet in the previous three months, more than one answer possible.
2) Including the use of social networking sites like Hyves, Facebook etc.
Young people aged 12 to 24 are the principal users of social media. Exchanging text messages is especially popular among this group. Almost eight in ten internet users aged 12 to 24 were active in this area in 2010. Older people make far less use of this particular technology. Slightly over one in ten older internet users engaged in instant messaging. Social media are used extensively by lower educated internet users in particular. Almost half of lower educated internet users engaged in instant text messaging in 2010 as against 30 percent of those with higher education. Users with low education levels were also more active in posting messages in a chat room or online discussion forum, and more of them had a web log than those with higher education. Solely reading web logs was more common among internet users with higher education than those with lower education.

**Social media use by Dutch young people almost highest in the EU**

Compared with their peers in other EU countries, young people in the Netherlands aged 16 to 24 were among the most frequent users of social media in 2010. Over nine in ten young internet users were active in this area (92 percent). Only the Polish in this age group made greater use of social media (94 percent). The Netherlands ranks in the middle group of EU countries if the use of “active” social media is based on all internet users irrespective of age. Almost half of Dutch internet users made use of “active” social media in 2010 (47 percent), just above the EU average of 46 percent. “Active” social media is defined as posting messages in a chat room or online discussion forum (Hyves, Facebook, etc) and exchanging text messages with others (instant messaging).

**Overview of the most well-known social networks in the Netherlands**

- **Hyves**
  A Dutch social networking service. Users can invite friends, send messages, photographs and videos and upload other files. Hyves has groups based on schools, companies, places of residence and a broad range of hobbies and subjects.

- **Facebook**
  A large, international social networking service that offers numerous options. Users can create a profile, send e-mail and invitations, upload photographs and videos and use other applications. In addition to being a personal social site, Facebook is also used for business networking.

- **Twitter**
  An international service for sending short messages. A Twitter message, commonly known as a tweet, is a maximum of 140 characters long. Twitter is mainly used to exchange news items and follow events in the lives of well-known individuals. Politicians, performers and media and other organisations are increasingly using Twitter.

- **LinkedIn**
  An international network for maintaining business contacts. LinkedIn is designed for individuals who are looking for work or employees or seeking to promote their company, or who wish to maintain contacts with current and former colleagues. The emphasis of a LinkedIn-profile is on profession and qualifications. LinkedIn does not have a chat function.
Number of e-shoppers up again in 2010

Purchasing, ordering and booking goods and services online are still increasing in popularity. The convenience of the internet, the ability to compare products, the growing quantity of information and lower costs are key factors behind the further increase in the number of e-shoppers, which rose to 9.3 million individuals in 2010 (Figure 4.2.9). While the number of e-shoppers increased again, however, growth was not as strong as had been the case in previous years. Growth in 2010 halved compared to that of 2009 in both absolute and relative terms. This declining growth is an indication that saturation is near.

Proportion of frequent e-shoppers more than doubled

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21%</td>
<td>55%</td>
</tr>
</tbody>
</table>

In 2010, 6.6 million individuals frequently ordered goods and/or services through the internet. Frequent e-shoppers are internet users who made internet purchases in the three months prior to the survey. The proportion of frequent e-shoppers increased from 51 percent in 2009 to 55 percent in 2010. The number of internet users who did not engage in online shopping further decreased to 2.7 million (23 percent of internet users). The corresponding figure for 2002 was 5.3 million internet users, which at the time constituted 60 percent of all internet users. For many Dutch people, online shopping has become an important part of internet activities.
### 4.2.9 E-shopping, 2002–2010

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-shopper</td>
<td>3.6</td>
<td>4.2</td>
<td>5.1</td>
<td>5.9</td>
<td>6.6</td>
<td>7.5</td>
<td>7.7</td>
<td>8.8</td>
<td>9.3</td>
</tr>
<tr>
<td>frequent e-shopper</td>
<td>1.9</td>
<td>2.2</td>
<td>2.9</td>
<td>3.9</td>
<td>4.5</td>
<td>5.3</td>
<td>5.4</td>
<td>6.0</td>
<td>6.6</td>
</tr>
<tr>
<td>less frequent e-shopper</td>
<td>1.7</td>
<td>2.0</td>
<td>2.2</td>
<td>2.0</td>
<td>2.1</td>
<td>2.2</td>
<td>2.4</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Not an e-shopper</td>
<td>5.3</td>
<td>5.1</td>
<td>4.7</td>
<td>4.8</td>
<td>4.2</td>
<td>3.8</td>
<td>3.7</td>
<td>3.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>8.9</td>
<td>9.2</td>
<td>9.8</td>
<td>10.7</td>
<td>10.9</td>
<td>11.3</td>
<td>11.5</td>
<td>11.8</td>
<td>12.0</td>
</tr>
</tbody>
</table>


1) Individuals aged 12-74 who use the internet. Frequent e-shoppers purchased online at least once in the previous three months; less frequent e-shoppers did so longer than three months previously.

### 4.2.10 E-shopping, international, 2010

![Chart showing e-shopping percentages for various countries.]

Source: Eurostat.

2) Individuals aged 16 to 74 who purchased online in the previous 12 months.
Netherlands among top e-shopping countries

Sixty-seven percent of internet users in the Netherlands engaged in e-shopping in 2010.\textsuperscript{2) Of the benchmark countries specified in Figure 4.2.10, the Netherlands, together with Denmark, the United Kingdom and Sweden, had the highest number of e-shoppers in relative terms. Denmark had the highest percentage of e-shoppers (68 percent). Online shopping occurred least in Greece, where only 12 percent of internet users engaged in this activity.

Typical Dutch e-shopper: male, 25–44 years, higher education

The profile of the frequent Dutch e-shopper did not change much in 2010 relative to 2009. The majority of such shoppers remain men, aged 25 to 44 years and persons with higher education.

Fifty-seven percent of male internet users could be classified as frequent e-shoppers (Figure 4.2.11). The corresponding figure for female internet users was 53 percent. Of all internet users aged 25 to 44, 69 percent frequently shopped online. Frequent e-shoppers were less common among internet users aged 65 or over. Nevertheless, 32 percent of older people were frequent e-shoppers. Seventy-one percent of internet users with higher education were frequent e-shoppers. The corresponding figure for lower educated internet users was 37 percent.\textsuperscript{3)

Travel, holidays and accommodation often booked online

As was the case in 2006 and 2008, “travel, holidays and accommodation” was the most common type of online purchase of internet users (Figure 4.2.12). Almost six in ten frequent e-shoppers booked travel and holidays online (58 percent). Other goods and services frequently purchased online were clothes (49 percent), tickets for events (45 percent) and literature (43 percent). In 2010 more internet users made online purchases in almost all of the different purchase categories than in 2008. Only online purchasing of electronic items and hardware did not increase. Compared to 2008, the greatest increase, 11 percentage points, occurred in the purchasing of “travel, holidays and accommodation” through the internet. Strong growth also took place in the online purchasing of clothes.

\textsuperscript{2) Due to the use of a different definition and delineation of the population by Eurostat, the percentage specified here is not the same as the percentage of Dutch e-shoppers given in Figure 4.2.9.

\textsuperscript{3) Level of education is related to other background characteristics of individuals and households, such as income. Only a study of determinants can identify which background characteristic best explains purchasing behaviour in statistical terms. Statistics Netherlands published such a study in 2003 (Fructus van der Veen, 2003).}
4.2.11 Frequent e-shoppers by personal characteristics, 2010


1) Individuals who purchased online in the previous three months.

4.2.12 Online purchases by category, 2006–2010


1) E.g. furniture, washing machines and toys.
2) Internet users who purchased online in the previous three months.
and sports items, and shares, insurance and other financial services. The increase was 10 percentage points in both cases.
All the different goods and services were purchased by both men and women. Nevertheless, there are clear differences between men and women in terms of online purchasing behaviour. More men than women purchased electronic items online in 2010, for example. The difference was 13 percentage points. Men also purchased hardware no less than four times as frequently as women and software over twice as frequently as women. On the other hand, women purchased more clothes and sports items through the internet than men; 60 percent of women as against 38 percent of men.

Average spending on online shopping continues to increase

According to Thuiswinkel.org spending on online shopping continues to increase. Compared to 2002, the first year of monitoring, average spending has more than doubled. In 2002 an average online buyer spent €318 on online purchases. The corresponding figure for 2009 was €737.


Average spending per e-shopper, 2002–2009

Internet banking, including the iDEAL payment system, is by far the most commonly used method of payment for online purchases. In 2010 over three quarters of internet users who ordered goods or services online paid by means of internet banking. A credit card or debit card was also used relatively frequently, namely by one-third of e-shoppers. Over a quarter paid without internet. Money was also transferred by post, particularly by individuals aged 65 or over. The preferred method of payment for online purchases hardly differed in terms of level of education. An exception in this regard was the use of a credit card to settle purchases made. People with higher education used a credit card more frequently than people with lower education levels. Prepaid cards, electronic vouchers and prepaid account details were hardly used to pay for online purchases.

Preference for traditional shopping main reason for not shopping online

Internet users who did not shop online in 2010 refrained from doing so mainly because of a preference for traditional shopping. They considered it important to be able to try on clothes, for example. Almost two-thirds of internet users who did not shop online cited this as a reason (64 percent). Another reason for not shopping online frequently cited by

4.2.13 Reasons for not purchasing online, 2010


1) Internet users who did not purchase online in the previous three months; more than one answer possible.
respondents was that they did not consider online shopping necessary (Figure 4.2.13). In addition to these reasons, security concerns also played an inhibitive part. Thirty percent of internet users who did not shop online cited security concerns and another 29 percent expressed concerns about privacy. Older individuals aged 65 or over cited concerns about security and privacy relatively frequently as a reason to refrain from shopping online. The inability to receive goods at home (2 percent) and speed of the internet connection were stated far less frequently as reasons for not shopping online.

4.3 Internet and security

As is the case in the "real" world, security is a major topic of discussion in the digital one. This section first describes the concerns users have in relation to internet security and the problems actually experienced in this regard, after which the focus shifts to the impact that these concerns and negative experiences have on internet use. The final part of the section discusses the use of security software and measures to prevent personal and other data from being lost on the computer.

Virtually all questions about the internet and security contained in the survey of ICT use by households and individuals carried out by Statistics Netherlands were asked for the first time in 2010. Developments over time can therefore not be presented in most cases. In certain respects, however, it is possible to compare Dutch outcomes with those of other (EU) countries.

Two-thirds of internet users concerned about misuse of personal data

The survey sought to determine whether internet users were concerned about six security problems. Internet users were also asked whether they had experienced any of these problems in the twelve months prior to the survey. The most common concerns among internet users are those pertaining to the misuse of personal data or other breaches of privacy (Figure 4.3.1). Two in three internet users (67 percent) expressed concern about these problems. “Other breaches of privacy” refers to issues like the misuse of photographs, videos and other information on networking sites. Over half of internet users are also concerned about fraud with debit cards and computer viruses. Only a small proportion of users have no concerns whatsoever about internet security. Almost nine in ten individuals (86 percent) who used the internet in the past year expressed concern about at least one of the security problems presented to them. The group that is somewhat concerned is clearly larger than the group that is extremely concerned.
**Spam and viruses affect many users**

The most common security problems are computer viruses and spam (unwanted e-mails). Approximately one quarter of internet users (24 percent) were affected by a computer virus such as a computer worm or a Trojan horse. Over two in three (67 percent) received spam. At 5 percent or lower, the other security problems were far less common.

### 4.3.1 Concerns and negative experiences in relation to internet security, 2010

<table>
<thead>
<tr>
<th>Security Issue</th>
<th>Concerned</th>
<th>Experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payment card fraud</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Phishing/pharming</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Undesirable access by children</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Misuse of personal data/privacy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Computer virus</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spam</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT Use by Households and Individuals, 2010.

1) The 'extremely concerned' and 'somewhat concerned' answer categories have been added together.

2) Individuals aged 12 to 74 who used the internet in the 12 months prior to the survey; more than one answer possible.

With respect to five of the six security problems, the proportion of individuals concerned is clearly higher than the proportion of individuals who actually experienced the problem in question. Major incidents like the misuse of personal data or financial loss due to phishing, pharming or fraud with debit cards are relatively uncommon but have a major impact on the perception of security. The opposite applies to spam: although many internet users have been affected by it, concern is relatively low.

Negative experiences that internet users have had influence their level of concern about internet security. Of the internet users who experienced security problems in the twelve months prior to the survey, 90 percent were extremely or somewhat concerned. Among

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4) “Pharming” and “phishing” are described in the Glossary at the end of this publication.
internet users who did not experience any security problems, the corresponding proportion was 73 percent.

**Older people experience fewer security problems**

A relatively small number of older people were affected by viruses on their computers. Of internet users in the 65 to 74 age group, 12 percent had been affected by a computer virus in the twelve months prior to the survey (Table 4.3.2). This proportion is considerably lower than the corresponding proportion for internet users in the 12 to 24 age group (32 percent). Older internet users were also least affected by spam. Approximately half of those aged 65 to 74 had been affected by spam. Taking all age groups as a whole, the average was 67 percent. Older internet users are also least affected by other security problems like privacy breaches. It is known that older people use the internet less frequently and that their internet activities are less diverse. They are therefore less at risk of having negative experiences in relation to internet security.

### 4.3.2 Negative experiences in relation to internet security by personal characteristics, 2010

<table>
<thead>
<tr>
<th></th>
<th>Experienced in the 12 months prior to the survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computervirus</td>
</tr>
<tr>
<td>Men</td>
<td>26</td>
</tr>
<tr>
<td>Women</td>
<td>21</td>
</tr>
<tr>
<td>12 to 24 years</td>
<td>32</td>
</tr>
<tr>
<td>25 to 44 years</td>
<td>24</td>
</tr>
<tr>
<td>45 to 64 years</td>
<td>20</td>
</tr>
<tr>
<td>65 to 74 years</td>
<td>12</td>
</tr>
<tr>
<td>Primary education</td>
<td>26</td>
</tr>
<tr>
<td>Secondary education</td>
<td>23</td>
</tr>
<tr>
<td>Higher education</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, ICT Use by Households and Individuals, 2010.

1) Individuals aged 12 to 74 who used the internet in the 12 months prior to the survey; more than one answer possible.
Fewer computer viruses, but more spam in the Netherlands

Almost one in three internet users in the EU were affected by a computer virus in the twelve months prior to the survey. The incidence in the Netherlands is lower than this EU average. Together with Germany, Finland, Ireland and Austria, the Netherlands is one of the five countries in which less than a quarter of internet users were affected by computer viruses. Figure 4.3.3 shows strong variation in the results for individual European countries. These results range from 14 percent in Austria to 58 percent in Bulgaria. Internet users in western and northern Europe are less frequently affected by computer viruses than those in the rest of Europe.

Level of spam above average in the Netherlands

Over half (56 percent) of internet users in the EU were affected by spam in the twelve months preceding the survey. The corresponding proportion for the Netherlands was

4.3.3 Negative experiences with computer viruses and spam, international, 2010
Spam is thus relatively common in the Netherlands. Differences between countries are likewise considerable with respect to spam. Proportions range from 18 percent in Ireland to 70 percent in France. Unlike computer viruses, spam does not exhibit geographic concentration in terms of its European distribution.

Security concerns mainly limit the use of social media

The 2010 survey of ICT use by households and individuals measured more than merely the negative experiences and levels of concern among users with respect to internet security. It also looked into which activities internet users refrain from because of security concerns. One in three internet users refrained from placing personal information on networking sites because of security-related considerations. Over one in five refrained from downloading software, music, videos, games or other data files for this reason. Interaction with service providers is less strongly influenced by security concerns. Internet users refrain from internet banking (9 percent) and communicating with the government (5 percent) due to security concerns less frequently than is the case with other activities.

4.3.4 Refraining from internet activities because of security concerns, 2010

Source: Statistics Netherlands, ICT Use by Households and Individuals, 2010.

1) Individuals aged 12 to 74 who used the internet in the 12 months prior to the survey, more than one answer possible.
In addition to concern, actual experiences in the area of security influence internet activities. Almost half of internet users (47 percent) who experienced misuse of personal data or suffered financial loss in the twelve months prior to the survey refrained from placing personal information on networking sites as a result of those experiences. One third of individuals in this group refrained from downloading, among other things, software and music, while almost a quarter (23 percent) refrained from purchasing products online.

Refraining from internet activities due to security concerns varies according to personal characteristics like gender, age and level of education. Men, young people and lower educated individuals are less likely to refrain from internet activities than women, older people and people with higher levels of education. Refraining from specific internet activities because of security concerns does not affect the general frequency of internet use. Of all individuals who refrained from one or more of the internet activities specified, 85 percent nevertheless used the internet on a daily basis or almost on a daily basis in the three months prior to the survey. An additional 13 percent used the internet at least once a week. These percentages are virtually identical with those for the group that did not refrain from any internet activities for security reasons.

Making backups becoming more common

Making reserve copies (backups) of files on a computer can prevent data loss. The proportion of internet users who “always” or “often” make reserve copies increased from 25 percent in 2007 to 31 percent in 2010 (Figure 4.3.5). It must be noted in this regard that data loss on a computer is not always caused by a security incident like a computer virus infection. Other computer problems, technical and otherwise, can also cause data loss.

Almost all internet users have security software

Security software designed to protect personal computers and data is used very extensively in the Netherlands. No less than 96 percent of internet users have security software like a virus scanner, anti-spam program or firewall. Figure 4.3.6 shows the use of various kinds of security software or methods. Virus scanners and anti-spyware programs are the most commonly used, namely by over four in five internet users. A large majority of internet users also have a hardware or software firewall (67 percent) and an e-mail filter against spam (60 percent). Just over one in ten users have a digital child lock or internet filter. Naturally, this kind of technology is used mainly in households with children. Approximately one in eight internet users (13 percent) are not aware of the exact contents of the security package.
4.3.5 Frequency with which backups are made on the computer, 2007–2010


1) Individuals aged 12 to 74 who used the internet in the 12 months prior to the survey; more than one answer possible.

4.3.6 Use of security software or method, 2010

Source: Statistics Netherlands, ICT Use by Households and Individuals, 2010.

1) More than one answer possible.
2) Individuals aged 12 to 74 who used the internet in the 12 months prior to the survey.
Following the installation of a security package, it is important to keep this software up to date. Many internet users are aware of this. Eighty percent of them install a new version every time one becomes available. An additional 12 percent install updated versions of the security package once in a while. Only one in twenty internet users never install an updated version of security software.

Far and away the most frequently cited reason for not updating the security package is a lack of awareness of how to do so. Over half (53 percent) of those who never update their software state this as the reason. Women (64 percent) and older people (67 percent) are strongly represented in this group.

**Netherlands top in EU in use of security software**

The Netherlands has the highest proportion of internet users with security software in the EU (96 percent). The EU average is 84 percent. In Norway (not an EU country) and Finland, too, over 90 percent of internet users have a security package. The figure for Italy in this respect is considerably below the EU average. Security software is used somewhat more extensively in north and west European countries than in south and east European ones. This concentration also reflects the respective levels of ICT development in European countries more generally.

**4.3.7 Use of security software, international, 2010**

![Chart showing use of security software across different countries]

Source: Eurostat.

1) Individuals aged 16 to 74 who used the internet in the 12 months prior to the survey.
More detailed figures on the subjects discussed in this chapter are contained in the statistical annex to this publication. The annex can be consulted online at www.cbs.nl/ict-knowledge-economy.
Research and Development
Research and Development

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Ten billion euro was spent on research and development (R&D) in the Netherlands in 2009. With R&D expenditure at 1.82 percent of GDP, the Netherlands is not a leading investor in international terms. The government of Prime Minister Mark Rutte is aiming to ensure that spending amounts to 2.5 percent of GDP by 2020.

R&D expenditure of companies fell by 10 percent in the period 2008–2009. In 2009, the public sector invested more in R&D than the private sector for the first time since 1993. The Netherlands spends more on public R&D per inhabitant than many other countries. Eleven percent of Dutch R&D is financed from abroad. This percentage has not changed much in the past ten years.

Dutch companies apply for a high number of patents in international terms. The number of Dutch high-tech patent applications has fallen sharply since 2001, however.

5.1 R&D in the Netherlands

Investing in R&D is important for the development of new knowledge and know-how. R&D is characterised by research that is oriented towards innovation. According to the international definition adhered to by statistical agencies, R&D is ‘creative work undertaken on a systematic basis in order to increase the amount of knowledge, including knowledge of man, culture and society, and the use of this amount of knowledge to devise new applications’ (OECD, 2002). An elaboration of this definition as used by Statistics Netherlands in its surveys and publications is provided in the box on the next page.

Traditionally, R&D has encompassed fundamental and applied research in new knowledge and technology that at a later stage may lead to more concrete development processes geared towards new products and/or processes. The emphasis in fundamental research is on increasing scientific knowledge. Knowledge institutes like universities and public research institutes focus mainly on this kind of research. Applied research is directed primarily towards finalising the development of ideas into new or significantly improved processes and manufacturable products. This kind of research is relatively frequently carried out by companies and can lead to innovations in the form of more efficient production or logistics methods (process innovations) or new goods and services (product innovations). Both the traditional, technologically-driven R&D carried out by companies themselves and the R&D carried out by specialised knowledge agencies are important for the success of R&D activities in the Netherlands. Research institutes and design and engineering firms are examples of joint venture partners.

R&D generates new knowledge and insights that in a number of cases actually result in innovations. Non-technological innovations also contribute to the Dutch economy’s capacity for growth. Examples in this regard are innovations in the area of organisation...
and marketing. In addition to the development of new knowledge by parties themselves, R&D is also about using knowledge that has been developed elsewhere and exchanging existing information, for which a properly accessible knowledge infrastructure is essential. The performance of R&D activities by companies, government authorities and knowledge institutes can increase both a country’s competitiveness and its attractiveness to foreign investors. Substantial R&D activities in a sector or country also entail high-quality employment.

**R&D and policy**

The quantity of R&D activities in a country is an indication of that country’s level of ambition with respect to developing new knowledge itself. Due to its great importance for the development of a knowledge economy, European heads of government have formulated objectives concerning R&D. As stated earlier in section 1.1, one of the aims set out by the European Commission in its ‘Europe 2020’ plan is to ensure that R&D expenditure amounts to 3 percent of GDP in the EU by 2020 (European Commission, 2010). A structural increase in R&D expenditure of this kind would have a clear effect on the Dutch economy. If the Netherlands achieves the objective, it would in the long term (2030) increase labour productivity by 7 percent (Donselaar et al., 2003).
The Rutte government’s plans for the Netherlands in this area were outlined in section 1.1 (Ministry of Economic Affairs, Agriculture and Innovation, 2011a). The aim is to ensure that R&D expenditure in the Netherlands comprises 2.5 percent of GDP by 2020. The government classifies this target as ambitious because of the structure of the Dutch economy. It relies to a large extent on its services sector, which is by nature less R&D-intensive than the manufacturing sector.

Ten billion euro spent on R&D in the Netherlands

R&D expenditure in the Netherlands amounted to 10.4 billion euro in 2009 (Table 5.1.1). This is somewhat less than the amount spent in the preceding year (10.5 billion euro). Viewed over a longer period, however, R&D expenditure is on an upward trend. The Dutch business sector performed almost half of all R&D in 2009 (47 percent). Institutions of higher education (universities, university medical centres and colleges for higher professional education (hbo)) jointly accounted for 40 percent of this activity. The remaining proportion of R&D activity was performed by public research institutes like the Netherlands Organisation for Applied Scientific Research (TNO) and by private non-profit organisations (PNPs).

The level of R&D activity at companies fell slightly in 2008 and 2009, possibly as a result of the economic recession. This drop was offset to some extent by institutions of higher education, where R&D expenditure was still increasing during this period. The business sector’s share of total R&D expenditure in the Netherlands has been on the decline already for a longer period. It fell from 55 percent in 2000 to 47 percent in 2009.

Figure 5.1.2 shows R&D expenditure by companies, public research institutes and the higher education sector for the period 1999–2009. It can be seen that the higher education sector is accounting for an increasing proportion of R&D. The contribution of public research institutes has remained fairly constant through the years.

In comparison with many other EU countries, the Dutch business sector spends a relatively small amount on R&D, whereas, by contrast, the higher education sector spends a relatively large amount. In most countries, including the Netherlands, the amounts spent by public research institutes constituted only a small part of total R&D expenditure.

In the Netherlands, 88 thousand working years were spent on R&D in 2009. Also in this case, staff at companies accounted for almost half of the total. The working years spent on R&D by companies decreased in 2008 and 2009, whereas the working years spent on R&D by the higher education sector increased in these years.

The number of working years measured with respect to R&D staff at companies and public research institutes fluctuates from year to year. This is probably due to the method

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1) This amount concerns only the R&D at companies and institutes with at least 10 employed persons. R&D at smaller companies is discussed in greater detail in section 5.2.
used by Statistics Netherlands to collect the data and does not appear to be the result of actual fluctuations (see also the ‘Accuracy of the figures’ box). To obtain an accurate picture it is best to observe the trend over a period of at least two years.

**Accuracy of the figures**

The amounts concerning R&D in the Netherlands specified in this section are taken from, among other sources, Statistics Netherlands surveys. These surveys are carried out on a sample basis, which means that not all companies expected by Statistics Netherlands to have potentially performed R&D activities are contacted for survey purposes. This expectation is based on previous R&D surveys and on the Innovation Survey, which functions as an additional investigative survey. Working on a sample basis in any case means that a margin of error must be taken into account when interpreting results. Amounts in Table 5.1.1 for example are given in million euro. This does not mean, however, that the figures are known to an accuracy of 1 million euro. R&D expenditure for 2009 as included in the aforesaid table, for example, must be interpreted as 10,408 million euro with a margin of error of plus or minus 50 million euro.

---

### Table 5.1.1 R&D performed with own staff: expenditure, working years and R&D intensity, 1995–2009

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R&amp;D expenditure</strong> mln euro</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6,005</td>
<td>8,089</td>
<td>10,175</td>
<td>10,343</td>
<td>10,502</td>
<td>10,408</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>companies</td>
<td>3,132</td>
<td>4,457</td>
<td>5,480</td>
<td>5,495</td>
<td>5,263</td>
<td>4,900</td>
</tr>
<tr>
<td>public research institutes&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>1,144</td>
<td>1,049</td>
<td>1,260</td>
<td>1,259</td>
<td>1,259</td>
<td>1,327</td>
</tr>
<tr>
<td>institutions of higher education and university medical centres</td>
<td>1,729</td>
<td>2,583</td>
<td>3,435</td>
<td>3,589</td>
<td>3,980</td>
<td>4,181</td>
</tr>
<tr>
<td><strong>R&amp;D working years</strong> FTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>79,634</td>
<td>91,313</td>
<td>97,835</td>
<td>93,788</td>
<td>93,432</td>
<td>87,874</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>companies</td>
<td>37,817</td>
<td>47,509</td>
<td>52,841</td>
<td>49,246</td>
<td>48,019</td>
<td>42,336</td>
</tr>
<tr>
<td>public research institutes&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>16,929</td>
<td>13,726</td>
<td>12,765</td>
<td>12,140</td>
<td>12,182</td>
<td>11,416</td>
</tr>
<tr>
<td>institutions of higher education and university medical centres</td>
<td>24,888</td>
<td>30,078</td>
<td>32,229</td>
<td>32,402</td>
<td>33,231</td>
<td>34,122</td>
</tr>
<tr>
<td><strong>R&amp;D expenditure as a percentage of GDP</strong> %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.97</td>
<td>1.94</td>
<td>1.88</td>
<td>1.81</td>
<td>1.76</td>
<td>1.82</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>companies</td>
<td>1.03</td>
<td>1.07</td>
<td>1.01</td>
<td>0.96</td>
<td>0.88</td>
<td>0.86</td>
</tr>
<tr>
<td>public research institutes&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>0.37</td>
<td>0.25</td>
<td>0.23</td>
<td>0.22</td>
<td>0.21</td>
<td>0.23</td>
</tr>
<tr>
<td>institutions of higher education and university medical centres</td>
<td>0.57</td>
<td>0.62</td>
<td>0.64</td>
<td>0.63</td>
<td>0.67</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, national accounts and R&D surveys.

<sup>1)</sup> R&D expenditure as a percentage of GDP is still provisional due to the provisional nature of GDP.

<sup>2)</sup> Including private non-profit organisations (PNPs).
Table 5.1.1 also specifies what is referred to as R&D intensity. This is defined as R&D expenditure divided by GDP and expresses the scope of R&D relative to the scope of the total economy. Although R&D expenditure has been on an upward trend for some time, the rate of growth has not always kept pace with the rest of the economy. The R&D intensity of the Netherlands therefore fell from 2 percent in 1995 to 1.8 percent in 2009. It should be noted with respect to 2009 that GDP was considerably lower than it had been a year earlier due to the economic recession. As a result, R&D intensity was higher than in 2008, in spite of a decrease in R&D expenditure.

Netherlands not an international leader

In comparison with other countries, R&D intensity (R&D expenditure as a percentage of GDP) is not high in the Netherlands. Dividing R&D expenditure by GDP scales it to the size of a country’s economy, which allows the level of R&D expenditure in different countries to be compared. The economic contraction that occurred in many countries in 2008 or 2009 must be taken into account in this regard. When GDP decreases, a country that maintains the same level of R&D expenditure achieves a higher R&D intensity. In 2009, R&D intensity in the Netherlands was 1.82 percent (Figure 5.1.3). This was somewhat higher than in the preceding year: the decrease in GDP (denominator) was sharper than the decrease in R&D expenditure (numerator). The increase followed a...
5.1.3 R&D intensity, 1981–2009

R&D-intensity lower in 2009 than in 1995

Source: OECD Main Science and Technology Indicators, Statistics Netherlands.

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moderately downward trend. R&D intensity in the Netherlands has been lower than average in the EU-15 for a number of years. Intensity is also lower than is the case in the United States and Japan, where R&D intensity is increasing sharply. The same applies to China, which is of additional interest given the strong growth of Chinese GDP in recent years.

The statistical annex to this publication contains a table that specifies the R&D intensity of a larger group of countries. The annex can be consulted online at www.cbs.nl/ict-knowledge-economy.

Compared with other countries, the number of working years spent on R&D in the Netherlands is average. Figure 5.1.4 shows the number of R&D working years as a proportion of total employment. In 2009, R&D working years amounted to 1.0 percent of total employment in the Netherlands. This means that the Netherlands is just below the EU average (1.1 percent). In relative terms, Finland spends twice as many working years on R&D as the Netherlands. R&D as a proportion of total employment in China is still modest in spite of the considerable increase in expenditure.

5.1.4 R&D working years as a percentage of total employment, 2009

![Bar chart showing R&D working years as a percentage of total employment for various countries in 2009.](image)

Bron: OECD Main Science and Technology Indicators februari 2011.

5.2 R&D at companies

The business sector performs almost half of all R&D in the Netherlands. This section discusses R&D at companies in greater detail in terms of, among other things, the most R&D-intensive industries, the differences between large and small companies and the costs that account for most of total R&D expenditure. Specific attention is paid to R&D in the ICT sector. In addition, the R&D of Dutch companies is placed in an international perspective.

At macro level, a knowledge-intensive, high-tech sector structure is a key factor for major R&D efforts. The nature and scope of the business sector’s R&D activities can in part be traced back to sectors in which a country has already built up a strong position, such as the chemical and electrical engineering industry in the Netherlands. Another important driver of R&D activities is the rapid emergence of new markets. Markets that develop rapidly are more attractive in terms of economic activity, and companies are more likely to locate production and development facilities there (AWT, 2006). Examples in this regard are Japan and South Korea for microelectronics and the United States for software.

In addition, R&D activities are influenced by the advent of new technologies like ICT and biotechnology (the special subjects part of Kennis en Economie 2009 published by Statistics Netherlands includes a contribution that discusses biotechnology in detail). A widely applicable new technology generates R&D activities that are aimed at improving and applying this technology. In recent years, the ICT sector in the Netherlands has made a more than proportional contribution to the growth of R&D expenditure.

R&D at companies 10 percent down in two years

Following a period in which it was on an upward trend, R&D expenditure of companies fell in 2008 and 2009 (Table 5.2.1). The amounts that companies spent on R&D performed by their own staff started increasing from 2002 and totalled almost 5.5 billion euro in 2007. Expenditure fell sharply in subsequent years, however, amounting to 4.9 billion euro in 2009. This fall of over 10 percent in two years is similar to the decrease in the Dutch business sector’s total investments caused by the economic downturn of the time (see section 1.1).

The shares of the manufacturing, services and ‘other’ sectors in total R&D expenditure remained virtually the same as from 2000.2) These shares also remained virtually the same in 2008 and 2009, when total R&D expenditure fell. The manufacturing sector

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2) See Table 5.2.2 for an overview of the branches of industry assigned to the manufacturing, services and ‘other’ sectors.
accounted for three quarters of total R&D expenditure, considerably more than the services sector and ‘other’ sectors. The manufacturing sector’s share in R&D expenditure has decreased somewhat in recent years, while that of the services sector in particular has increased.

In absolute terms, the decrease in R&D expenditure of companies occurred primarily in the manufacturing sector. In 2009, expenditure in this sector was half a billion euro less than it had been in 2007. R&D expenditure also fell in the services sector. However, because the services sector had been spending less to begin with, the decrease was much smaller in absolute terms than was the case in the manufacturing sector.

Although R&D expenditure is mainly on an upward trend, the number of individual companies that perform R&D has been decreasing for a number of years. The top part of Table 5.2.1 shows that almost 2,500 companies in the Netherlands performed some R&D in 2009. The number of companies that report having performed R&D activities varies strongly from year to year. This variation is probably the result of the observation method used by Statistics Netherlands. To obtain an accurate picture it is best to observe the trend over a period of at least two years.

The downward trend with respect to the number of R&D companies can be seen in all three sectors. The number of companies in the services sector that engaged in R&D increased strongly between 1995 and 2000: in 1995 (not included in the table) there were 346 and in 2000 almost 1,600. The share of the services sector in the total number of R&D companies rose from 15 percent in 1995 to 40 percent in 2009. Accounting for just over half of all R&D companies, however, the manufacturing sector’s share remains the largest.

**Most R&D companies in the manufacturing sector**

The number of working years that staff at companies spent on R&D – in other words, the quantity of R&D staff – was over 42,000 in 2009. As stated in section 5.1, the focus in this regard must be on the trend rather than on a single year. The quantity of R&D staff at companies increased from 48,000 to 53,000 working years in the period 2000-2006. It decreased considerably in the period 2007–2009 in both the manufacturing sector and the services sector.
R&D concentrated in a few branches of industry

There are considerable differences between specific branches of industry in terms of R&D expenditure and intensity. It is interesting to examine whether shifts can be seen in the distribution of R&D activities across the various sectors. An analysis at the level of branch of industry must take into account the fact that a company may be active in several branches. A corporate group may be a supplier of products in both the chemical and pharmaceutical industries, for example. In this case, the group is assigned to the branch of industry in which it achieves most of its turnover and all of the group’s R&D is assigned to that branch of industry. However, this is not necessarily the branch of industry in which a specific company performed most of its R&D, although the probability of this being the case is extremely high, since more turnover suggests more activity in any form whatsoever. The classification system means that a company may change in terms of branch of industry, although most companies usually remain assigned to a similar branch of industry. It would be impossible to publish information about specific branches of industry without such a classification system.

Source: Statistics Netherlands, R&D surveys.

1) From 2008, classification by sector is based on Standard Industrial Classification 2008.
### 5.2.2 R&D by branch of industry, 2009

<table>
<thead>
<tr>
<th>Industry Type</th>
<th>Min. Euro</th>
<th>Number</th>
<th>FTE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food, drink and tobacco industries</td>
<td>276</td>
<td>160</td>
<td>2,280</td>
</tr>
<tr>
<td>Tobacco industry</td>
<td>297</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Textile, clothing and leather industries</td>
<td>13</td>
<td>32</td>
<td>149</td>
</tr>
<tr>
<td>Clothing industry</td>
<td>11</td>
<td>25</td>
<td>126</td>
</tr>
<tr>
<td>Leather industry</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Wood, paper and printing industries</td>
<td>30</td>
<td>49</td>
<td>255</td>
</tr>
<tr>
<td>Paper industry</td>
<td>24</td>
<td>24</td>
<td>205</td>
</tr>
<tr>
<td>Printing and reproduction companies</td>
<td>5</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>Crude oil industry</td>
<td>3</td>
<td>6</td>
<td>26</td>
</tr>
<tr>
<td>Chemical industry</td>
<td>834</td>
<td>140</td>
<td>5,629</td>
</tr>
<tr>
<td>Rubber and synthetics industry</td>
<td>41</td>
<td>134</td>
<td>556</td>
</tr>
<tr>
<td>Other non-metallic mineral products industry</td>
<td>19</td>
<td>61</td>
<td>234</td>
</tr>
<tr>
<td>Base metal</td>
<td>x</td>
<td>23</td>
<td>x</td>
</tr>
<tr>
<td>Metal products industry</td>
<td>63</td>
<td>127</td>
<td>844</td>
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<td>Computer, electronic and optical equipment industry</td>
<td>398</td>
<td>95</td>
<td>3,517</td>
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<td>Electronic components industry</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Computer industry</td>
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<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Communication equipment industry</td>
<td>12</td>
<td>6</td>
<td>94</td>
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<tr>
<td>Consumer electronics industry</td>
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<td>12</td>
<td>288</td>
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<tr>
<td>Measurement and regulation equipment industry</td>
<td>39</td>
<td>39</td>
<td>1,441</td>
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<td>Electromedical equipment industry</td>
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<td>6</td>
<td>104</td>
</tr>
<tr>
<td>Optical instruments industry</td>
<td>9</td>
<td>15</td>
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<tr>
<td>Electrical equipment industry</td>
<td>557</td>
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<td>4,160</td>
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<tr>
<td>Manufacturing industry</td>
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<td>282</td>
<td>4,750</td>
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<td>Vehicle manufacturing industry</td>
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<td>32</td>
<td>705</td>
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<tr>
<td>Other mode of transport industries</td>
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<td>31</td>
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<td>Shipping industry</td>
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<tr>
<td>Aircraft industry</td>
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<tr>
<td>Other mode of transport industries not named elsewhere</td>
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<td>11</td>
<td>107</td>
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<tr>
<td>Furniture industry</td>
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<tr>
<td>Other industries</td>
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<tr>
<td>Medical instruments industry</td>
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<td>1,631</td>
</tr>
<tr>
<td>Other industries not named elsewhere</td>
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<td>7</td>
<td>36</td>
</tr>
<tr>
<td>Repair and installation</td>
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<td>32</td>
<td>x</td>
</tr>
<tr>
<td><strong>Services</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wholesale and retail, repair of cars</td>
<td>185</td>
<td>285</td>
<td>2,180</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>39</td>
<td>12</td>
<td>446</td>
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<tr>
<td>Information and communications</td>
<td>350</td>
<td>339</td>
<td>3,993</td>
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<tr>
<td>Telecommunications</td>
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<td>12</td>
<td>134</td>
</tr>
<tr>
<td>Provision of services for information technology</td>
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<td>308</td>
<td>3,745</td>
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<tr>
<td>Provision of services for information</td>
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<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Other information and communications not named elsewhere</td>
<td>22</td>
<td>8</td>
<td>97</td>
</tr>
<tr>
<td>Financial institutions</td>
<td>20</td>
<td>20</td>
<td>213</td>
</tr>
<tr>
<td>Leasing and trading in immovable property</td>
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</tr>
<tr>
<td>Consulting, research and specialist business services</td>
<td>521</td>
<td>304</td>
<td>5,083</td>
</tr>
<tr>
<td>Research and development</td>
<td>373</td>
<td>113</td>
<td>3,280</td>
</tr>
<tr>
<td>Consulting, research and specialist business services not named elsewhere</td>
<td>148</td>
<td>191</td>
<td>1,803</td>
</tr>
<tr>
<td>Hiring out of movable property and other business services</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

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1) R&D expenditure R&D companies R&D staff

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148 Statistics Netherlands
The revised Standard Industrial Classification (SIC 2008) has been used since the 2008 reporting year. This means that the detailing of R&D according to specific branch of industry for reporting years from 2008 onwards differs from the years prior thereto and, consequently, the later results cannot always be properly compared with those obtained prior to 2008 at this level of detail.

Table 5.2.2 shows the different branches of industry. For each branch, R&D expenditure of the companies is specified first. This is followed by the number of R&D companies and, finally, the number of working years spent on R&D, all for the 2009 reporting year. R&D intensity (R&D expenditure as a percentage of gross added value) can as yet not be detailed according to branch of industry. Gross added value for 2009 according to the new system of industrial classification was not yet available at the time of writing. R&D intensity is available on a higher aggregate level (classification according to manufacturing, services and ‘other’ sectors), however, because the old and new systems of industrial classification do not differ much on this level. These intensities are included in Table 5.2.3.

The R&D intensity of the manufacturing sector has been on a downward trend in recent years, falling from 5.6 percent in 2006 to 4.7 percent in 2008. Intensity increased again to 5 percent in 2009. Although R&D expenditure in the manufacturing sector decreased in 2009, the drop in gross added value was even sharper, as a result of which intensity was higher.

As was also the case in 2008, the chemical, pharmaceutical, electrical equipment and machine and equipment industries accounted for the highest level of R&D expenditure in absolute terms. Average R&D expenditure per company was particularly high in the pharmaceutical industry and the electrical equipment industry. In the pharmaceutical
industry an average of 21 million euro per company was spent on R&D in 2009. R&D in this branch of industry is concentrated in a small number of companies.

### 5.2.3 Development of R&D intensities by sector, 2006–2009

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th></th>
<th>2007</th>
<th></th>
<th>2008(^1)</th>
<th></th>
<th>2009(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mln euro</td>
<td>%</td>
<td>mln euro</td>
<td>%</td>
<td>mln euro</td>
<td>%</td>
<td>mln euro</td>
</tr>
<tr>
<td><strong>Manufacturing</strong></td>
<td>4,094</td>
<td>72,764</td>
<td>5.63</td>
<td>4,010</td>
<td>78,050</td>
<td>5.14</td>
<td>3,758</td>
</tr>
<tr>
<td><strong>Services(^3)</strong></td>
<td>1,200</td>
<td>251,484</td>
<td>0.48</td>
<td>1,284</td>
<td>267,897</td>
<td>0.48</td>
<td>1,307</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>186</td>
<td>65,035</td>
<td>0.29</td>
<td>201</td>
<td>67,425</td>
<td>0.30</td>
<td>198</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, national accounts and R&D surveys.

\(^1\) R&D expenditure by Standard Industrial Classification (SIC) 2008. The gross added value by SIC 2008 was not available at the time of writing and is therefore based on SIC 1993.

\(^2\) R&D intensity was calculated as the quotient of expenditure on R&D with own staff and the gross added value (market prices). The figures for 2008 and 2009 are provisional.

\(^3\) Excluding expenditure on R&D with own staff of public research institutes and private non-profit organisations.

R&D intensity in the services sector remained stable at around 0.48 percent in the period 2006–2008. Intensity decreased to 0.44 percent in 2009. The services sector is in this case defined to include SIC code 72 and exclude public research institutes and PNPs. Based on the activities classification system used by Statistics Netherlands, companies or institutes whose main activity is R&D (SIC Code 72) are assigned to the services sector. This is not, however, conducive to comparability with other sectors. Pertinent in this regard is the consideration that research companies and institutes mainly perform R&D work for third parties and not so much for their own business operations as such. Although these third parties may very well be in the services sector, they could equally be in the manufacturing sector or could indeed be organisations outside the business sector altogether. The R&D expenditure of this broadly defined services sector largely comprises the expenditure of research companies and institutes. In 2009, this share amounted to approximately half of the total. In addition to the aforementioned research companies, IT service providers accounted for the highest level of R&D expenditure in the services sector. IT services is also the branch of industry with the most R&D working years within the services sector.

At 0.3 percent, the R&D intensity of the ‘other’ sector is not high. As already shown in Table 5.2.1, this sector’s contribution to the total R&D expenditure of Dutch companies is modest (4 percent of R&D at companies in 2009). R&D expenditure in the ‘other’ sector remained more or less the same in the period 2006–2009.
Most R&D performed by large companies

Table 5.2.4 contains a comparison similar to that given in Table 5.2.1. Classification, however, is based on company size as defined by number of employed persons. It is often stated that R&D is the preserve of large companies. Among other things, this is related to the fact that product lifecycles are becoming shorter and batch sizes are decreasing (AWT, 2003). It is therefore more difficult to recoup R&D costs, as a result of which a decreasing number of small companies can afford R&D activities. For these smaller companies, an alternative to performing R&D with only their own staff would be to cooperate with other companies, public research institutes and other knowledge suppliers.

The R&D surveys of Statistics Netherlands reveal that R&D in the Netherlands does indeed take place primarily in larger companies. Table 5.2.4 shows that large companies (those with 250 or more employed persons) account for most R&D expenditure. It must be

<table>
<thead>
<tr>
<th>5.2.4</th>
<th>R&amp;D companies, expenditure and staff according to company size(^i), 2000–2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>number</td>
</tr>
<tr>
<td>R&amp;D companies</td>
<td>3,837</td>
</tr>
<tr>
<td>10–49 employed persons</td>
<td>1,990</td>
</tr>
<tr>
<td>50–249 employed persons</td>
<td>1,172</td>
</tr>
<tr>
<td>250 or more employed persons</td>
<td>675</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>4,457</td>
</tr>
<tr>
<td>10–49 employed persons</td>
<td>265</td>
</tr>
<tr>
<td>50–249 employed persons</td>
<td>590</td>
</tr>
<tr>
<td>250 or more employed persons</td>
<td>3,602</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
</tr>
<tr>
<td>R&amp;D staff</td>
<td>47,509</td>
</tr>
<tr>
<td>10–49 employed persons</td>
<td>6,071</td>
</tr>
<tr>
<td>50–249 employed persons</td>
<td>6,071</td>
</tr>
<tr>
<td>250 or more employed persons</td>
<td>33,315</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
</tr>
</tbody>
</table>

\(^i\) For 2000, classification of company size is based on the following numbers of employees: 10–49 employees, 50–199 employees and 200 or more employees.

Source: Statistics Netherlands, R&D surveys.
noted in this regard that company size in this case concerns a company’s total number of employed persons, not only those active in R&D. Large companies accounted for approximately 72 percent of R&D expenditure in 2009, even though this group constituted only 13 percent of all R&D companies. The decrease in R&D expenditure in 2008 and 2009 occurred mainly at large companies. By contrast, a moderate increase in expenditure took place at smaller companies. Large companies employed 63 percent of all R&D staff in the Netherlands in 2009. Only a small proportion, namely 13 percent, were employed at a company that had 10 to 50 employed persons. Companies with fewer than 10 employed persons were not included in the surveys. Statistics Netherlands did, however, estimate the R&D expenditure of companies in this category based on data collected pursuant to the Promotion of Research and Development Act (see box below).

**Estimating R&D expenditure of small companies through the Promotion of Research and Development Act (WBSO)**

There is no official statistical information about the R&D expenditure of small companies (companies with fewer than 10 employed persons) in the Netherlands. Although Statistics Netherlands asks companies about innovation and R&D, this group of companies does not form part of the defined population. Based on previous research, Statistics Netherlands assumes that although this group of companies is large, it accounts for only a small part of R&D expenditure. In the interest of proportionality, no major survey efforts are undertaken among small companies. An important starting point in Statistics Netherlands’ current monitoring strategy is the collection of missing data by means of secondary sources like registers. It is now possible to provide a better description of Dutch R&D expenditure by using the register maintained under the Promotion of Research and Development Act (WBSO) in addition to the surveys carried out.

The possibility of estimating the share of small companies in R&D expenditure by means of the register maintained under the Promotion of Research and Development Act was explored in Statistics Netherlands publication *Kennis en Economie* 2009 (CBS, 2010b). The Promotion of Research and Development Act provides for a tax scheme administered by NL Agency (AgentschapNL) which is accessible to a broadly defined group of users. This incentive scheme is intended for all entrepreneurs in the Netherlands who carry out research into technological innovations. The exploratory analysis showed that in 2005 and 2006, approximately 3.7 percent and 3.2 percent respectively was missing in R&D expenditure as a result of not taking small companies into account. These percentages were in keeping with previous research. Small companies accounted for 2.8 percent of total Dutch R&D expenditure in 2000. At the time, this was determined by including a select group of companies with 1 to 10 employees in the Innovation Survey 1998–2000 on a non-recurring basis.

The most important qualification that must be made with respect to the exploratory analysis included in *Kennis en Economie* 2009 is that only labour costs can be determined by means of the Promotion of Research and Development Act data. Statistics Netherlands wishes to estimate the share of small companies in total R&D expenditure, however, which of course includes items other than only labour costs, like investments in buildings, laboratories or equipment for R&D. In addition, it must be ascertained whether the share of small companies is sufficiently substantial to warrant the future inclusion of the smallest companies in the statistical determination of total R&D expenditure. Although an R&D share of 3 percent on the part of small companies as estimated on the basis of Promotion of Research and Development Act and Statistics Netherlands data appears to be realistic in a 2011 context, it may be larger. Due to uncertainty about the current estimates and the ongoing need for information, Statistics Netherlands is continuing the study into this problem.

The estimation method can be further strengthened by including several ‘Promotion of Research and Development Act years’ in the analysis. Although using the years 2005 and 2006 was a good start for exploration, it is too short a period to form a stable picture of the nature and size of this group of small companies. Statistics Netherlands will design and test a modernised method in 2011. Use will be made in this regard of information about companies’ applications filed under the Promotion of Research and Development Act in the period 2005–2008. The statistical relationship between S&O pay on which subsidy under the Promotion of Research and Development Act is granted and the R&D pay of – in the first instance – larger companies will also be studied. Outcomes will then be ‘translated’ into the context of companies with less than 10 employees, for which only information about subsidised S&O pay is available, after which an estimate of small companies’ total R&D expenditure will be made. The ultimate aim is for this estimate to constitute an addition to the existing R&D statistics of Statistics Netherlands. It must be noted that the possible meanings of R&D and S&O in this particular context are not identical. *Kennis en Economie* 2009 comprehensively discusses the similarities and differences.
On average, large companies each spent almost 11 million euro on R&D in 2009. This is almost 40 times as much as the average R&D expenditure of small companies (0.3 million euro). Approximately half of the companies that performed their own R&D in 2009 had 10 to 50 employed persons. The share of this group of small companies in total R&D expenditure fluctuated at around 7.5 percent in the period 2000–2009.

In spite of the fact that small and medium-sized companies are becoming more important in the Dutch R&D landscape, they still account for only a small proportion of total R&D expenditure. As stated earlier, large companies account for the largest share of R&D expenditure by far. Moreover, within this group, only a few major players account for the lion’s share of total Dutch R&D expenditure.

Less company R&D than in other countries

The R&D expenditure of companies in the Netherlands is low relative to other countries. Figure 5.2.5 shows amounts spent on R&D by the business sector divided by GDP for a number of countries. This company R&D intensity was 0.86 percent in the Netherlands in 2009, considerably lower than the EU average of 1.25 percent. With a corresponding figure of 2.8 percent, three times the Dutch one, Finnish companies were the most R&D-intensive.

5.2.5 R&D expenditure of companies, international, 2009

Source: Eurostat.

The large economies of Japan and the United States stand out because their respective levels of R&D intensity at companies are higher than the EU average. Although the R&D intensity of companies in China is still below the EU average, it has increased considerably in recent years. Due to major differences in terms of sector structure, countries cannot simply be compared without qualification. The Netherlands is a typical services economy and, from this perspective, it is understandable that relatively less R&D is performed in the country. The Dutch manufacturing sector, the one that generally accounts for more R&D than the services sector, is relatively small. This is of course not to say that R&D activities are not possible in the services sector. Nevertheless, Figure 5.2.5 shows that Dutch performance in this regard is below the EU average. The figure also shows that only a few countries had already surpassed the European standard of 3 percent in 2009. These were the Scandinavian countries, Japan, South Korea and the United States.

The Dutch business sector accounted for 3.3 percent of the total R&D expenditure of companies in the EU. Figure 5.2.6 shows the distribution of R&D expenditure within the EU according to Member State. Germany accounted for almost one third of total European R&D expenditure (147 billion euro in 2009).

If one looks not only at company R&D but also at total R&D expenditure in the Netherlands (pie chart on the right in Figure 5.2.6), it can be seen that the Netherlands accounted for 4.5 percent of all R&D in the EU (237 billion euro in total). This means that the Netherlands made the biggest contribution of all the smaller EU countries.

5.2.6 R&D expenditure of companies (left) and all sectors (right) in the EU, 2009, billion euro

![Pie charts showing R&D expenditure by country in the EU in 2009.](image)

Source: Eurostat.
Labour costs main cost item

Figure 5.2.7 shows that approximately 67 percent of Dutch R&D expenditure in 2009 consisted of (gross) labour costs and 26 percent comprised 'other R&D costs'. In addition, a small part of total R&D expenditure consists of investments in buildings (3 percent) and investments in machines, equipment and other assets (4 percent). Labour costs constituted 61 percent of R&D expenditure in 2007. The increase in the labour costs share in 2009 occurred at the expense of the 'other R&D costs' share. In 2007, this share was 30 percent of total R&D expenditure.

More is spent on wages and less on 'other R&D costs' in the services sector. By contrast, labour costs are less important in the 'other' sector.

Labour costs accounted for three quarters of total R&D expenditure at small companies in 2009. This proportion was lower at medium-sized and large companies (67 percent). Constituting 27 percent of total R&D expenditure, medium-sized and large companies spent considerably more on 'other R&D costs' than small ones (18 percent).

5.2.7 R&D expenditure by cost type and sector, 2009

% of R&D expenditure

- Gross labour costs
- Other R&D costs
- R&D investments in buildings
- Other R&D investments

Source: Statistics Netherlands, R&D and Innovation Survey.

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3 In this case, 'other R&D costs' means all R&D expenditure other than labour costs, investments in buildings, machines, equipment and other assets. These costs concern, for example, costs for loose tools, rental costs, maintenance of laboratories, scientific literature, the rent of computer time, insurances, energy and water and travel expenses.

4 Companies with 10–49 employed persons.

5 Companies with 50–249 employed persons or 250 or more employed persons.
Labour costs by nature constitute the largest cost item in R&D. It is therefore understandable that the tax subsidy provided for by the Promotion of Research and Development Act (WBSO) is designed to reduce precisely this cost item. Research has shown that for each euro granted in subsidy, companies spend an average of 1.72 euro more on R&D (De Jong and Verhoeven, 2007). The different effects of this subsidy are comprehensively discussed in section 3.4 of Kennis en Economie 2007 (Statistics Netherlands, 2007).

Most R&D in North Brabant

Figure 5.2.8 shows the R&D expenditure of companies according to province. These data were compiled by asking R&D companies and public research institutes for a rough distribution of the number of R&D working years across the provinces where the research took place. Companies in the province of North Brabant accounted for the highest level of R&D expenditure in 2009. They jointly spent 1.6 billion euro, approximately one third of the total R&D expenditure of companies in the Netherlands. This is nevertheless lower than two years previously, when the province of North Brabant accounted for 40 percent of R&D expenditure. Expenditure also fell in absolute terms: in 2007, 2.2 billion euro was spent on R&D in North Brabant.

The western and southern regions of the Netherlands accounted for almost 80 percent of all R&D expenditure. The other regions played a much smaller role. In 2007 the western and southern regions of the Netherlands accounted for more than 80 percent. This change is the result of a decrease in absolute R&D expenditure in the western and southern Netherlands and an increase of this expenditure in other regions.

Underlying figures and other regional data, such as the quantity of R&D staff, are contained in the statistical annex to this publication. The annex can be consulted online at www.cbs.nl/ict-knowledge-economy.

Within the EU, North Brabant is in seventeenth place out of approximately 300 regions as regards R&D intensity. In terms of absolute expenditure, North Brabant was even in twelfth place in 2007. The Stuttgart region heads the list with almost 8 billion euro in R&D expenditure, more than the total company R&D expenditure of the entire Netherlands.

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6 The regional distribution of R&D expenditure discussed is based on the distribution of research staff across the provinces where the research took place as reported by the respondents. Since expenditure per working year differs rather strongly per respondent, it cannot be assumed that regional expenditure will entirely match the regional working years spent on research.

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R&D staff: more researchers, fewer assistants

The development in the number of R&D working years was discussed earlier in this section (see among other things Table 5.2.1). The focus in the following is on the kind of staff who performed these working years. R&D staff at companies can be divided into researchers, technical and non-technical assistants and other R&D staff. The manufacturing, services and ‘other’ sectors differ from each other in terms of the quantity of each of these types of R&D staff deployed. Figure 5.2.9 shows the proportions in the total number of working years broken down according to job category and sector worked in. The proportion of technical and non-technical assistants in the manufacturing sector was approximately equal to that of researchers in 2009. Staff composition differs from that found in the services sector, where researchers predominate.

The proportion of researchers within R&D staff at companies increased from 44 percent to 52 percent in the period 2003–2008. The increase was greatest in the services sector and the ‘other’ sector. In 2009, the proportion of researchers decreased to 48 percent, however. This decrease occurred in all sectors.

Source: Statistics Netherlands, R&D and Innovation Surveys.
R&D in the ICT sector

The ICT sector is characterised by rapidly changing products and services. A newly introduced computer chip may already be outdated a year later. The continuous modernisation of products and services is essential. R&D and innovation are therefore crucial to the continued existence of companies in the ICT sector.

R&D expenditure in the ICT sector amounted to 629 million euro in 2009 (Table 5.2.10). The ICT sector therefore accounted for 12.8 percent of all R&D expenditure by Dutch companies. The ICT services sector accounted for slightly over half of R&D expenditure in the ICT sector, namely 361 million euro.

In the ICT sector, 6,117 working years were spent on R&D, 14.4 percent of all R&D working years at companies in the Netherlands. Seventy percent of R&D staff in the ICT sector worked in the ICT services sector.


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R&D working years at companies by job category and sector, 2003, 2007 and 2009

Source: Statistics Netherlands, R&D and Innovation Survey.

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---

See section 1.3 for a delineation of the ICT sector.
5.3 R&D in the public sector

The preceding section described R&D in the business sector. The present section focuses on R&D in the public sector. In addition to an analysis of developments in terms of expenditure and staff, the scientific fields in which R&D occurs are also discussed. The section concludes with a consideration of the position occupied by the Netherlands in international terms with respect to public R&D.

In the public sector, a distinction is made between two kinds of organisations that perform R&D, namely public research institutes and institutions of higher education.

Public research institutes are public or semi-public research agencies like the Netherlands Organisation for Applied Scientific Research (TNO) or large technology institutes like the Energy Research Centre of the Netherlands (ECN). Public research institutes also include government agencies whose functions include R&D, such as the National Institute for Public Health and the Environment (RIVM) and the CPB Netherlands Bureau for Economic Policy Analysis, and what are referred to as private non-profit organisations (PNPs), which are usually based on a set of ideals or serve charitable purposes.

Institutions of higher education include universities, colleges for higher professional education (hbo) and university medical centres.

Public sector spent 5.5 billion euro on R&D

The public sector spent 5.5 billion on R&D in 2009. This amount has risen each year (Table 5.3.1). In 2009, R&D expenditure by the public sector exceeded that of the private sector for the first time since 1993.
Public research institutes accounted for almost a quarter of total R&D expenditure in 2009. At 76 percent, the share of institutions of higher education was the largest. The corresponding figure for 2000 was 71 percent and in 1995 the share of institutions of higher education in public R&D expenditure was even smaller, namely 60 percent. This can be attributed, however, to the transfer of staff employed by the Netherlands Organisation for Scientific Research (NWO, a public research institute) to institutions of higher education.\(^8\)

Like public R&D expenditure, the quantity of R&D staff working in the public sector is rising. In 2009, 45,500 FTEs were deployed on R&D in the public sector. The majority of these FTEs (75 percent) were deployed by institutions of higher education, a quarter by public research institutes. The number of R&D staff at public research institutes decreased in recent years, whereas this number continued to increase in institutions of higher education. As a result, the share of institutions of higher education in the quantity of R&D staff in the public sector increased from 69 percent in 2006 to 75 percent in 2009. This shift from public research institutes to institutions of higher education occurred together with the change in the share of R&D expenditure.

\(^8\) Since 1999, the R&D expenditure and R&D working years of university research financed by the Netherlands Organisation for Scientific Research ‘NWO’ (second flow of funds or ‘Tweede Geldstroom’) have been attributed to R&D in institutions of higher education rather than to research institutes, which was the case until 1999. See also section 7.3.
Distribution according to expenditure type at public research institutes does not differ that much from the distribution at companies. Labour costs comprised 62 percent of public research institutes’ R&D expenditure in 2009. Other current costs amounted to 27 percent of expenditure. Amounts spent on buildings and equipment for R&D constituted a much smaller part of expenditure.

In 2009, 60 percent of R&D staff at public research institutes were researchers and approximately 25 percent were (technical) assistants. A relatively greater number of researchers therefore worked at public research institutes than in the business sector, where the corresponding figures were 48 percent researchers and 38 percent technical and non-technical assistants respectively. Approximately 15 percent of R&D FTEs were other supporting staff in both the business sector and at public research institutes.

More details about R&D expenditure and staff in higher education are given in section 7.3.

**Considerable amount of R&D in health sector**

Figure 5.3.2 shows the research areas in which R&D staff at public research institutes work. Most researchers work in engineering (32 percent). The natural sciences also have a large share (27 percent).
5.3.2 R&D staff at public research institutes, by research area, 2009

![Pie chart showing R&D staff at public research institutes, by research area, 2009.](chart)


5.3.3 R&D staff at institutions of higher education, by HOOP area, 2009

![Pie chart showing R&D staff at institutions of higher education, by HOOP area, 2009.](chart)

Source: Statistics Netherlands.
Figure 5.3.3 shows R&D staff in higher education divided according to research area. Classification in this case is based on ‘HOOP’ area. HOOP areas are the scientific fields distinguished in the Higher Education and Research Plan of the Ministry of Education, Culture and Science, of which plan HOOP is the acronym (Ministry of Education, Culture and Science, 2004).

One third of R&D staff in higher education, over 11,000 FTEs, work in the health HOOP area. In addition, as is the case at public research institutes, many R&D staff in higher education work in the natural sciences (20 percent) and engineering (17 percent).

Netherlands international leader in public R&D

Figure 5.3.4 compares the public R&D expenditure of a number of countries. Expenditure is expressed on a per inhabitant basis. At 333 euro per inhabitant, the Netherlands is among the countries that have the highest levels of public R&D expenditure in relative terms. On average, EU countries spent only 175 euro per inhabitant on R&D in 2009. China spends a considerable amount on public R&D in absolute terms. If total public R&D expenditure is divided by the very high number of inhabitants, however, China’s public R&D expenditure is relatively low.

In most of the countries shown, much more is spent by institutions of higher education than by public research institutes. This is also the case in the Netherlands.

5.3.4 R&D in the public sector, international, 2009

<table>
<thead>
<tr>
<th>Country</th>
<th>Higher education</th>
<th>Public research institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td></td>
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<tr>
<td>Denmark</td>
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<td>Sweden</td>
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<tr>
<td>Netherlands</td>
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<td>Italy</td>
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<td>Spain</td>
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<td>United Kingdom</td>
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<tr>
<td>Norway</td>
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</tbody>
</table>

Source: Eurostat.

5.4 Financing R&D

The first three sections of this chapter on R&D focused on the performers of R&D. However, the performer is not necessarily the party that also finances R&D. R&D is increasingly being outsourced, for example to other companies or to research institutes. In addition, R&D can also be financed by foreign parties, such as foreign business units of a multinational.

This section discusses the financing of R&D in the Netherlands in terms of the parties that play the largest roles in this regard. It also compares the financing structure in the Netherlands with those in a number of other countries. The final part focuses on the development of financing from abroad.

The financing structure has an effect on decision-making with respect to the type and scope of R&D performed. Companies that rely heavily on the resources of third parties have less influence on the use of R&D resources than companies that finance their R&D themselves. Internal and external financiers determine the parties to whom resources are allocated and also take part in deciding the purpose for which these resources are used. The financing structure therefore influences decision-making and thereby the use of resources. Companies that provide a large share of the financing themselves are those that have a high level of ambition to perform R&D and concrete plans for the carrying out of this R&D, and are also willing to make resources available for the purpose.

Figure 5.4.1 shows the total expenditure on R&D in the Netherlands divided according to financier. A distinction was made in this regard between private parties (companies and private non-profit organisations, or PNPs), public institutions (government authorities and institutions of higher education) and foreign organisations.

Companies financed 45 percent of all R&D in the Netherlands in 2009. Financing by companies in this case means financing by a company itself or financing by other companies. Government authorities financed 41 percent of all R&D, while PNPs accounted for 3 percent of financing. Institutions of higher education are primarily performers of R&D and finance R&D at other organisations only to a very limited extent (0.3 percent). The remaining 11 percent was financed from abroad. These proportions have remained virtually the same over the past ten years. In the years prior to the aforesaid period, the increase in financing from abroad is striking. This aspect is discussed in greater detail later in this section.

Table 5.4.2 further divides the financing structure into performing sectors. It can be seen that the business sector finances 80 percent of its own R&D and that 16 percent of R&D at companies is financed from abroad. The government’s contribution to R&D at companies is limited.
5.4.1 Financing of R&D in the Netherlands, 1981–2009

![Graph showing the financing of R&D in the Netherlands, 1981–2009.](image)

Source: Eurostat, Statistics Netherlands.

5.4.2 Financing of R&D in the Netherlands, 2005–2009

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies</td>
<td></td>
<td>4,086</td>
<td>4,563</td>
<td>3,925</td>
<td>79</td>
<td>83</td>
<td>80</td>
<td>46</td>
<td>49</td>
<td>45</td>
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<td>Government</td>
<td></td>
<td>177</td>
<td>125</td>
<td>183</td>
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<td>2</td>
<td>7</td>
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<tr>
<td>Institutions of higher education</td>
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<td>5</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Private non-profit organisations</td>
<td></td>
<td>12</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Abroad</td>
<td></td>
<td>890</td>
<td>795</td>
<td>781</td>
<td>17</td>
<td>14</td>
<td>16</td>
<td>17</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5,769</td>
<td>5,459</td>
<td>4,900</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands.
Naturally, public research institutes are financed mainly by government authorities. R&D in higher education is likewise financed primarily by the government. Private parties nevertheless account for approximately 19 percent of financing.

**Financing in keeping with international norm**

The financing of R&D in the Netherlands, where the proportions of financing by the business sector and the government were more or less equal in 2009, does not deviate from the norm in international terms. The differences between countries are pronounced, however (see Figure 5.4.3). The financing structure in the Netherlands is very similar to the EU average. There are countries in which the share of the business sector as a financier of R&D was much larger than was the case in the Netherlands. In Germany, for example, companies accounted for 67 percent of financing. At the other end of the spectrum is, among others, Russia, where companies accounted for only 27 percent of financing and the government plays a very large role.

5.4.3 Financing of R&D, international, 2009*1*

![Bar chart showing financing of R&D in different countries](chart.png)

Source: Eurostat, Statistics Netherlands.


The United Kingdom stands out because of the relatively high level of financing from abroad (18 percent). In Germany, for example, this amounts to only 4 percent. At 1.3 percent
and 0.3 percent of all R&D expenditure respectively. China and Japan (not included in the figure) have the lowest level of foreign financing in relative terms.

**Internationalisation of R&D at companies**

R&D can be outsourced beyond the borders of a country. Dutch companies, for example, may outsource their research activities to foreign institutes or a multinational headquartered in the United States may have its R&D performed at a Dutch subsidiary. Part of the R&D activities performed in the Netherlands are financed by foreign parties. This internationalisation of R&D in the business sector is discussed in greater detail below. Figure 5.4.4 shows the proportion of foreign financing in the total R&D expenditure of companies in the Netherlands. In the 1990s this proportion increased from a few percent to an average of 15 percent. From 2000, financing from abroad ceased to increase and fluctuated around 15 percent.

**5.4.4 Percentage of R&D expenditure by companies financed from abroad, 1970–2009**

The Netherlands is one of the countries with a high degree of internationalisation in R&D. Figure 5.4.5 shows the foreign proportion of total R&D financing at companies for a group of EU countries and a number of large non-EU countries. In relative terms, Dutch
companies received more foreign financing for their R&D in 2009 than the EU average. Almost a quarter of R&D at companies in the United Kingdom was financed by foreign parties in 2009. Foreign financing is far less common in other major economies, including those of Japan and China.

In general, financing from abroad has increased since 2000. Only in Russia and Japan has it decreased. The increase was particularly strong in Ireland: total R&D expenditure of companies in Ireland was twice as high in 2009 as in 2000.

5.4.5 Percentage of financing from abroad in the total financing of R&D at companies

![Bar chart showing the percentage of financing from abroad in total R&D financing at companies in various countries for 2009 and 2000.]

Source: Eurostat, Statistics Netherlands.


Although a high degree of internationalisation in R&D with a large proportion of foreign financing has its advantages, it also entails dependence. Attracting foreign investment opens up more opportunities for R&D. The large proportion of financing from abroad indicates that foreign companies like to have their R&D performed in the Netherlands. A potential disadvantage is the dependence that arises as a result: the foreign financier partly determines the kind of research to be carried out. In addition, an international group of companies can decide with relative ease to relocate the R&D being performed in the Netherlands to another country on the grounds of, for example, efficiency considerations.
5.5 Patents

A patent is an intellectual property right issued by authorised bodies. A patent gives its owner the legal right to prevent others from manufacturing, using, selling or importing the patented invention. The protection applies for the term of the patent and only in those countries concerned by the protection. Patents can be granted to, for example, companies, universities, institutes or private parties, as long as the invention satisfies the conditions for patentability: novelty, non-obviousness and industrial applicability. A competent patent office determines whether or not an invention meets these criteria and ultimately grants or rejects a patent application.

Patents are commonly seen as a key output of a country’s R&D activities. A high number of patent applications is taken as an indication of a knowledge-intensive economy and the competencies associated therewith. Indicators pertaining to patents are used in this context to assess countries’ inventive performance. Interest in the nature and scope of patent applications is not a new phenomenon. There is also a pragmatic reason behind the increasing number of publications on the subject. In recent years, holders of patent registrations – the different patent offices in the world – have opened these registrations in digital form and made them available for statistical purposes. These registrations also include a number of characteristics of the patent application, which makes it possible to detail patent applications according to area of technology, such as ICT. This in turn reveals the areas of technology in which a country is strongly represented and those in which it is less prominent.

The indicators presented in this section concern patent applications at the European Patent Office (EPO). A patent granted by the EPO is valid in each country that is an EPO member (38 members in 2011) provided that the applicant has validated his, her or its rights at the national patent office of a country. A patent only becomes effective after it has been granted by the national patent organisation. The validation of an EPO patent in the Netherlands, for example, means that the claims of the patent must be translated into Dutch (the other parts may be stated in English) and that the fees associated with the patent must be paid. In addition, the indicators presented in this section are classified according to year based on the priority date. This is the first date of filing of a patent application, anywhere in the world, to protect an invention. It is the date that is closest to the time at which the invention was actually made. ICT patent applications are delineated by means of the technology code that is assigned to each patent application by a patent office.

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9) An example in this regard is PATSTAT, a database containing information about patents which was specially designed for statistical purposes and developed by the European Patent Office (EPO). The database contains harmonised information about patents at patent-granting organisations in approximately 80 countries.
Dutch parties apply for relatively many patents

In 2006, the most recent year for which definite figures are available, Dutch parties filed 375 patent applications at the EPO for each billion euro of R&D expenditure (Figure 5.5.1). Following Germany with 398 patent applications, the Netherlands was the country with the highest number of patent applications of the benchmark countries. A relatively small group of large companies account for a large proportion of Dutch patent applications. In 2006, for example, over 70 percent of Dutch patent applications were filed at the EPO by companies with 500 or more employees. However, this group of companies constituted only 16 percent of the total number of Dutch companies that filed a patent application in 2006 (De Heij and Kuipers, 2010).

Netherlands among European leaders in terms of patent applications

The number of Dutch patent applications was considerably higher than the EU-27 average, which was 261 patent applications per billion euro of R&D expenditure. Of the benchmark countries, the United States had the lowest number of patent applications per billion euro of R&D expenditure (115). It must be noted in this regard that the United States is not an EPO member and that non-members file a comparatively higher number of patent applications in their home markets (OECD, 2009b).

If the number of patent applications filed at the EPO is expressed per million inhabitants of a country, Germany is likewise the country that filed the most applications in 2006. German parties filed 284 patent applications per million inhabitants. The corresponding figure for the Netherlands was 221. The Netherlands was second after Germany in terms of patent applications in relation to R&D expenditure but only fourth, after Germany, Sweden (280) and Finland (249), when the figure is viewed per million inhabitants. This has to do with the fact that R&D expenditure in the Netherlands is relatively low (see section 5.2). With 64 and 69 EPO patent applications respectively, Ireland and Canada had the lowest numbers per million inhabitants. This does not necessarily mean, however, that Irish and Canadian R&D work is less fruitful, since parties can also opt to protect the knowledge developed in other ways, such as by means of secrecy.
Dutch ICT sector extensive user of intellectual property rights

Intellectual property rights encompass more than just patents. They also apply to industrial designs and trademarks filed, as well as established copyrights. If one looks only at innovators, it is apparent that parties in the ICT sector are very active in the area of intellectual property rights. In the period 2006–2008, over one in three companies in the ICT manufacturing sector used an intellectual property right (35 percent). Twenty-nine percent of companies in the ICT services sector did so. In the other sectors of the economy, 23 percent of innovators used one of the forms of intellectual property protection.\(^\text{10}\)

If one looks specifically at patents, it is apparent that the ICT manufacturing sector in particular is very active. Almost one in three companies (31 percent) in this sector applied for a patent as against 9 percent of innovative companies in the ICT services sector. The low percentage in the ICT service sector is linked to the fact that services lend themselves less well to patenting. Twelve percent of innovators outside the ICT sector applied for a patent.

\(^{10}\) For the concept of ‘innovator’ see the Glossary at the end of this publication.
ICT service providers file trademarks with relative frequency. Twenty percent of innovators in the ICT services sector filed a trademark in the period 2006–2008 as against 14 percent of innovators in the ICT manufacturing sector, for example. The figure was likewise 14 percent in other sectors of the economy (excluding the ICT sector). ICT service providers are also very active in the area of copyrights. Seven percent of innovative companies in the ICT services sector established a copyright as against 4 percent of innovators in other sectors.

**Over a third of Dutch patent applications concerned ICT**

Thirty-five percent of all Dutch patent applications filed at the EPO in 2006 concerned ICT. These ICT patents were applied for by a range of companies, not only ICT ones. With 61 percent, South Korea had the largest proportion of ICT patent applications in the total. Finland, Canada, Japan, Ireland, Sweden and the United States also surpass the Netherlands in this area. The EU-27 average was 25 percent.

### 5.5.2 ICT patent applications filed with the European Patent Office, international, 2006

![Graph showing ICT patent applications by country and category](image-url)

- **Source:** Eurostat.
Netherlands no longer leader in consumer electronics

During the years 1997 up to and including 2005, the Netherlands consistently filed the most patent applications of all benchmark countries in the area of consumer electronics. The sole exception in this regard was 2003, when Japan and Finland filed a higher number of patent applications in this area. The Netherlands lost the lead again in 2006. Per million inhabitants, South Korean parties applied for 16 patents, the highest number of all benchmark countries. The Netherlands and Japan followed with 14 patent applications in the area of consumer electronics (Figure 5.5.2).

Netherlands strongest in terms of ‘Other ICT’

Although the Netherlands lost the lead with respect to consumer electronics, it headed the list of benchmark countries in the area of ‘Other ICT’. ‘Other ICT’ includes, among others, producers of semiconductors and cables for communication. Per million inhabitants, Dutch parties filed 31 patent applications in this area in 2006. The Netherlands therefore took over the lead from Germany, which had filed the most patent applications per million inhabitants in 2005. Dutch parties had never accounted for the most patent applications in this ICT subarea in the period 1997–2005.

The Netherlands is also relatively strong in the technology area ‘Computers and office machinery’. Dutch parties applied for a relatively small number of patents with respect to ‘Telecommunications’, namely 13 patents per million inhabitants. With 74 patent applications, Finland led the benchmark countries in this area, followed by Sweden (50).

Fewer Dutch high-tech patent applications

Although the number of high-tech patents applied for by Dutch parties was initially on an upward trend during the period reviewed, it decreased in recent years (Figure 5.5.3). In 2006, Dutch parties filed 52 high-tech patents per million inhabitants. This is just over half the number for 2001, when 100 patents that could be classified as high-tech ones were applied for. With the exception of Sweden, the number of high-tech patents started decreasing in 2004 in all benchmark countries, also in Finland, which consistently applied for the highest number of high-tech patents during the period 1996–2006. Almost a quarter (24 percent) of all Dutch patent applications filed in 2006 were for high-tech patents. The Netherlands was therefore fifth among the benchmark countries listed in Figure 5.5.3. With 42 percent, Finland had the highest proportion of high-tech patent applications. Japan likewise performed strongly in this respect: almost one in three patents applied for by Japanese parties could be classified as being high-tech ones (30 percent).
The figures presented in this section must be interpreted with a measure of caution. R&D expenditure (Figure 5.5.1), for example, often does not coincide with the year in which a patent application is filed, since R&D expenditure usually precedes a patent application. This gap in terms of time can produce a degree of distortion. In addition, national cultures differ with respect to the protection of knowledge, which does not by any means always have to be effected by means of a patent. The presence or absence and size of certain sectors in a country can also play a part in that country’s position. In 2006, for example, almost 70 percent of inventions in the area of electronics were patented, whereas ‘only’ 25 percent of inventions in certain parts of the chemical manufacturing sector were patented. Patent-related figures would therefore probably be lower for a country with a relatively large chemical manufacturing sector than for one with a relatively large electrical engineering sector.

11) Based on the EPO applicant panel survey 2006 (OECD, 2009b).
Knowledge potential
Knowledge potential

6.1 Education in the Netherlands
- Participation in education increased considerably
- New structure: more secondary school graduates in science clusters
- Less interest in ICT in highest level of mbo
- Number of hbo students in natural science cluster rising again
- More natural science and engineering students in universities
- Half of vwo graduates have a master’s degree within seven years
- Drop-out rate wo particularly high after the first year
- Lifelong learning and post-initial education
- Netherlands just behind European leaders in terms of lifelong learning
- Participation of women in post-initial education continues to rise

6.2 Knowledge in the Netherlands and in an international context
- Many German students come to the Netherlands
- Many Dutch students enrol in Belgium
- Education level of Dutch women has increased considerably
- High labour force participation in the Netherlands
- Netherlands just behind world leaders in terms of high qualified individuals
- Netherlands lagging in terms of science graduates
- Human resources in science and technology (HRST)
- HRST: Netherlands third in the EU

6.3 ICT skills
- Dutch are skilled computer users
- Internet skills increasing
The Dutch population’s level of education continues to rise, especially among women. Due to the increased labour force participation of highly educated women in particular, the working population’s level of education has also risen. The number of participants and graduates in natural sciences and technology, which include ICT/computer science and which are important to R&D, increased somewhat. Nevertheless, the proportion of students who graduate in natural sciences in the Netherlands is small in international terms. The Netherlands is just behind the world’s leading countries, however, in terms of the proportion of ICT graduates, the proportion of highly educated individuals in the total population and the proportion of inhabitants who complete further education and training. In international terms, the Netherlands is performing well with respect to increasing the number of highly educated individuals.

A large proportion of the Dutch labour force constitutes human resources in science and technology (HRST). The Netherlands is third in Europe. The Dutch population’s internet skills have increased considerably in recent years. Sixty percent of Dutch internet users had average or above-average internet skills in 2010.

### Education in the Netherlands

English definitions of abbreviations used for the various levels of secondary and higher education:

**secondary education**
- bbl = apprenticeship-based track of mbo1
- bol = school-based track of mbo
- havo = senior general secondary education
- lwoo = extra learning support in vmbo
- mavo = junior general secondary education
- mbo = senior secondary vocational education
- vavo = basic secondary education for adults
- vmbo = preparatory secondary vocational education
- vwo = pre-university education

**higher education**
- ho = higher education
- hbo = higher professional education
- wo = university education

### 6.1 Education in the Netherlands

Human capital is the central theme of this chapter; that is, the knowledge potential of individuals and the knowledge and skills of the population at large and the labour force in particular. In practice, this knowledge potential is often linked to the number of individuals in employment who have obtained qualifications in higher education – the ‘stock’ of highly educated individuals. To present the trend in the number of highly educated individuals in the Netherlands, this section outlines the development of participation in education in senior general secondary education (havo)/pre-university education (vwo), senior secondary vocational education (mbo) and higher education (ho). The fields of
natural sciences, ICT and technology are discussed in greater detail, since these areas of study are of particular relevance to research and development (R&D). The concluding part of this section focuses on lifelong learning. This concerns participation in courses and training programmes on the part of individuals who are generally already employed.

Participation in education increased considerably

Participation in education by young people has increased considerably since the 1990s. A growing number of students remain in education or return to it following the end of compulsory attendance (Statistics Netherlands, 2010a). Figure 6.1.1 shows the differences in levels of participation in education between 1997/’98 and 2009/’10 for the different types of education. Among other things, this figure indicates that participation in havo and vwo has increased. In 2009/’10 over 42 percent of 16-year-olds were in third grade or higher of havo or vwo. The corresponding proportion for 1997/’98 was less than 36 percent. The proportion of havo and vwo students among 18 and 19-year-olds decreased somewhat due to more rapid progression to further education. The number of those in mbo likewise increased. Relative to 1997/’98, there were both more young (aged 16 to 18) and older (aged 21 to 26) mbo students in 2009/’10. Participation in higher education increased considerably with respect to all age groups. The largest group in higher education is aged

6.1.1 Participation in education 1997/’98–2009/’10(2)

<table>
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<tr>
<th>% of the population group concerned</th>
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<th>5</th>
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<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
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<td>16</td>
<td>17</td>
<td>18</td>
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<td>21</td>
<td>22</td>
<td>23</td>
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</tr>
<tr>
<td>Havo/vwo 3+ 2009/’10</td>
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<td></td>
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<td>50</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, education statistics.

1 Seniors general secondary education (havo) and pre-university education (vwo), years 3, 4, 5 and 6.
2 Higher education refers to higher professional education (hbo) and university education (wo).
3 Mbo refers to senior secondary vocational education.
4 Figures for 2009/’10 are provisional.
Over 31 percent of the population aged 21 was enrolled as a student in higher professional education (hbo) or university education (wo) in 1997/’98. The corresponding proportion for 2009/’10 was just under 40 percent. Given the composition of the country’s population, it is important that a relatively increasing number of young people complete studies in order to maintain the level of highly educated individuals in the Netherlands.

**New structure: more secondary school graduates in science clusters**

The number of graduates in havo and vwo rose from 64,000 in 2003/’04 to 75,000 in 2008/’09. This is an increase of 17 percent, while the number of 17 and 18 year-olds in the population grew by 6 percent in the same period. More young people are therefore graduating from these highest levels of secondary education also in relative terms. The number of graduates fell somewhat in 2009/’10, as did the proportion of 17 and 18 year-olds in the population. The proportion of students who passed their examinations also decreased in 2009/’10.

In the final years of havo and vwo, students can select one of four subject clusters, namely Natural Science and Technology, Natural Science and Health, Economics and Society or Culture and Society. A combination of subject clusters is also possible. Traditionally, more boys than girls opted for Natural Science and Technology and more girls than boys opted for Culture and Society.

**6.1.2 Havo and vwo graduates by subject cluster, 2003/’04–2009/’10**

<table>
<thead>
<tr>
<th>Subject Cluster</th>
<th>2003/’04</th>
<th>2009/’10*</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM and CM (double subject cluster)</td>
<td></td>
<td></td>
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<tr>
<td>Culture and Society (CM)</td>
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<td></td>
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<tr>
<td>Economics and Society (EM)</td>
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<td></td>
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<tr>
<td>NT and NG (double subject cluster)</td>
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<td></td>
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<tr>
<td>Nature and Health (NG)</td>
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<td></td>
</tr>
<tr>
<td>Nature and Technology (NT)</td>
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<td></td>
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<tr>
<td>EM and CM (double subject cluster)</td>
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<td>Culture and Society (CM)</td>
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<td>NT and NG (double subject cluster)</td>
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<td>Nature and Health (NG)</td>
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<tr>
<td>Nature and Technology (NT)</td>
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</tbody>
</table>

Source: Statistics Netherlands, education statistics.

1) Excluding very small numbers of graduates in other subject cluster combinations.
2) The figures for 2009/’10 are provisional.
The introduction of a modernised second stage in havo and vwo caused profound shifts in choice of subject cluster. Previously, Economics and Society had been the most frequently chosen subject cluster in both havo and vwo. Following the introduction of the modernised second stage, this subject cluster grew somewhat further, accounting for 42 percent of graduates in havo. By contrast, interest in it decreased in vwo. The growth of the Economics and Society subject cluster in havo was primarily the result of different choices on the part of girls, who now opt for Culture and Society to a far lesser extent. In addition, students in havo now opt more frequently for a combination of subject clusters, especially for double natural science ones. The frequency with which double subject clusters were chosen increased even more sharply in vwo. Thirty percent of vwo graduates completed final examinations in a combined natural science subject cluster and 12 percent did so in a combined society subject cluster in 2009/10. The corresponding figures for 2003/04 together did not even total 4 percent. This trend appears to be anticipating the plans of the Minister of Education to reduce the number of subject clusters to two in the future.

The number of diplomas obtained in a natural science subject cluster as opposed to a society subject cluster have been on the rise in both havo and vwo since 2003/04. The introduction of the modernised second stage strengthened this trend. The share of natural science subject clusters in havo increased from 27 percent in 2003/04 to 35 percent in 2009/10. In vwo, this share increased from 46 percent to 52 percent. Girls in particular are opting more frequently than was previously the case for one or a combination of the natural science subject clusters.

**Less interest in ICT in highest level of mbo**

A total of 530,000 students were enrolled in senior secondary vocational educational (mbo) in 2010/11. In terms of the number of individuals enrolled, this makes it the most common type of education referred to in this section (havo/vwo, mbo, hbo and wo). The number of participants in mbo has grown by almost 10 percent since 2005/06. There are four levels of difficulty in mbo in the Netherlands, of which only the first (lowest) level does not result in the award of a basic qualification for the labour market upon successful completion. Approximately 5 percent of those in mbo are attending a first-level training programme (assistant training). Almost half of mbo participants are female, though the proportion of females varies according to field of education and level. Only one-third of participants undergoing basic vocational training (level 2) are female, while just over half

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4 Subject clusters were introduced into havo and vwo starting from the 1998/99 school year. With the introduction of the ‘new style’ second stage in the fourth year of havo and vwo in the 2007/08 school year, changes occurred with respect to subject combination and the distinction between main subjects and half subjects disappeared.

5 For a definition of a basic qualification, see the Glossary at the end of this publication.
of those undergoing management training and specialist training, the highest level, are female.

For the subdivision of education and training according to field, this chapter adheres to the main classification of the International Standard Classification of Education (ISCED). Not every field has training programmes at each distinctive level. In the field of ‘education’, for example, only training to become a teaching assistant, a fourth-level programme, is taken into account.

In 2009/’10 181,000 participants in mbo successfully completed a training programme at level 2, 3 or 4, which is 22 percent more than in the preceding year. This sharp increase was largely the result of an amendment to the Childcare Provision Act pursuant to which reimbursements for childminding services are now only provided if these services are obtained from qualified childminders. In the field of ‘health care and social welfare’ there were therefore four times as many graduates in level 2 mbo as there had been in 2008/’09. If this group is not taken into account, the increase in the number of mbo graduates relative to 2008/’09 was only 4 percent.

6.1.3 Mbo graduates, level 2 and higher\(^1\) by specialisation and level, 2009/’10\(^2\)

![Graph showing Mbo graduates, level 2 and higher by specialisation and level, 2009/’10]

Source: Statistics Netherlands, education statistics.

\(^1\) Mbo training programmes at levels 2, 3 and 4, therefore without assistant training. This graph concerns only training programmes that result in the award of a diploma deemed to be a basic qualification for the labour market. External candidates have been included in the figures.

\(^2\) The figures for 2009/’10 are provisional.

In 2009/’10 181,000 participants in mbo successfully completed a training programme at level 2, 3 or 4, which is 22 percent more than in the preceding year. This sharp increase was largely the result of an amendment to the Childcare Provision Act pursuant to which reimbursements for childminding services are now only provided if these services are obtained from qualified childminders. In the field of ‘health care and social welfare’ there were therefore four times as many graduates in level 2 mbo as there had been in 2008/’09. If this group is not taken into account, the increase in the number of mbo graduates relative to 2008/’09 was only 4 percent.
Training programmes in the field of ‘engineering, manufacturing and construction’ occur mainly on level 2 and level 3, that is basic vocational training and vocational training. Approximately 25,000 individuals successfully completed such programmes in 2009/’10, almost 4,000 more than in 2005/’06. Level 4 of this field accounted for only 8,000 graduates in 2009/’10. At 24,000, the number of level 2 and level 3 mbo graduates in the field of ‘personal services, transport, environment and safety’ was also much higher than the number of level 4 graduates (over 8,000). In the field of ‘business administration, accounting and law’ the number of graduates on levels 2, 3 and 4 was virtually the same. Accounting for fewer than 6,000 graduates in 2009/’10, ‘ICT’ is a less frequently chosen field in mbo. ‘ICT’ was also the only field other than ‘education’ in mbo in which the number of graduates decreased (figure 6.1.3). In 2005/’06, there were almost 1,000 more mbo graduates in ‘ICT’ than in 2009/’10. The decrease occurred mainly at the highest level of mbo.

**Number of hbo students in natural science cluster rising again**

Approximately 417,000 students were enrolled in higher professional education (hbo) in 2010/’11. The corresponding figure for 1995/’96 was 271,000, which therefore means an increase of 54 percent. The number of students enrolled in hbo has increased each year since 1995/’96. The number of women grew more strongly than the number of men in this regard. The proportion of women increased from 49 percent to 52 percent during this period. Grouped according to the main ISCED categories, almost one third of hbo students are attending a training programme in the ‘social sciences, technology management and law’ subject cluster. Within this group, 72 percent are completing business and administration studies. The ‘engineering, manufacturing and construction’ and ‘natural science, applied mathematics and computer technology’ subject clusters are of particular importance to R&D. Approximately 13 percent of hbo students are attending a training programme in one of these exact science subject clusters; almost 6 percent in the natural science subject cluster and almost 8 percent in the engineering subject cluster. Almost all students in the natural science subject cluster are attending an ICT training programme (94 percent). With the exception of a slight decrease in 2007/’08, the proportion of students in the natural science subject cluster increased continuously. Although the decrease lasted somewhat longer in the ‘ICT’ field, student numbers are also on the rise again. Training programmes in communication systems in particular are attracting an increasing number of students. The proportion of hbo students in the engineering subject cluster decreased continuously between 1995/’96 and 2006/’07. This proportion has been moderately increasing again in recent years, however. The proportion of women in the natural science and engineering subject clusters is small (15 percent). In comparison with other countries, the proportion of women attending exact science programmes in Dutch higher education is extremely small (Hartgers et al., 2011). Programmes that focus on...
communication systems constitute a favourable exception in this regard. Approximately 27 percent of students attending such programmes in 2010/11 were female.

Number of technology students up slightly in hbo

The ratio between the number of first-year students and graduates is a predictive indicator with respect to the trend in graduate numbers for the coming years. When comparing fields of study, however, it must be borne in mind that they differ in terms of dropout rates. The ‘social sciences’ subject cluster in particular will produce a substantially higher number of graduates in the near future. The field of ‘education’ will probably lose ground. Interest in this field decreased following the introduction of compulsory language and arithmetic tests. The number of first-year students in ‘training for primary school teachers’ fell from 9,700 in 2003/04 to 6,700 in 2010/11. At the same time, however, the number of those who enrolled in hbo educational studies – studies that belong to the same subject cluster – increased in recent years. The ‘natural science, applied mathematics and computer

6.1.4 Hbo first-year students and graduates, 2009/10-2010/11

First-year students, 2010/11

Graduates, 2009/10

Source: Statistics Netherlands, education statistics.

1) First-year students and graduates (bachelor's degree) in higher professional education (hbo). The figures are provisional.

2) ISCED 3 excluding ‘business/administration’ (ISCED 32).

3) ISCED 4 excluding ‘computer science’ (ISCED 48).
The natural science subject cluster ('natural science and applied mathematics') is extremely small. This part will probably produce more graduates of bachelor degree programmes of HBO in the coming years, since there were relatively more first-year students in 2010/'11 than there were graduates in the preceding year. The number of first-year students in this subject cluster also increased in recent years, from 104 in 2006/'07 to 445 in 2010/'11. The number of first-year students in life sciences in particular grew strongly, though applied mathematics and statistics also attracted more interest. Nevertheless, the numbers remain extremely low. The number of first-year computer technology students in HBO increased from 4,939 in 2006/'07 to 5,453 in 2009/'10. This number fell to 5,155 in the 2010/'11 academic year. Interest in the 'engineering, manufacturing and construction' subject cluster increased between 2005/'06 and 2008/'09. The number of first-year students increased from 7,523 to 8,412 during this period. This number remained fairly stable in subsequent years, amounting to 8,361 in 2010/'11. With 39 first-year students in 2010/'11, the electronics and computer technology field in HBO is extremely small.

**More natural science and engineering students in universities**

The number of students enrolled in government-funded university education (WO) has increased by 36 percent since the 1995/'96 academic year, from 178,000 to 242,000 in 2010/'11. This growth is therefore somewhat less pronounced than the one that occurred in HBO (54 percent). In university education, this growth was primarily the result of an increase in the number of women who enrolled. In the period referred to, the number of female students increased by 53 percent, from 82,000 to 125,000. More women than men have enrolled in university education programmes every year since 2006/'07 (figure 6.1.5). The number of students with non-Western foreign backgrounds in higher education also increased very strongly, almost tripling from 11,000 in 1995/'96 to 31,000 in 2010/'11. Although this occurred together with an increase in the number of people with non-Western foreign backgrounds in the relevant age group of the population, these individuals participated more frequently in university education also in relative terms (Hartgers, 2010). The trend in the number of individuals enrolled in the 'natural science, applied mathematics and computer technology' and 'engineering, manufacturing and construction' ISCED subject clusters has in recent years virtually paralleled the trend in the total number of individuals enrolled in higher education. From 2005/'06, this number grew by 17 percent to 40,000 in 2010/'11. The number of ICT students within these subject clusters increased considerably until 2004/'05, after which it fell for a number of years and stabilised at just over 6,000 from 2008/'09. In university education, electronics and computer technology can only be studied in the master's phase. The number of students in this regard went from 73 in 2000/'01 to 437 in 2009/'10 and 436 in 2010/'11.
As is the case with respect to HBO, the largest proportion of students in university education are enrolled in the ‘social sciences, technology management and law’ subject cluster. Indeed, in university education almost half are enrolled in this cluster, which amounts to 119,000 students. Of this number, approximately 40 percent are business administration students. With 35,000 enrolled students, health care and social welfare is the second largest subject cluster in university education. In 2010/11, approximately 40,000 students were engaged in studies relevant to R&D in the fields of natural science and engineering. This is over 16 percent of the total number of individuals who enrolled in that year, namely 7.5 percent in the natural science subject cluster and 9 percent in the engineering subject cluster. One third of students in the natural science subject cluster were attending an ICT study programme. This number has increased almost continuously since the 1997/98 academic year, from 13,000 to 18,000 in 2010/11. A slight decrease occurred only in 2007/08, as was also the case with respect to HBO. The number of ICT students in the natural science subject cluster increased from 4,491 in 1996/97 to 7,334 in 2004/05, after which it dropped to 6,049 in 2009/10. Somewhat more students enrolled again in an ICT study programme in university education in the 2010/11 academic year.

This concerns the ‘natural science, applied mathematics and computer technology’ and ‘engineering, manufacturing and construction’ (including electronics and automation) subject clusters.
Recent years have also witnessed an increase in the number of students who undertake studies in communication systems at university. The number of university students engaged in business information technology has decreased, as has the number of those engaged in technical computer science. In the early 2000s, the number of students enrolled in the engineering subject cluster continued to fluctuate at around 17,500 students. This number started increasing from 2007/’08 and amounted to 21,600 students in 2010/’11. At 25 percent, the proportion of women engaged in the fields of natural science and engineering taken as a whole in university education is larger than the corresponding proportion in hbo (15 percent). By contrast, the proportion of women attending ICT study programmes in university education is, at under 12 percent, extremely small.

The ratio between the number of students who enrol in a university education programme for the first time and the number of those who actually obtain a master’s degree is a predictive indicator with respect to the number of graduates in the coming years (figure 6.1.6). The ‘humanities and arts’ and the ‘engineering, manufacturing and construction’ and ‘natural science and applied mathematics’ (excluding computer technology) subject clusters have a favourable ratio between first-year students and graduates. Studies in computer sciences are just below the average. The number of
first-year students in the engineering subject cluster rose from 3,629 in 2006/’07 to 4,722 in 2010/’11. Increased interest in studies in the ‘natural science and applied mathematics’ (excluding computer technology) subject cluster started much earlier. In 2002/’03 there were 1,546 students in the subject cluster. This number subsequently increased each year to 2,741 in 2010/’11. Interest in studies in the computer technology subject cluster only started increasing again somewhat in the past three years. In the 2010/’11 academic year, 1,366 students enrolled in an ICT study programme, whereas the corresponding figure for 2007/’08 was 1,117. The strong growth in the number of first-year students in informatics and information technology study programmes that occurred between 2009/’10 and 2010/’11 is striking. However, with the exception of technical computer science, the number of first-year students enrolled in the other ICT study programmes decreased.

Half of vwo graduates have a master’s degree within seven years

In addition to describing the intake of students into university education and the number of students who ultimately graduate, it is also important to describe what happens in

### Intended amendments to the Student Finance Act 2000

The “Studying is Investing” Policy Memorandum of the Ministry of Education, Culture and Science (Ministry of Education, Culture and Science, 2011) sets out the intention of Prime Minister Mark Rutte’s government to amend the Student Finance Act 2000 (WSF 2000) in a number of respects effective as from 1 August 2012. These amendments concern the basic grant, the student travel allowance scheme, tuition fees and student loans.

The government is calling on those who take a disproportionate amount of time to complete their studies to fund more of their own education. The low basic rate with respect to tuition fees will be limited. As from three years following the end of the nominal duration of study, entitlement to this low rate in relation to tuition fees will lapse and, from that time, students will have to pay a higher rate. In addition, the basic grant will no longer be provided for a master’s degree programme. The government will, however, provide a supplementary grant if parents are unable to contribute and will also grant specific allowances for students who are themselves parents. In addition, the period of validity of the student travel allowance scheme (the student travel pass or chip card for public transport) will be brought back from three years to one year following the nominal duration of a master’s degree programme.

<table>
<thead>
<tr>
<th>Bachelor’s degree programme (nominal duration)</th>
<th>Master’s degree (nominal duration)</th>
<th>Up to and including the first year beyond nominal duration</th>
<th>Up to and including the second year beyond nominal duration</th>
<th>Up to and including the third year beyond nominal duration</th>
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<tr>
<td>Basic grant</td>
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<tr>
<td>Supplementary grant</td>
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<tr>
<td>Student travel allowance scheme</td>
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<tr>
<td>Low rate with respect to tuition fees (basic rate)</td>
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<tr>
<td>Student grant governed by social security legislation</td>
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The financial incentives on which these measures are based are designed to compel students to make more conscious choices as regards field of study and assume greater personal responsibility with respect to study progress.
between these two points in time. Questions concerning the dropout rate in higher education and the time it takes students to complete their studies are also politically relevant (see box on the following page). A nominal study duration of five years applies to most programmes in natural science and engineering (bachelor’s and master’s degree). Many other master’s degree programmes can be completed within four years. Of the students who had completed vwo and enrolled in a full-time university degree programme in 2003/04, just over half obtained a master’s degree after seven years of study. A further 8 percent obtained a bachelor’s degree following the completion of a programme of hbo and 7 percent left higher education without having obtained a degree. A slightly smaller proportion, 6 percent, stopped studying after obtaining a university bachelor’s degree. The remaining 30 percent were still enrolled in higher education programmes, mostly at universities.

Graduation rates following seven years of study differ strongly per degree programme and in terms of gender. Sixty-one percent of female full-time students who had completed vwo obtained a master’s degree after seven years as against 40 percent of male students. On average, around 53 percent of students obtained a master’s degree after seven years in subject clusters in which most programmes have a nominal duration of study of four years.

### 6.1.7 Situation after seven years of students who completed pre-university education (vwo) and enrolled in full-time university education in 2003/04, by gender

![Diagram showing graduation rates after seven years by gender and subject]

Source: Statistics Netherlands, education statistics.

1) Science encompasses studies in the category ‘Natural science, Mathematics and Computing’.
2) Engineering encompasses studies in the category ‘Engineering, Manufacturing and Construction’.
years. Fifty-eight percent of students in social sciences (excluding law and business and administration) obtained a master’s degree after seven years of study. Students completing programmes in natural science and engineering required considerably more time. As stated above, however, the nominal duration of study of most programmes in natural science and engineering is one year longer. Only 30 percent of ICT students obtained a master’s degree after seven years of study. Approximately one in six ICT students transferred to HBO after starting in university education (16 percent). Over two-thirds of this group obtained a HBO bachelor’s degree within seven years following the start of the original university degree programme. Approximately 38 percent of ICT students were still in university education after seven years and 6 percent left higher education after obtaining a university bachelor’s degree. The remaining 11 percent left higher education without having obtained a degree. Full-time students who enrolled in a degree programme in the engineering subject cluster in 2003/04 following the completion of VWO are rather similar to ICT students in terms of yield figures, although slightly fewer of them left without a master’s degree. Forty-four percent of them were still in university education after seven years (as against 38 percent of ICT students). Students who enrolled in a degree programme in the natural science subject cluster (excluding ICT) did better in this regard. Almost half of them (48 percent) obtained a master’s degree within seven years. They also transferred to HBO less frequently. After seven years, approximately one third of these students were still in university education, 3 percent were in HBO and 12 percent were no longer in education. Half of this last-mentioned group had obtained a university bachelor’s degree, however.

**Drop-out rate was particularly high after the first year**

As stated above, 7 percent of those who enrolled in a university degree programme in 2003/04 following the completion of VWO had left higher education after seven years without having obtained a degree (figure 6.1.7). Over a quarter of university students who had completed a programme of HBO left without having obtained a master’s degree. The high dropout rate among graduates of HBO is easy to explain: they already hold a full-fledged degree. Among university students who had completed a programme of HBO, men dropped out somewhat more frequently than women (29 percent and 25 percent respectively). The difference between men and women who had completed VWO was more pronounced (10 percent and 4 percent respectively). A large proportion of students who do not complete their degree programmes drop out already after the first year. This applies to both students who completed a programme of HBO and those who completed VWO. Three percent of students who had completed VWO and enrolled in a full-time university degree programme in 2003/04 dropped out of higher education after one year of study. The corresponding figure for students who had completed a programme of HBO was 16 percent. The figures for programmes in natural science and engineering were
similar: 3 to 4 percent of students who had completed VWO dropped out after one year of study.

Lifelong learning and post-initial education

The participation of primarily young people in mainstream, government-funded education has been described above. The final part of this section will focus on the learning undertaken by people who have completed their initial education. Although this aspect concerns mainstream, government-funded education as well, it also encompasses continuing training and long and short courses completed during leisure time. The focus in this regard is on the number of people who are attending a course or training programme and on a number of background characteristics of this group. Dutch data can be placed in an international perspective when considering this aspect.

Lifelong learning is increasingly coming to be seen as something undertaken as a matter of course. In a society that is constantly evolving and in which technologies are succeeding each other at a rapid rate, it is important for individuals to be sufficiently skilled and, in addition, for them to continuously develop their competencies through further education and training (Borghans et al., 2009). The necessity of doing so is also recognised on a European level. The Lisbon Strategy set out by the European Council in March 2000 aimed to make the EU ‘the most competitive and dynamic knowledge-based economy in the world’. This aim was based on the globalisation of the economy on the one hand and the emergence and increasing significance of new technologies like ICT on the other. A number of concrete objectives were formulated to foster the further development of the knowledge economy, one of which was to ensure that 12.5 percent of Europe’s entire population aged 25 to 65 was participating in some form of training programme or course, both work-related and leisure-based, by 2010 (the lifelong learning indicator). The aim for 2020 is to achieve a participation rate of 15 percent. The Dutch government has set itself a more ambitious target and is aiming to achieve a participation rate of 20 percent by 2020 (Ministry of Education, Culture and Science, 2011; see also Hartgers and Pleijers, 2010).

Netherlands just behind European leaders in terms of lifelong learning

Although the Netherlands has amply surpassed the Lisbon standard for lifelong learning of 12.5 percent for many years, the Dutch target for 2020 had not yet been achieved in 2009. In that year, 17 percent of the Dutch population aged 25 to 64 attended a training programme or course. The best European performers in terms of the indicator are the Scandinavian countries, the United Kingdom and the non-EU countries Switzerland and Iceland. The Netherlands is just behind the leading group. Other
European neighbours, such as France, Belgium and Germany, had participation rates ranging from 6 percent to 8 percent. In most European countries, relatively more women than men attend training programmes or courses. This has also been the case in the Netherlands since 2003.

Many Dutch people complete further education and training

The European indicator for lifelong learning is a fairly rough measure. Everyone aged 25 to 64 who is participating in a training programme or course according to the Labour Force Survey is included. The indicator therefore includes students in hbo and wo who are taking a relatively long time to complete their studies as well as a few students in mbo. On the other hand, a 23 year-old employee who is completing an in-company training course, for example, is not included. Statistics Netherlands therefore developed the post-initial education indicator, which shows the rate of participation in training programmes and courses after the initial period of full-time education.

6.1.8 Lifelong learning (25 to 64 year-olds) and post-initial education (15 to 64 year-olds) by gender

![Graph showing lifelong learning and post-initial education by gender from 1998 to 2009](image)

Source: Eurostat/Statistics Netherlands.

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1) Post-initial education: percentage of the population group in question no longer in initial education.
Post-initial education includes all forms of part-time education as well as full-time education if the current full-time education of the individual concerned is separated from his or her initial full-time education by a period of at least five years. The indicator is expressed as a percentage of the population aged 15 to 64 who is no longer attending initial education. Pupils and students are therefore disregarded. The European indicator for lifelong learning includes a lower age limit of 25 because only a few people above this age are still active in initial education.

Both indicators show a similar development over the years. The indicator for post-initial education is consistently at a somewhat lower level than the lifelong learning indicator (figure 6.1.8). Differences between the participation of men and women are likewise similar in both indicators. The greatest differences can be seen in the youngest age groups.

**Participation of women in post-initial education continues to rise**

In 2009, almost 1.5 million people aged 15 to 64 attended a training programme or course in the context of post-initial education. The participation rate was 15.5 percent, which was somewhat less than the 2008 participation rate. Men accounted for this decrease, since their participation rate fell from 15.3 percent in 2008 to 14.9 percent in 2009. By contrast, women participated in post-initial training programmes somewhat more frequently. Their participation rate rose from 16.1 percent to 16.2 percent (Statistics Netherlands, 2010a).

Participation in post-initial education differs according to a number of background characteristics. With a 2009 participation rate of 23 percent, individuals aged 25 to 29 took part most frequently in post-initial training programmes in relative terms. The participation rate was lower the older the age group, amounting to only 6 percent among individuals aged 60 to 64. People who are already highly educated attend training programmes or courses more frequently than those with a lower level of prior education. With a participation rate of 15 percent, native Dutch people attended post-initial training programmes less frequently than those with a foreign background. At 19 percent, the participation rate of individuals with a non-western foreign background was the highest (figure 6.1.9). The training that forms part of the civic integration course is an important factor in this regard.

Individuals who belong to the labour force in employment attended post-initial training programmes somewhat more frequently in 2009 than individuals who were unemployed or who worked for 12 hours or less a week. At 9 percent, the participation rate was lowest among individuals who did not work for at least 12 hours a week and who were also not looking for a job.

Most of the training programmes and courses were attended in connection with the labour market. For 18 percent of participants, the training programme or course in question had been made compulsory by the employer or benefits agency. Other
participants cited the following main reasons for attending a training programme or course: ‘to keep pace’ (34 percent), ‘to be able to do different work’ (25 percent), ‘to be eligible for promotion’ (17 percent) and ‘to increase employment prospects’ (5 percent).

6.2 Knowledge in the Netherlands and in an international context

The opening part of this section focuses on students who go abroad specifically for the purpose of studying. Both incoming and outgoing students are discussed. The focus then shifts to the Dutch population’s level of education, particularly that of the labour force in employment, and the labour force participation rate for each level of education. Both subjects are placed in an international context, as are the stock and increase in the number

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1) As a percentage of the relevant population group that is no longer attending initial education. VMBO refers to preparatory secondary vocational education, MAVO to junior general secondary education and VBO to preparatory vocational education.
2) VMBO, MAVO and VBO are lower levels of secondary education.
of highly educated individuals and the proportion of natural science, engineering and ICT students in the total number of graduates in higher education.

The introduction of the bachelor-master system in the Netherlands and other EU countries has made it easier for students in higher education to complete all or part of a degree programme in another country. Dutch students go abroad to study and foreign students come to the Netherlands to study. Students pursue a study abroad for different reasons. Acquiring international experience in connection with plans to live and work abroad in the future is one of them. Other reasons why students pursue studies abroad include a failure to secure a place determined by lot due to the limited availability of places in the degree programme of first choice and the wish to study at a prestigious foreign university.

In an international context, it has been agreed to define 'mobile students' as those who have completed their prior education at a foreign institution (OECD, 2010a). This definition therefore focuses exclusively on students who go to another country specifically to pursue a study, and the nationality of the individual concerned plays no part in determining a given student's 'mobility'. So a proportion of mobile students in the Netherlands, for example, are Dutch nationals. These Dutch students completed their secondary or other prior education abroad and subsequently came to the Netherlands to study. This section only presents what is referred to as 'degree mobility', which relates to students who enrolled for an entire degree programme in a foreign country as opposed to those who went abroad only to complete a constituent part of their respective degree programmes (see also CBS, 2010a).

Many German students come to the Netherlands

Over 33,000 mobile students studied in the Netherlands in 2008/’09. This was over 5 percent of all students in higher education in the Netherlands that year. Over a quarter of these students were Dutch nationals who, for example, were children of Dutch emigrants or of Dutch people who temporarily lived abroad and whose children therefore completed a foreign prior education. In addition, students from the Netherlands Antilles are also Dutch nationals. Accounting for over 40 percent, Germans constituted the largest proportion of mobile students in the Netherlands. Approximately 5 percent came from China and 3 percent from Belgium. Indonesia, Suriname, Bulgaria, Poland and France each accounted for approximately 1 percent of mobile students in the Netherlands.

Mobile students in the Netherlands opt for different degree programmes than non-mobile ones. They relatively frequently choose a study in the fields of ‘social sciences, technology management and law’. Forty-seven percent of mobile students were active one of these fields in 2008/’09 as against 37 percent of non-mobile students. Degree programmes in ‘education’ and ‘engineering, manufacturing and construction’ are opted for less frequently by mobile students than by non-mobile ones. The choice of degree programme is also linked to a mobile student’s country of origin. Germans, for example, opt more frequently than other groups for ‘healthcare and social welfare’ and relatively
rarely for ‘engineering, manufacturing and construction’. Belgian students in the Netherlands opt twice as often as the average mobile student for ‘humanities and arts’ and for ‘engineering, manufacturing and construction’.

**Many more foreign students in the Netherlands than Dutch students abroad**

**Foreign students in the Netherlands**

**Dutch students abroad**

![Calculated image](image)

x 10,000 students

The proportion of women among mobile students in the Netherlands is higher than it is among non-mobile ones. The difference is considerable in natural science and engineering. The proportion of women among mobile students was far higher than among non-mobile ones in 2008/09, particularly in the fields of ‘engineering, manufacturing and construction’ (33 percent as against 16 percent). This reflects the national situation in the Netherlands in that Dutch women opt far less frequently for degree programmes in natural science and engineering than women in other countries.⁴

**Many Dutch students enrol in Belgium**

Approximately 14,000 Dutch students were enrolled in a foreign institution of higher education in the 2007/08 academic year (OECD, 2010a). Half of these students were in Belgium or the

⁴ See also Statistics Netherlands, Emancipatiemonitor 2010 (Merens, et al., 2011).
United Kingdom. In addition, a relatively high number had gone to the United States, France, New Zealand, Switzerland and Spain. Dutch performance in 2007/’08 in terms of both outgoing and incoming students was below the average of 19 EU countries. The average of these countries for that year was over 6 percent with respect to incoming students and almost 3 percent with respect to outgoing students. The corresponding percentages for the Netherlands were 5 percent and 2 percent respectively. Among European countries, the United Kingdom and Austria take in a high number of foreign students (figure 6.2.1).

Education level of Dutch women has increased considerably

The Dutch population’s average level of education has increased across the board in recent years. The proportion of individuals aged 15 to 64 without a basic qualification (havo/vwo or level 2 or higher of mbo) decreased in the period 2003–2010. The proportion of individuals who completed degree programmes in higher education increased during the same period. This increase in level of education also applies to the labour force in employment. The level of education of individuals with a job comprising at least 12 hours of work a week is, on average, higher than that of the total population. The proportion of individuals in the employed labour force whose highest qualifications had been obtained in primary education, secondary education or mbo decreased in the period 2003-2010. The proportion of individuals who had completed a degree programme in higher education increased from 29 percent in 2003 to 35 percent in 2010.
As discussed above, more women than men enrol in higher education and they also complete their programmes more quickly. This is clearly reflected in the average level of education of young people, among whom more women than men are highly educated. The difference between young men and young women is even greater in the employed labour force. Not only are young women more highly educated, on average, than older women, more of them also have jobs comprising at least 12 hours of work a week. This also has to do with the fact that the higher the level of education, the higher the labour force participation rate, something that applies even more to women than to men. It must be noted in this regard that men in all age groups and in all groups classified according to completed level of education still work more than women. In 2010, for example, the net labour force participation rates for men with a hbo degree or university education degree were 86 percent and 88 percent respectively. The corresponding rates for women were 79 percent and 82 percent respectively.

The proportion of higher educated (hbo/wo) women in the employed labour force increased more sharply than the proportion of higher educated men between 2003 and 2010. This difference will become more pronounced in the future. The proportion of highly educated women in the employed labour force is significantly greater the younger the age group, more so than is the case with respect to men (Figure 6.2.2). In 2010 almost half of women aged 25 to 34 had a high level of education (49 percent). The corresponding proportion for men in this age group was 38 percent. Factors that play a part in this age
group are that relatively more women than men graduate, women complete their degree programmes more quickly and that the labour force participation rate of women is more strongly linked to level of education than is the case with respect to men.

**High labour force participation in the Netherlands**

In comparison with other EU countries, the proportion of individuals aged 25 to 64 in paid employment, irrespective of the number of hours worked, is fairly high. With a labour force participation rate of 79 percent, the Netherlands was second after Sweden (81 percent) in 2009. The EU-27 average was 71 percent. These rates do not say anything about hours worked in paid employment, however, since the international figures also include jobs comprising less than 12 hours of work a week. In all EU countries, the labour force participation rate increases as the level of education rises. Higher educated individuals are more likely to be employed than those who have completed only secondary education (havo, vwo and level 2–4 mbo). In turn, individuals who have completed secondary education are more likely to be employed than less educated ones. These proportions in the Netherlands were 88 percent, 82 percent and 64 percent respectively in 2009. The Netherlands was therefore among the top five of the EU for all three levels of education.

**Netherlands just behind world leaders in terms of high qualified individuals**

Obtaining a basic qualification is defined as the completion of secondary or higher education. In the Netherlands, these levels of education concern havo, vwo, level 2–4 mbo and higher. Seventy-two percent of EU inhabitants aged 25 to 64 held qualifications at these levels in 2009. At 73 percent, the proportion in the Netherlands was about average. Proportions of individuals who have completed at least secondary education are low in Belgium, Ireland, France and Southern European countries. Proportions are high in Eastern European countries, Germany (86 percent) and Austria (82 percent).

The Netherlands is just behind the world’s leading countries in terms of the proportion of highly qualified individuals. Thirty-two percent of the Dutch population aged 25 to 64 had completed higher education (hbo or wo) in 2008. The Netherlands was therefore in seventh place out of a total of 16 selected countries. At 43 percent and 41 percent respectively, the stock of high educated individuals was largest in Japan and the United States, and smallest in Italy and the Czech Republic (both 14 percent).

---

5) 'Stock' in this case is defined as the proportion of highly educated individuals in the population aged 25 to 64.
The Netherlands is performing fairly well in international terms with respect to increasing the number of high educated individuals.\(^6\) This indicator provides information about the proportion of high educated individuals in terms of its future development. With an increase of 41 percent, the Netherlands was in fifth place in 2008, behind Poland (50 percent), Australia, Denmark and Ireland (figure 6.2.3). With corresponding figures of approximately 25 percent, Germany and Austria lagged behind to a considerable extent. Both the stock and increase of highly educated individuals rose slightly in the Netherlands relative to 2004.\(^7\) The stock was 29 percent and the increase 40 percent in 2004. The proportion of highly educated individuals will probably undergo a further increase in the Netherlands, since a large positive difference between the increase and stock of high educated individuals indicates that a greater number of young people are attending higher education than previous generations. The proportion of high educated individuals in a country is also determined by various demographic factors, such as the composition of the population and emigration and immigration flows. A country with a relatively high number of old people, for example, often has a small proportion of high educated individuals because old people are frequently less educated. The emigration of large

---

6) ‘Increase’ in this case is defined as the proportion of individuals of the age concerned who have obtained a first degree in higher education within the total population summed over these age groups. By taking only the first degree obtained into account, each individual in this group can only be counted once.

numbers of high educated individuals likewise reduces a country’s stock of such individuals. It is clear that a greater number of young people in many emerging economies are attending higher education than was the case in the past. In Germany and the United Kingdom, for example, the difference between increase and stock is not that large, however. In the United States and Japan the proportion of highly educated individuals even seems to be decreasing.

**Netherlands lagging in terms of science graduates**

In comparison with other countries, the proportion of graduates in natural science and engineering subjects in the Netherlands is low. In 2009, 14 percent of students in the Netherlands obtained a degree in higher education in one of the fields of ‘natural science, applied mathematics and computer technology’ or ‘engineering, manufacturing and construction’. In the 27 countries of the EU, the average for 2008 was 22 percent. Only Cyprus and Latvia have lower proportions than the Netherlands. Accounting for 5 percent of students in natural science and engineering subjects, Dutch women in particular are poorly represented. The Netherlands performed somewhat better in international terms regarding ICT graduates in higher education. With a proportion of 3.7 percent in 2009, the
Netherlands was above the EU-27 average of 3.4 percent. The proportions were particularly high in Austria and Spain, while Italy and Belgium lagged behind to a considerable extent. In keeping with the trend in other countries, the proportion of ICT graduates in the Netherlands has decreased since 2006.

**Human resources in science and technology (HRST)**

The OECD has adopted a definition of people who play or could play an important role in research and development (R&D), innovation and a number of other aspects of a knowledge economy (OECD, 1995). This group is internationally referred to as human resources in science and technology (HRST). HRST are people who meet one or other of the following criteria with respect to their education and occupation. All individuals who have

### 6.2.5 HRST aged 25 to 64 years, 2009

<table>
<thead>
<tr>
<th></th>
<th>HRST 1)</th>
<th>Of whom</th>
<th>Non-HRST occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3,994</td>
<td>73</td>
<td>62</td>
</tr>
<tr>
<td>Of whom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 34 yrs</td>
<td>1,029</td>
<td>76</td>
<td>69</td>
</tr>
<tr>
<td>35–44 yrs</td>
<td>1,162</td>
<td>76</td>
<td>60</td>
</tr>
<tr>
<td>45 to 64 yrs</td>
<td>1,803</td>
<td>69</td>
<td>59</td>
</tr>
</tbody>
</table>

|                |         |         |                      |
| Men             | 2,043   | 71      | 64                   |
| Of whom         |         |         |                      |
| 25 to 34 yrs    | 479     | 75      | 68                   |
| 35–44 yrs       | 570     | 74      | 63                   |
| 45 to 64 yrs    | 994     | 68      | 64                   |

| Women            | 1,951   | 75      | 60                   |
| Of whom          |         |         |                      |
| 25 to 34 yrs     | 550     | 78      | 70                   |
| 35–44 yrs        | 592     | 77      | 58                   |
| 45 to 64 yrs     | 809     | 71      | 54                   |

| x 1,000         | %       |         |                      |
|-----------------|---------|---------|                      |
| Total           | 3,994   | 73      | 62                   |
| Of whom         |         |         |                      |
| 25 to 34 yrs    | 1,029   | 76      | 69                   |
| 35–44 yrs       | 1,162   | 76      | 60                   |
| 45 to 64 yrs    | 1,803   | 69      | 59                   |

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| Of whom         |         |         |                      |
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| 45 to 64 yrs    | 994     | 68      | 64                   |

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| Of whom         |         |         |                      |
| 25 to 34 yrs    | 550     | 78      | 70                   |
| 35–44 yrs       | 592     | 77      | 58                   |
| 45 to 64 yrs    | 809     | 71      | 54                   |

Source: Eurostat.

1) Human Resources in Science and Technology.
2) The percentages in this column are calculated on the basis of HRST occupation (HRST occupation = 100%).
completed HBO or university education are counted as HRST, even if they are unemployed and do not form part of the labour force. In terms of employment, HRST include those with an HRST occupation, specialists in, for example, physics, health care, law, economics, automation, journalism and many other fields. Technicians and assistants who work at a high level in these fields are also counted as HRST by virtue of their respective occupations. The definition is therefore fairly broad. In 2009, 4.6 million individuals in the Netherlands aged 15 to 74 belonged to this group.

In terms of HRST, this section focuses mainly on members of the labour force aged 25 to 64 because doing so ties in better with the concept of labour potential. Fifty-one percent of the Dutch labour force (employed and unemployed) aged 25 to 64 constituted HRST in 2009. This concerns almost 4 million people, of whom 73 percent had an HRST occupation (table 6.2.5). Sixty-two percent of individuals with an HRST occupation in 2009 were also highly educated. This group meets both HRST criteria (education and occupation) and is therefore referred to as the HRST core. Of the HRST occupations group, 17 percent of individuals were specialists, while the remaining 83 percent were technicians and assistants. Twenty-seven percent of Dutch HRST individuals did not have an HRST occupation. They therefore formed part of HRST solely on the basis of having completed tertiary education. Over 1.9 million women formed part of HRST and, of this group, three quarters had an HRST occupation. At 71 percent, the proportion of men with an HRST occupation was smaller. Sixty-four percent of men with an HRST occupation were also highly educated. The corresponding proportion for women with an HRST occupation was smaller (60 percent). In 2009, the absolute number of young HRST women (aged 25 to 34) was greater than the number of HRST men in the same age group. The proportion of women who formed part of the HRST core in this age group was also higher than that of men.

**HRST: Netherlands third in the EU**

The average proportion of HRST in the labour force aged 25 to 64 in the EU was 40 percent in 2009 (figure 6.2.6). With a proportion of 51 percent, the Netherlands was third after Luxembourg and Denmark. With a proportion of 55 percent, Switzerland, a non-EU Member State, also surpassed the Netherlands.

Thirty-seven percent of males in the labour force in the EU-27 are HRST. The corresponding proportion for women is 44 percent. In many countries, the proportion of women who are HRST is over 10 percentage points higher than the proportion of men. The difference between men and women is somewhat smaller in the Netherlands (49 percent and 54 percent). The proportion of men who are HRST in the labour force is larger than that of women in only a few countries. In 2009, the proportion of HRST in the total EU population aged 25 to 64, i.e. employed and unemployed members of the labour force as well as individuals who are not members of the labour force, was 33 percent for men (45 percent...
in the Netherlands) and 34 percent for women (44 percent in the Netherlands). The proportion of men who were HRST in the EU population was still higher than that of women in 2000 (29 percent and 26 percent respectively), though the proportion of women who are HRST is now greater. This was not yet the case in the Netherlands in 2009. The same applied to Switzerland, Austria and Germany, for example.

Additional figures concerning HRST are contained in the statistical annex to this publication. The annex can be consulted online at www.cbs.nl/ict-knowledge-economy.

### 6.3 ICT skills

Computer and internet skills are important in enabling ICT facilities to be used effectively and efficiently. The Dutch government attaches great importance to the development of the Dutch population’s ICT skills. This is evidenced by, among other things, its participation in *Digivaardig & Digibewust*, a programme launched in 2009 that aims to increase these
skills in the Dutch population. Efforts are being undertaken within the framework of the programme to reduce the number of individuals who are unable to use computers and the internet and to make it possible for Dutch people to make better use of ICT capabilities. The programme also aims to encourage safe internet use and increase awareness of digital risks. Statistics Netherlands surveys the Dutch population’s computer and internet skills each year.

Dutch are skilled computer users

Almost 40 percent of Dutch computer users had many computer skills in 2010 (Figure 6.3.1). There was also a group constituting 35 percent of users who had average skills. Less than one in ten individuals who had at some point used a computer had no computer skills.

Relatively more men than women have many computer skills

![Graph showing relatively more men than women have many computer skills]

<table>
<thead>
<tr>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>53%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Visit www.digivaardigdigibewust.nl for more information about this programme.
Although this group therefore used a computer, their activities were different than the ones distinguished by Statistics Netherlands (for the skills concerned see the box on the previous page). Over half of men had many computer skills (53 percent). This proportion is over twice as high as that of women, only a quarter of whom had many computer skills. The largest proportion of women had average skills (41 percent).

The number of individuals who had average skills or many computer skills increased slightly relative to 2006. This proportion was 69 percent in 2006 and 74 percent in 2010. The Dutch population’s computer skills have therefore not increased strongly in recent years.

Level of skill with respect to computer use is linked to personal characteristics like level of education, whether or not one has paid work and professional category (Hoksbergen, 2009). The correlation is strongest between computer skills and level of education. In 2010, almost 60 percent of highly educated individuals had many computer skills as against 20 percent of less educated ones. The proportion of computer users with no computer skills was largest among less educated individuals (16 percent). By way of comparison, only 2 percent of highly educated individuals had no computer skills.

Computer users in the 25 to 44 age group are the most skilful. Forty-nine percent of them had many computer skills in 2010. Individuals aged 65 or over were the least skilful computer users. Of those in the 65 to 74 age group, almost one third had limited and a quarter had no computer skills. Nevertheless, older people are becoming increasingly
skilful with computers, since the proportion of individuals aged 65 to 74 with no computer skills was higher in 2006, namely 33 percent. In addition, the proportion of individuals aged 65 to 74 who have many computer skills has increased sharply in recent years, from 12 percent in 2006 to 19 percent in 2010.

**Internet skills increasing**

Sixty percent of internet users had average skills or many internet skills in 2010. The internet skills of the Dutch population have increased considerably relative to 2006, when only 46 percent of internet users had average skills or many internet skills (Figure 6.3.2). Differences between men and women are much smaller in terms of internet use than they are with respect to computer skills. Sixty-four percent of men have average skills or many internet skills as against 56 percent of women. Slightly more women than men have only a few internet skills (54 percent of women as against 46 percent of men).

There is a strong correlation between age and internet skills (Hoksbergen, 2009). Eighty-five percent of individuals aged 12 to 24 had average skills or many internet skills in 2010. The situation was likewise favourable with respect to individuals aged 25 to 44, a quarter of whom had many internet skills (22 percent) and over four in ten of whom had average skills. Virtually all individuals aged 12 to 44 had some skill with respect to the internet in 2010; almost none of them had no internet skills whatsoever. The contrast with individuals aged 65 to 74 is pronounced. Two-thirds of individuals in this group had only a few or no internet skills (67 percent) and only 4 percent had many internet skills in 2010. The internet skills of older people have increased considerably since 2006, however (Figure 6.3.3).

The correlation between level of education and internet skills is less strong than that between level of education and computer skills. Twenty percent of less educated internet users have many internet skills as against 24 percent of highly educated ones. The difference is greater in terms of having only a few or no internet skills. Thirty-three percent of highly educated individuals had only a few or no internet skills as against 44 percent of less educated ones. The internet skills of less educated individuals have increased

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**Measurement of internet skills**

To measure internet skills, respondents were asked whether they had at some point performed one or more of the following activities:

- Using a search engine to find information;
- Sending an e-mail with attachments;
- Posting messages in chat rooms, newsgroups or a discussion forum;
- Using the internet to make telephone calls;
- Sharing folders with others to exchange music, movies and the like;
- Designing a webpage.

The respondents were subsequently subdivided into the following categories:

- No skills: had not performed any of the activities referred to;
- Few skills: had performed one or two of the activities referred to;
- Average skills: had performed three or four of the activities referred to;
- Many skills: had performed more than four of the activities referred to.
6.3.2 Internet skills of internet users, 2006 and 2010

![Internet skills of internet users chart]

Source: Statistics Netherlands, ICT use by households and individuals, 2006 and 2010.

1) People aged 12 to 74 years who use computers.

6.3.3 Internet skills by age group, 2006 and 2010

![Internet skills by age group chart]

Source: Statistics Netherlands, ICT use by households and individuals.

1) People aged 12 to 74 years who use computers.
The purpose of the Digivaardig & Digibewust programme is to optimise the computer and internet use of the Dutch population. It is being implemented by ECP-EPN, a Dutch platform for the information society, for the Ministry of Economic Affairs, Agriculture and Innovation. On the instructions of those responsible for the Digivaardig & Digibewust programme, the University of Twente conducts an annual survey into the use of computers and the internet by the Dutch population. In this survey, internet skills are measured through performance ratings in the context of which actual assignments must be carried out online. In addition to the performance-related tests, the level of internet skill is identified by means of a questionnaire. The method adhered to in this survey to rate internet skills differs from that used by Statistics Netherlands. Statistics Netherlands asks respondents about internet activities performed without asking them to actually perform assignments. The University of Twente's survey distinguishes between operational skills ('knowledge of buttons'), formal skills (working with files, browsing and navigating), information skills (searching for information in computer files and on the internet) and strategic skills. This last-mentioned set of skills concerns the ability to use computers and the internet as a means to achieve a certain personal or professional purpose. The level of operational and formal skills has a pronounced effect on the level of information and strategic skills. Operational and formal skills are even seen as a precondition for performance with respect to information and strategic skills, since finding information on the internet requires minimal knowledge as how to operate a computer (operational skills).

Among other things, the survey reveals that the Dutch population is fairly skilled with regard to operational and formal internet skills, even though there is no international standard that makes comparison possible (no rating of internet skills has taken place in a European context since 2007). The Dutch population is somewhat less skilled, however, when it comes to information and strategic skills. The survey also shows that internet experience, intensity of internet use, level of education and age do not have a major influence on each of the internet skills. Internet experience, for example, only has a positive effect on operational and formal skills. Information and strategic skills therefore do not demonstrably improve with increasing internet experience. In addition, the number of hours that individuals spend online was found to have no effect on the internet skills distinguished in the survey. Level of education, on the other hand, affects all skills. Age exhibits a negative correlation with the level of operational and formal skills: the performance of young people in these respects is far better than that of older people. However, age has a positive, direct relationship with information and strategic skills. This means that the older people are, the greater their information and strategic skills. This positive effect is negated by a lack of operational and formal skills, however. Older people are therefore hampered by their limited operational and formal skills in such a way that they perform less well than younger people with respect to content-related skills.

Source: Van Deursen and Van Dijk, 2010.
Capita selecta
Capita selecta

7.1 The Dutch software sector: ICT as an innovation axis
- Introduction: ICT’s silent revolution
- The Dutch software sector in figures
- Characteristics of products and services
- Software and innovation
- The strategic importance of software

7.2 New indicators on the public financing of R&D
- Introduction and background
- Method and data collection
- Initial results
- General conclusions and discussion

7.3 R&D expenditure in the higher education sector: a historical overview
- Research commitment of academic staff
- From research commitment to R&D expenditure
- The financing basis of R&D expenditure in the higher education sector
- R&D expenditure in the period 1999–2009
- The financing basis of R&D expenditure in the higher education sector in the period 1999–2009
- General developments in R&D expenditure in higher education in 1999–2009
This chapter contains three contributions that deal in greater depth with themes discussed elsewhere in the present publication. Two of these contributions were provided by external authors. The following subjects are addressed:

– The Dutch software sector (Dialogic / ICT-Office);
– Government financing of R&D (Rathenau Institute / Ministry of Education, Culture and Science);
– R&D in the higher education sector.

Statistics Netherlands has included external contributions in the present book to cast light on other research in the fields of ICT and R&D. In some cases the figures presented do not match those published by Statistics Netherlands. This is largely due to differences in definitions, the population defined and the research method used.

7.1 The Dutch software sector: ICT as an innovation axis

The largest productivity gains in an economy are not achieved by having ICT but, rather, by its use as an innovation axis. To be able to use ICT, a country requires a substantial, endogenous software foundation. According to the authors of this contribution, the Dutch software sector provides the required foundation and accounts for gross added value in excess of 17 billion euro. They conclude that in a services-oriented economy, a robust software foundation of this kind gives the ICT revolution tremendous potential.

Authors: Robbin te Velde, Dialogic and Bart Pegge, ICT-Office

Introduction: ICT’s silent revolution

As an enabler of the global information society, ICT was accorded top priority in the European Commission’s policy already at an early stage following the publication of the Bangemann Report (Commission of the European Communities, 1994). That priority has since fallen in status, especially after the end of the internet hype on the financial markets in 2000. Ironically, ICT’s actual contribution to economic growth was still limited in 1994, whereas its current contribution is at a historically high level (Oulton, 2011). The essential point in this regard is that, initially, new technologies always have a limited economic impact (Crafts, 2011). At the same time, the introduction
of such new technologies always give rise to excessively high expectations (Te Velde, 2004).

Figure 7.1.1 is a vivid illustration of this general pattern. The continuous line shows the trend of the NASDAQ Composite Index, a measure of expectations with respect to ICT, while the dotted line indicates the share of e-commerce in total sales in the United States. Although the internet bubble burst at the beginning of 2000, the share of e-commerce exhibits almost linear growth over the entire period 1999–2009. Following excessively high expectations, the actual magnitude is underestimated. ICT has had a far greater impact on American economic growth than the steam engine ever had on the economic growth of Great Britain, for example (Crafts, 2011.). The ICT revolution overshadows the Industrial Revolution by a substantial margin, and if the growth figures are to be believed, the turning point has only recently been reached. The global information society is still very much in its infancy.

7.1.1 NASDAQ Composite Index and E-commerce as a percentage of total sales in the US, 1999–2009

![Graph](image)

Source: NASDAQ, US Department of Commerce (adjusted by Dialogic).

Given ICT’s crucial importance to economic development in the long term, it is striking that no detailed figures concerning the ICT industry are as yet available. ICT is often included in official statistics as a large, single whole. It is important, however, to distinguish different sectors within the ICT industry. These range from hardware and office technology to software services and telecommunications. The hardware manufacturing sector is
relatively small in the Netherlands, certainly when compared to countries like Finland, South Korea and Japan. On the other hand, Finland’s software sector is small in comparison with its hardware manufacturing sector. Comparisons between international ICT sectors as carried out by the OECD do not take the tremendous differences that exist between individual countries into account (OECD, 2010c). The same applies to Statistics Netherlands, which only publishes general figures on the ICT industry as a whole (ICT-Office, 2008).

The Dialogic survey sample

Table 7.1.2 provides an itemisation of the SIC 62 category and an overview of the sample size, sampling frame and response rates. The samples were taken from the Trade Register of the Chamber of Commerce. All companies with more than 100 employees were included in the sample. The quality of the Trade Register left quite a lot to be desired, however. Although only the head offices of companies in the software sector (therefore not branch offices or associations or foundations) were included in the sample, a random check of 250 companies revealed that 25 of them had no online presence (they had neither a website nor a LinkedIn profile). This means that the size of the sampling frame must be multiplied by a factor of 0.8. This results in an effective response of 6.36 percent for the total sample with a confidence interval of 3.35 percent at a confidence level of 95 percent.

<table>
<thead>
<tr>
<th>SIC code</th>
<th>Description</th>
<th>Sampling frame</th>
<th>Sample size</th>
<th>Of which</th>
<th>Response 1)</th>
<th>Confidence interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>Service-related activities in the area of information technology</td>
<td>30,461</td>
<td>14,171</td>
<td>72</td>
<td>721(6.36%)</td>
<td>3.35</td>
</tr>
<tr>
<td>6201</td>
<td>Developing, producing and publishing software</td>
<td>16,400</td>
<td>6,031</td>
<td>31</td>
<td>317(6.57%)</td>
<td>5.32</td>
</tr>
<tr>
<td>620101</td>
<td>Developing, producing and publishing standard software</td>
<td>2,275</td>
<td>739</td>
<td>10</td>
<td>9(5.15%)</td>
<td>10.24</td>
</tr>
<tr>
<td>620102</td>
<td>Developing, producing and publishing custom software</td>
<td>14,125</td>
<td>5,292</td>
<td>21</td>
<td>19(6.57%)</td>
<td>5.32</td>
</tr>
<tr>
<td>6202</td>
<td>Consultancy services in the area of information technology</td>
<td>11,951</td>
<td>6,030</td>
<td>32</td>
<td>317(6.56%)</td>
<td>5.32</td>
</tr>
<tr>
<td>620201</td>
<td>Consultancy services in the area of hardware</td>
<td>1,369</td>
<td>667</td>
<td>3</td>
<td>3(5.15%)</td>
<td>10.24</td>
</tr>
<tr>
<td>620202</td>
<td>Consultancy services in the area of software</td>
<td>10,582</td>
<td>5,363</td>
<td>29</td>
<td>29(6.57%)</td>
<td>5.32</td>
</tr>
<tr>
<td>6209</td>
<td>Other service-related activities in the area of information technology</td>
<td>2,110</td>
<td>2,110</td>
<td>9</td>
<td>87(5.15%)</td>
<td>10.24</td>
</tr>
<tr>
<td>620901</td>
<td>Other service-related activities in the area of software application</td>
<td>668</td>
<td>668</td>
<td>3</td>
<td>3(5.15%)</td>
<td>10.24</td>
</tr>
<tr>
<td>620909</td>
<td>Other service-related activities in the area of information technology not pertaining to software application</td>
<td>1,442</td>
<td>1,442</td>
<td>6</td>
<td>6(5.15%)</td>
<td>10.24</td>
</tr>
</tbody>
</table>

1) Taking into account a correction factor of 0.8.

To acquire a more accurate picture of the Dutch software sector in particular, Dialogic carried out a study in 2010 on the instructions of ICT-Office (Te Velde et al., 2010). The purpose of this study was to obtain detailed figures on the size and characteristics of the Dutch software sector as well as the contribution that it makes to the Dutch economy. The
study was based on a broad survey that included all Dutch software companies. Furthermore, a strict definition of the software sector was used, namely all organisations assigned to the category defined by Statistics Netherlands as “the provision of services in the area of information technology” with the exception of “the management of computer facilities”. In terms of Statistics Netherlands’ Standard Industrial Classification (SIC), the study concerned all companies in the SIC 62 category excluding SIC 6203. Hardware, office technology, telecommunications and organisations that produce software but are not registered as information technology companies were not included in the survey sample.

The Dutch software sector in figures

There were more than 24,000 software companies in the Netherlands in 2010. These companies are located throughout the Netherlands, with concentrations around technical universities and in the border region between the provinces of Utrecht and Gelderland. Based on the study, total employment in these companies was estimated as being 192,000 FTEs in 2010. The distribution of this employment is extremely skewed: two thirds of software companies are sole proprietorships. According to Dialogic’s study, they collectively generate total sales of 25 billion euro. Total gross added value exceeded 17 billion euro in 2010, or 2.8 percent of GDP. This means that the software industry is at least as large as other strategic clusters within the Dutch economy, such as agriculture and food, life sciences and the chemical industry. Software is therefore not only important because it is applied and used in an extraordinarily high number of industries. The software industry is also important because it makes an important contribution to the Dutch economy as an independent sector.

Within the software sector, the production of software constitutes the largest distinct branch of industry by far in terms of number of companies. Although the number of companies that provide software services is smaller than the number of software producers, they make a proportionally greater contribution to employment.

7.1.3 Overview of the Dutch software sector by branch of industry, 2010

<table>
<thead>
<tr>
<th>SIC code</th>
<th>Description</th>
<th>Sales</th>
<th>Added value</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mln euro</td>
<td>mln euro</td>
<td>FTE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>6201</td>
<td>Developing, producing and publishing software</td>
<td>17,025</td>
<td>11,746</td>
<td>116.43</td>
</tr>
<tr>
<td>6202</td>
<td>Consultancy services in the area of information technology</td>
<td>6,526</td>
<td>4,630</td>
<td>62.21</td>
</tr>
<tr>
<td>6209</td>
<td>Other service-related activities in the area of information technology</td>
<td>1,473</td>
<td>891</td>
<td>13.43</td>
</tr>
</tbody>
</table>

Source: Dialogic (2010).
Dialogic calculated the total sales value of software in the Netherlands as being 10.2 billion euro in 2010, or 41 percent of the software sector’s total sales volume. This is far less than the share of the software production industry (SIC 6201, Table 7.1.3), something that can be attributed to the “domino effect” of the latter sector. Software production forms the foundation on which other activities, such as consultancy and implementation, are based. This applies not only between but also within branches of industry. Even for software production companies, the sale of software accounts for less than 50 percent of income. Other important sources of income for these companies are support services (16 percent) and implementation and testing (12 percent). For producers of custom software, the production of software for third parties is naturally also an important source of income (20 percent). More or less similar proportions apply to the number of employees who are involved in these activities.

### Characteristics of products and services

According to Dialogic, the sale of product software (standardised software packages) accounts for 42 percent of the total sales volume. This contradicts the widespread assumption that the Netherlands imports virtually all of its product software and therefore has no significant software industry of its own. Software producers naturally account for the lion’s share of software sales, namely 83 percent (as against 86 percent for custom software). It must nevertheless be noted that 40 percent of all software consultancy firms also sell software products on the open market. This amounts to approximately 2,500 companies and 6,000 software products, or 15 percent of the total market for product software. It is clear that “size matters” in the case of product software.

#### 7.1.4 Distribution of work across six types of activity, at sector and subsector level

<table>
<thead>
<tr>
<th>SIC code</th>
<th>Software sector</th>
<th>Software production</th>
<th>Consultancy services</th>
<th>Other services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard 620101</td>
<td>Custom 620102</td>
<td>Hardware 620201</td>
<td>Software 620202</td>
</tr>
<tr>
<td>Software development</td>
<td>35.3</td>
<td>44.8</td>
<td>51.4</td>
<td>26.6</td>
</tr>
<tr>
<td>Implementation</td>
<td>24.3</td>
<td>14.1</td>
<td>33.3</td>
<td>37.5</td>
</tr>
<tr>
<td>Support</td>
<td>14.0</td>
<td>15.3</td>
<td>10.1</td>
<td>13.9</td>
</tr>
<tr>
<td>Sales/marketing</td>
<td>9.8</td>
<td>10.4</td>
<td>8.7</td>
<td>14.3</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>7.4</td>
<td>8.4</td>
<td>9.4</td>
<td>3.9</td>
</tr>
<tr>
<td>Other</td>
<td>9.1</td>
<td>7.0</td>
<td>7.1</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Source: Dialogic (2010).
the larger the company, the larger the share of product software relative to custom software. Despite the strong presence of product software, the supply of custom software to customers, including specialist installation and integration, remains the most important activity of Dutch software companies. This applies to both software producers and software consultancy firms.

The provision of software services through the internet (Software as a Service, or SaaS) and the use of open source software also formed part of the study. SaaS accounts for approximately 15 percent of total software sales. It must be noted, however, that the use of SaaS has continued to increase rapidly since the survey was carried out (May 2010). An interesting finding of the study was that there was no correlation whatsoever between company size and the provision of SaaS. The survey revealed that a relatively low percentage of companies used and/or sold open source products. One of the problems in this regard is that a majority of software products are composite ones; that is, certain constituent parts are open source while others are not. From a legal perspective, it is not easy to determine whether such hybrid products can be classified as open source. This does not detract from the fact, however, that the study nevertheless found consistent figures concerning the use of open source products. Both the input (open source products as a "raw material") and the output (income from open source products and services) amounted to 11 percent of all companies. Hybrid forms are present also in this case. In other words, there are companies that supply and provide both closed and open source products and services. Many companies provide custom services in addition to supplying open source products, for example. Such companies do not generate income from the open source product itself but, rather, through the provision of supporting services.

Software and innovation

The literature on the subject indicates that there is a very strong correlation between innovative behaviour and the use of ICT. Unfortunately, it is often difficult to distinguish between cause and effect. In other words, it is not known whether innovative companies require more ICT or whether the use of ICT leads to more innovative behaviour. What is known, however, is that the strong correlation between innovative behaviour and the use of ICT is completely independent of company size (Todhunter and Abello, 2011). Another key finding is that investments in ICT have a far greater impact on productivity when they are combined with intangible investments, particularly in education and training (O’Mahony and Peng, 2011). This finding is in keeping with recent publications that stress the role of organisational changes and the accompanying retraining of employees in the dissemination of new technology. Moreover, the marginal productivity gain of these combined investments is higher in the services sector than in the manufacturing one. In the case of ICT-intensive companies, the difference between services and manufacturing is almost twice as high as in the manufacturing sector.
7.1.5 Productivity trends in ICT-intensive (high risk) sectors, in US and EU (top) and in EU countries with high and with low employment protection legislation (bottom) 1990–2005

Source: Bartelsman et al., 2011.
Differences in the level of intangible investments probably also explain in part the differences in productivity between the United States and Europe. Productivity growth in the United States is far stronger than it is in Europe (Van Ark et al., 2008). Another possible explanation is that the general business environment in the United States is more favourable to ICT-induced changes in organisational terms than is the case in the EU. High-risk innovative sectors that make intensive use of ICT are relatively smaller in Europe, with its more stringent employment protection legislation, than they are in the United States (Bartelsman et al., 2011). Moreover, countries within Europe that have high levels of employment protection legislation have relatively smaller ICT-intensive sectors than those with lower levels of protection. In relative terms, countries with more stringent legislation in this area are ultimately less productive. There has of course always been more legislation pertaining to employment protection in EU Member States than there has been in the United States. The crucial point in this regard is that this legislation is more expensive in the ICT era. Put differently, countries that are less regulated in terms of employment protection achieve disproportionately more profit from the ICT revolution than other countries (Figure 7.1.5).

It is as yet unclear to which group of countries the Netherlands belongs. Although its starting position is fairly good, the Netherlands does not invest much in R&D and probably

### 7.1.6 Number of applicants under the Promotion of Research and Development Act in 2009 and the growth of R&D working years, 2008–2009

![Diagram showing the number of applicants under the Promotion of Research and Development Act in 2009 and the growth of R&D working years, 2008–2009](image-url)

*Source: NL Agency (2010).*
also not in intangible assets and institutional change (see below). The recent expansion of
the tax incentive scheme under the Promotion of Research and Development Act (in
Dutch: WBSO) to include software projects is proving to be a powerful stimulus with
respect to the R&D investments of ICT companies in the Netherlands (Figure 7.1.6). The
participation of ICT and telecommunications companies in R&D has increased
tremendously since this expansion. ICT and telecommunications now constitute the
largest sector by far.

This concerns primarily the software sector, though possibilities for further breakdown
are limited. These figures are in contrast to R&D investments in ICT in the Netherlands.
Although the share has somewhat decreased, the R&D investments of ICT hardware
manufacturers still account for over 80 percent of all R&D investments in ICT (Statistics
Netherlands, 2009). Dialogic’s survey revealed that 7.4 percent of all labour capacity
within software companies is used for R&D (Table 7.1.4). This figure is almost twice as
high as the figures of Statistics Netherlands indicate. The latter are based, however, on
formal R&D as defined in the internationally applicable Frascati Manual (OECD, 2002).
Only a small proportion of larger companies employ full-time researchers. This does not
mean that other companies do not invest in innovation. They often reserve a number of
hours for activities that cannot be invoiced, and these activities can be classified as
innovation in the broader sense expressed by Schumpeter (the carrying out of new
combinations, such as new developments in the market). Although such activities are not
deemed to be formal R&D, they were included as innovation in Dialogic’s survey.

This could explain why Dialogic’s survey found no correlation between company size and
innovation, whereas it is known that R&D is mainly carried out by larger companies. A
correlation was found, however, albeit a weak one, between product software and
innovation (defined as the introduction of products or services that are new to the company).
This does not accord with Table 7.1.4, which indicates that producers of custom software
allocate more labour capacity to R&D, i.e. not innovation, than product software
companies. However, software producers allocate more labour capacity to R&D than
consultancy or service providing companies. In the specific case of software, it must also be
noted that there is a gradual difference between R&D, innovation and “regular” software
development. A further complication is the fact that, under EU legislation, no patents may
be granted for computer programs that have only a business function and not a technical
one. Given the crucial importance of organisational changes to ICT-induced productivity
gains, this legislative status quo is unfortunate from an innovation perspective.

The strategic importance of software

The steam engine’s direct economic contribution to the Industrial Revolution was a
tremendous increase in available horsepower. Between 1760 and 1910, the number of
horsepower in the United Kingdom increased by a factor of 2,000 (Kanefsky, 1979). Naturally,
the manufacturing sector accounted for almost all of the gains made in this regard. Economic growth, however, concerns costs per unit of production. Development was less impressive in this sense, since costs per unit in the steam power era decreased by a factor of 2 in a period of 30 years (Crafts, 2011). Similar figures also apply to the later introduction of electric motors. Costs per unit of production for computing power, however, decreased by a factor of 10,000,000 in 30 years (Nordhaus, 2002). Even if only a small part of this technological progress translates into productivity growth, the effect of the ICT revolution will be far greater than the one that the Industrial Revolution had on the British economy. This casts a different light on Figure 7.1.1. Although short-term expectations are excessively high, it is precisely ICT’s long-term impact that appears to be strongly underestimated.

There is an important difference with respect to the invention of the steam engine, however. In the earlier revolution, the technological progress made (an increase in horsepower) translated directly into productivity gains, principally in the manufacturing sector. In the case of the ICT revolution, by contrast, the real productivity gains (a sharp decrease in the costs per unit of computing power) are only made by software that actually uses the increased computing power available. This means that the indirect gain is far more important than the direct gain. In addition, this effect is more pronounced in the services sector than in the manufacturing one.

Unfortunately, as stated earlier, most economic literature treats ICT as a large, single whole without differentiating according to, for example, software. Nevertheless, a number of interesting conclusions can be drawn if trends in ICT output (the share of the ICT industry’s added value in the total added value of the market sector) are compared with trends in ICT income (a proxy for the degree of ICT spread). First, there is no significant correlation between these two variables. At most there is a slightly negative one. A high level of ICT output is therefore not always linked to a high level of ICT income. In almost all OECD countries, ICT output has continuously decreased over the last 30 years, while ICT income has continuously increased (Oulton, 2010). The Netherlands is no exception to this rule.

Second, the ICT income effect is in general far stronger than the ICT output effect (Figure 7.1.7). The ICT income effect accounts for over two thirds (0.54 percentage points) of the 0.79 percent annual average GDP growth as a result of ICT. In other words, the largest gains are not achieved by having ICT but, rather, by using it as an innovation axis. The ICT output effect does not influence the growth of consumption in the long term, since ICT products are available through international trade if they are not produced domestically (Oulton, 2010). This implies that, in principle, countries can simply purchase their respective shares in the ICT revolution. It seems that the Netherlands is indeed doing this, since it is achieving a relatively high level of ICT income from a relatively low level of ICT output. A possible explanation for this situation is the fact that the Dutch economy is strongly oriented towards services, and ICT productivity gains manifest themselves mainly in the services sector.

On closer consideration, however, this explanation appears to be an oversimplification.
7.1.7 ICT output effect (top) and ICT income effect (bottom), Netherlands, 1970–2007

Although the Netherlands does indeed have a weak domestic foundation in ICT hardware, this is not a significant hindrance given the free availability of ICT hardware. Product software is perhaps also characterised by free availability: the same generic productivity software is sold throughout the world, for example, but perhaps this is the exception to the rule. In general, product software is extremely specialised and geared towards specific niches. This also became apparent in the study into the software sector, which revealed that a lot of software production occurs outside the strictly defined software sector according to SIC 62. It is estimated that the economic value of software production in this sector in a broad sense is approximately 40 percent higher (Te Velde et al., 2010). As such, product software is strongly linked to a country’s specific economic structure. It must be locally produced. The same applies of course to custom software, software consultancy services and other software services. In other words, software is much more locality-based than hardware. Comparable to the concept of absorptive capacity for R&D (Cohen and Levinthal, 1990), countries therefore require a substantial, endogenous software foundation to be able to use ICT. Although little is as yet known about the – possibly symbiotic – relationships between product software, custom software, consultancy and services, it can fortunately be concluded on the basis of the foregoing that the Netherlands does indeed have a substantial, endogenous software foundation of the kind required. The country has a large product software sector of its own, for example, a fact that is usually overlooked. There is no time for resting on laurels, however. All countries at the
top of the list in Table 7.1.8 make heavy R&D investments in ICT services in comparison with the R&D investments of the ICT industry as a whole. The Netherlands is a negative exception in this regard. Investing in R&D on its own is not enough, however. Intangible investments, for example in education and training, instead of solely in R&D constitute the key to using ICT (Marrano et al., 2007). When they have areas of overlap with ICT, company-specific intangible investments are even more important in the services sector than they are in the manufacturing one (O’Mahony and Peng, 2011). An important condition for such investments, for example in organisational restructuring, is that they are both permitted and not discouraged by prevailing legislation.

In summary, the ICT revolution has tremendous potential for a services-oriented economy with a robust endogenous software foundation like the Netherlands. The largest gains can be achieved through structural changes in organisations at all levels of the economy: companies, sectors, national economies and even the global economy as a whole. Such changes will only occur, however, if they are not hindered by legal and cultural factors, and if the underlying investments in software and R&D are accompanied by intangible investments.

7.2 New indicators on the public financing of R&D

This contribution describes the results of an OECD project started in 2008 to develop a methodology for the compilation of new indicators on the public financing of research and development (R&D) and collect the data for this purpose. The aim is to use, to the greatest extent possible, the already existing data collection on public financing, which is based on national government budgets. An important distinction maintained in the project is that between project financing and institutional financing.

The contribution presents the provisional results of data collection for 18 countries and draws conclusions regarding the possibility of using data as currently collected by the OECD and Eurostat to compile a more differentiated set of indicators that ties in more closely with current discussions about the public financing of R&D.

Author: Jan van Steen, Rathenau Institute / Ministry of Education, Culture and Science

See for example Statistics Netherlands, The digital economy 2009, Figure 7.1.3.
Introduction and background

National governments constitute an important source of funding for R&D within national R&D systems. Although companies in many countries account for far and away the largest share of total R&D funding, the respective shares of governments of OECD countries range from 14 percent to 70 percent and average 28 percent. The average share within the EU-27 is 34 percent. The share of public funding in the Netherlands is even higher, 40 percent. Among other reasons, government authorities finance R&D in order to maintain their country's basic knowledge infrastructure in the long term, for example by funding universities through the "first flow of funds", i.e. funds for research, granted to scientific institutions directly by the Ministry of Education, Culture and Science. In addition, such funding is also an instrument for government authorities to stimulate developments in the R&D system and its organisation in the medium term (Maass, 2003). An example in this regard is the public funding earmarked for the Innovational Research Incentives Scheme of the Netherlands Organisation for Scientific Research (NWO). The purpose of this subsidy instrument is to contribute to the modernisation of scientific research and encourage talented researchers to pursue sustained careers in the Netherlands. Finally, government authorities finance R&D to gather knowledge about their own policies in the short term, principally in the form of policy-oriented research like policy evaluations. How the funding is organised, who is responsible for it, the instruments deployed for the purpose and the parties that deploy these instruments differ per country. Data on the situations in different countries enables comparisons between them, thereby making it possible for countries to learn from each other. The ultimate question concerns effectiveness; that is, does the system of funding instruments in a country lead to the intended effects?

Data on the public funding of R&D as part of international agreements within the OECD and set out in the Frascati Manual (OECD, 2002) are collected in two different ways:

- With respect to the performers of R&D: by Statistics Netherlands on the basis of a survey involving companies and public research institutes and analysis of the financial statements of institutions of higher education (universities and university medical centres). The survey asks respondents to specify the sources of funding for the R&D performed. The government is one of those sources.
- With respect to financiers of R&D: by the Ministry of Education, Culture and Science (until 2010, after which responsibility for this data collection was transferred to the Rathenau Institute) on the basis of questioning the different ministries about their R&D expenditure within ministerial budgets. This aspect concerns realised and

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1) Eurostat, the statistical office of the European Union, is also closely involved in this work.
2) As part of the science system assessment duty that the Rathenau Institute has had for a number of years. This duty concerns research and data collection and analysis pertaining to the organisation and development of the science system.
intended expenditure.\footnote{R&D expenditure is often part of a budget item in respect of which the ministries must estimate the R&D share within the item concerned.} The data are collected on the level of budget articles with classification according to government objectives and, to the extent already known, the purpose of expenditure per article.\footnote{Based on Eurostat’s NABS (Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets) classification.} The OECD project described in this contribution focuses on the second set of data, the collection and annual publication of which is referred to in the Netherlands as “Total Research Financing”.\footnote{In OECD terminology, data collection in this area is referred to as Government Budget Appropriations or Outlays on Research and Development (GBAORD).}

Although current data collection has a long history, use of these data is limited both in discussions about policy governing the public financing of R&D and in studies concerning the functioning of research systems. The policy discussions referred to concern, among other things, the ratio between institutional and project financing and trends in these forms of financing over time, where decisions about projects and programmes are made, where the public funds actually end up and the type of research that is financed.

The data’s limited value in use prompted researchers to study the different aspects of project financing within the framework of an EU project (Lepori et al., 2007; Versleijen, 2007).\footnote{The project was implemented as part of the EU PRIME project and financed from resources for the EU’s Seventh Framework Programme. Results have also been published on the PRIME website at http://www.enid-europe.org/PRIME/project_funding.html.} The OECD project follows on from this EU project and uses the definitions developed but attempts to use Government Budget Appropriations or Outlays on Research and Development (GBAORD) data as a scaffold to broaden existing paths in an international context. The advantage of doing so is that it keeps the creation of any new response burden to a minimum. The project has the following three objectives:

1. the development of a methodology for internationally comparable figures concerning the public financing of R&D,
2. the collection of data for these indicators, and
3. the implementation of the methodology on a broad scale, ultimately resulting in the revision of the text of the Frascati Manual.

**Method and data collection**

The development of the indicators and collection of data are based on a model of a research system that has financing flows on three different levels (see Figure 7.2.1). The government functions as a kind of base station that provides institutional and project financing to institutions of higher education, public research institutes and companies. In addition, the government is a source of financing for intermediary organisations that redistribute these resources. These intermediary organisations, which constitute the
second level, can be seen as more or less independent organisations that may themselves make decisions regarding the selection and granting of resources. The third level consists of organisations that receive funding for the performance of research, who may or may not divide and allocate such funding internally. In terms of category, these organisations are subdivided into institutions of higher education, public research institutes and companies.

Six different forms of public financing based on three dimensions are distinguished in the project:

- Type of financing: project and institutional financing. In this context, project financing is defined as money that is granted to a group or to an individual to perform R&D activities which are circumscribed in terms of scope, budget and time. In many cases,

### 7.2.1 Diagram of the Dutch research system

Project financing is based on the submission and assessment of a project or programme proposal that describes the R&D activities. In addition to the foregoing, institutional financing is defined as the financing of institutions without the direct selection of projects or programmes (Lepori et al., 2007).

– Source of financing: national and international financing.
– Purpose of the financing: national and international performers.

This results in the following schema of six financing forms.

### 7.2.2 Overview of forms of financing

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<thead>
<tr>
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<th>National public financing of R&amp;D</th>
<th>International public financing</th>
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<tbody>
<tr>
<td></td>
<td>Public financing of national performers</td>
<td>Public financing of international performers</td>
</tr>
<tr>
<td>Project financing</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Institutional financing</td>
<td>2</td>
<td>4</td>
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</tbody>
</table>

In addition to the foregoing, three variables are distinguished:

– The performing sector: companies, institutions of higher education, research institutes and private non-profit organisations (PNPs);

– The financing organisation: ministries responsible for higher education and research, other ministries, independent organisations and regional government authorities;

– The orientation of the financing instrument: academically oriented, policy-oriented and innovation-oriented.

Five different indicators were developed in the project. These indicators are linked to the cells shown in Overview 7.2.2 and the three additional variables referred to.

OECD countries were asked to participate in the collection of data on a voluntary basis. As at the present time, 18 countries have supplied data for the compilation of the different indicators by means of a questionnaire developed in the project. The GBAORD data collected by OECD countries each year constitute the foundation of the new sets being developed. The basic units of these data, often budget articles, subsequently had to be classified according to the different variables. Assistance was sometimes required in this regard. This assistance could at times be found in documents and, at other times, was provided by experts involved in national budgets. When necessary, information was also obtained from ministries or other research organisations.
Initial results

The data supplied by the countries for the different indicators are presented below for each indicator.

**Indicator 1:** National public financing by type of financing and purpose, national and international (concerns financing forms 1, 2, 3 and 4 in Overview 7.2.2).

This indicator, which is based on a country’s total government financing, characterises the organisation of a country’s public financing of R&D based on the distribution of this financing across the different types of financing. Data covering a longer period of time make it possible to discern trends in the different forms of financing. In the Netherlands, for example, the share of project financing slowly increased starting in 1975 from approximately 7 percent to over 30 percent by 2010. This warrants the conclusion that government control has increased over the years. It may be noted in this connection that many projects or programmes are circumscribed by themes determined by the government or an intermediary organisation; themes within which the research must take place. Moreover, to enable selection of the best research proposal, researchers must often compete with each other to gain eligibility to perform the research. Taken together, these factors mean less freedom on the part of researchers and research organisations to engage in research of their own choice according to their own views and priorities. Based on this indicator, the key conclusions are that financing systems in the various countries differ strongly from each other (the share of project financing ranges from 20 percent to 70 percent), that the institutional financing of institutions of higher education accounts for a large share in total institutional financing and that financing from international organisations and projects is limited in scale (Figure 7.2.3).

**Indicator 2:** National public financing of national performers by type of financing and performing sector (concerns financing forms 1 and 2 in Overview 7.2.2).

Maintaining a distinction between the two types of financing, this indicator specifies the kind of organisation to which public financing is granted in terms of public or private. Based on this indicator, the key conclusions are that there are major differences between countries also in this respect, that most institutional financing goes to the public sector (institutions of higher education or research institutes) and that the purpose of project financing varies, even though the public sector constitutes the largest recipient in most countries (Figures 7.2.4 and 7.2.5).

**Indicator 3:** Public project financing of national performers by financing organisation (concerns financing forms 1 and 5 in Overview 7.2.2).

This indicator, which is limited to project financing, focuses on the organisations that are responsible for granting the financing. The question in this regard is whether responsibility is vested mainly in the government or in intermediary organisations.
7.2.3 National public financing by type of financing, international, 2008

Source: OECD, provisional data collected in the project concerning the public financing of R&D.

7.2.4 National public financing of national performers by performing sector, project financing, international, 2008

Source: OECD, provisional data collected in the project concerning the public financing of R&D.
7.2.5 National public financing of national performers by performing sector, institutional financing, international, 2008

Source: OECD, provisional data collected in the project concerning the public financing of R&D.

7.2.6 National public project financing of national performers by financing organisation, international, 2008

Source: OECD, provisional data collected in the project concerning the public financing of R&D.

1) In order of the share of independent organisations.
Based on this indicator, the key conclusions are that there are major differences between countries also in this respect and that in half of the countries the lion’s share of project financing is managed by independent organisations at intermediary level. In the Dutch case, these are the Netherlands Organisation for Scientific Research (NWO) and NL Agency (for more innovation-oriented financing) (Figure 7.2.6).

**Indicator 4:** National public project financing of national performers by type of instrument (concerns financing form 1 in Overview 7.2.2).

This indicator, which is limited to project financing, focuses on the dominant orientation of project financing based on the following orientations: academic, policy and innovative.

### 7.2.7 National public project financing by national performers and project orientation, international, 2008

[Bar chart showing national public project financing by national performers and project orientation for various countries.

Source: OECD, provisional data collected in the project concerning the public financing of R&D.

For many countries, it was difficult to make the distinction between the three kinds of orientation in project financing because the basic data were not always unequivocal. The countries that were able to make the distinction again exhibit major differences (Figure 7.2.7).

**Indicator 5:** International financing of national performers by performing sector (concerns financing forms 5 and 6 in Overview 7.2.2).
This indicator focuses on the financing of national performers by parties based abroad. It quickly became apparent that it was difficult for most countries to supply data, or at any rate complete data, on this aspect. In addition, the data required had to be obtained from sources other than those that could be used for the other indicators. This made comparability problematic and it was therefore decided to discard this indicator already at an early stage of the project.

**General conclusions and discussion**

The methodology and indicators developed were tested in a number of countries for a first round of data collection with experimental indicators. The data must therefore be treated and interpreted with caution. Nevertheless, we may draw a number of tentative conclusions:

- National data collection and the information on national budgets obtained from these are a useful source with respect to the indicators discussed in this contribution. In many OECD countries, however, the data required to compile the indicators are not readily available. In addition, time and budget were reasons for many countries not to participate in the project. The participation of a greater number of countries is ultimately required to enable introduction on a broader scale and the collection of internationally comparable data.

- An important advantage of the chosen methodology is that it is based on the use of existing data rather than on the collection of new data. Countries were therefore able to supply data in a relatively short time.

- The results show that there are major differences between countries. To be able to interpret the findings and differences, additional, qualitative data are required. Figures alone do not explain the differences found.

- It was not always easy for countries to classify the data in the correct manner. This limits international comparability. It also means that the methodology and definitions must be refined and examples provided to make the definitions easier to use. Subjects that require further study are the distinction between institutional and project financing, the classification of financing according to performing sector (such as how to treat financing that is allocated to several sectors), the classification of financing organisations (the characteristics of an independent organisation) and the type of instruments used in project financing. The terminology used must also be examined more closely in order to make it as simple and clear as possible.

The project constitutes an important first step in the development of indicators on the public financing of R&D that are of relevance to policy. Data collected in the context of the project have already been used in an official OECD publication (OECD, 2010b). Many countries support the project and consider its further progress important. At the same
time, however, it has become clear that there is still a long way to go and a lot of work to do. A range of methodological hurdles must still be overcome before a reliable collection system that provides internationally comparable data can be put in place and included as part of the OECD’s and Eurostat’s regular collection of data. In addition, the participation of a greater number of countries is required.

The figures presented in this section are contained in the statistical annex to this publication. The annex can be consulted online at www.cbs.nl/ict-knowledge-economy.

7.3 R&D expenditure in the higher education sector: a historical overview

The way in which figures on Research and Development (R&D) expenditure in the higher education sector are compiled has changed several times over the years. Sometimes this was the result of changes in the way in which R&D was organised in the higher education sector. In other cases it was the result of a switch to other statistical sources and methods, for example to reduce the administrative burden on universities and university hospitals.

Based on figures concerning R&D expenditure in the higher education sector, this section first provides a brief historical overview of these periodic changes, after which the R&D expenditure of the higher education sector in the period 1999–2009 and the way in which these figures were compiled are discussed in greater detail.

Author: Andries Kuipers

Research commitment of academic staff

In the period 1970–1989, R&D expenditure in the higher education sector was calculated using the research coefficients of the academic staff of universities, colleges for higher professional education and university hospitals. These research coefficients were derived from periodic time use surveys. In these surveys, which were relatively large-scale, a proportion of the academic staff of universities, colleges for higher professional education and university hospitals were asked to keep an accurate record of the time spent on different, distinct categories of work during a certain week of the year. Sixty-seven percent
of the total of 21,260 individuals approached for the purpose took part in the last time use
survey of 1982/’83. The survey’s terms of reference distinguished between eight categories
of work. The time spent on these eight categories of work was ultimately converted into
four main activities, namely education, scientific research, healthcare and other. When the
results were published, the time use of academic staff was further detailed according to
faculty and subfaculty and job grade and appointment categories (for more information
about the structure and results of this last time use survey, see Statistics Netherlands, 1986).

7.3.1 R&D expenditure in the higher education sector, 1970–2009

Three time use surveys were carried out in the period 1970–1989. The results of the
1969/’70 time use survey were used to calculate R&D expenditure in the higher education
sector for the years 1970–1972. The results of the 1972/’73 time use survey were used to
calculate R&D expenditure for the years 1973–1980. The results of the last time use survey
concerning the 1982/’83 reporting year were used to calculate R&D expenditure for the

The working method outlined above had two disadvantages. First, viewed collectively, the
surveys constituted a considerable burden for academic staff working in the higher
education sector. Second, because time use surveys were not carried out annually, the
research coefficients derived from a given survey had to be used for several years to
calculate R&D expenditure in the higher education sector.
Starting from the 1990 reporting year, a different source was used to obtain an indicator of the time spent by universities’ academic staff on scientific research. At the time, the Association of Universities in the Netherlands (VSNU) was already collecting annual data on the total research commitment of universities’ academic staff (expressed in full-time equivalents (FTEs)). The quotient of this research commitment and the total number of academic staff in the salaried employment of universities was a suitable, alternative indicator for the time spent by universities’ academic staff on scientific research. Together with the Association of Universities in the Netherlands and the Ministry of Education, Culture and Science, the decision was made to switch to this source and the methodology associated with it.

The advantages were obvious: a reduced administrative burden for universities’ academic staff and the availability of “fresh” research coefficients each year. It was agreed in addition, however, that the results obtained through this working method would in due course be tested by means of an “old-fashioned” time use survey. On the instructions of the Ministry of Education, Culture and Science, EIM Business & Policy Research (EIM BV) conducted such a survey in relation to four scientific areas for the 2006/’07 reporting year (Ministry of Education, Culture and Science, 2007).8

From research commitment to R&D expenditure

The time use coefficients calculated with respect to scientific research were used to estimate the accompanying R&D expenditure. In the period 1970–1989, when these coefficients were based on an underlying time use survey, three coefficients relating to the following played a role:

1. The proportion of staff in salaried employment involved in R&D;
2. Expenditure on materials and equipment for R&D;
3. Expenditure on staff for R&D.

Re 1. This coefficient in fact concerned the percentage of working hours spent by academic staff on scientific research. This was multiplied by the sum of the total number of academic staff in the salaried employment of a university and the supporting and administrative staff. The result was the research commitment of staff in the salaried employment of a university expressed in FTEs excluding general services staff, who were not taken into account.

8 This “calibration” with the statistical sources and associated methodology used as from 1990 resulted in the following research coefficients: engineering 67 (64), law 52 (45), behaviour and society 53 (51), language and culture 52 (49). The research coefficients for 2006 calculated by Statistics Netherlands based on data of the Association of Universities in the Netherlands are given in parentheses. The survey’s conclusion was that in spite of small differences, the sources and methodology used were valid.

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Re 2. The coefficient used to calculate expenditure on materials and equipment for R&D also took what were referred to at the time as “pure scientific researchers” (ZWO staff) into account.\(^9\) These researchers were academic staff who were not in the salaried employment of a university but nevertheless worked at one. As such, this category of working individuals used the available materials and equipment of universities and colleges for higher professional education, for which these universities and colleges received payment from the Netherlands Organisation for Pure Scientific Research (ZWO).

Re 3. In principle, the first coefficient was used to calculate expenditure on staff for R&D. However, since the time use per job grade was known, it was weighted with the average salary of the job grade in question for the calculation of expenditure on staff. The time use of a professor was therefore weighted more heavily, because it was more expensive, than the time use of an academic employee in a lower job grade.

In this period, the estimation of the R&D component in the investments of universities and colleges for higher professional education was not directly linked to a time use coefficient but was determined on a case-by-case basis in relation to the different investment projects of the time.

This approach to estimate R&D expenditure in the higher education sector did not in essence change when the switch was made in 1990 to data pertaining to the research commitment of academic staff as collected each year by the Association of Universities in the Netherlands and the accompanying total number of academic staff in the salaried employment of universities.\(^10\) Two research coefficients were used also in this case. The first concerned the calculation of expenditure on staff for R&D, in respect of which academic staff employed by what had by this time come to be called the Netherlands Organisation for Scientific Research (NWO) were not taken into account.\(^11\) Although these researchers worked at a university, they were not in the salaried employment of one and were therefore also not included in the university’s staff costs. The second coefficient was needed to determine expenditure on materials and equipment for R&D, in respect of which, as had been the case in the preceding period, Netherlands Organisation for Scientific Research staff were taken into account insofar as they worked at universities.

Starting from 1990, this last coefficient was also used to determine the R&D component in the investments of universities. Weighting with the average salary per job grade was abandoned in 1990 for the calculation of expenditure on staff for R&D. The basic data available did not provide enough reference points for this more detailed approach.

\(^9\) Academic staff employed by the Netherlands Organisation for Pure Scientific Research, the Foundation for Fundamental Research on Matter and other institutes of the kind insofar as such staff physically worked at universities and colleges for higher professional education.

\(^10\) The research commitment of academic staff is taken from University Research Key Indicators (KUOZ). Data concerning the nature and total number of university staff is obtained from Scientific Education Personnel Information (WOPI data). Source: VSNU (2011).

\(^11\) The Netherlands Organisation for Pure Scientific Research (ZWO) later became the Netherlands Organisation for Scientific Research (NWO).
Table 7.3.2 provides an overview of the development of research coefficients over time. The results of the three time use surveys of Statistics Netherlands are reasonably comparable. The figures show that the scientific research component in the total time use of academic staff in the salaried employment of universities grew in size through the years. The research coefficient was highest for all scientific areas in 1982/’83. As shown by the 1982/’83 time use survey, including the research commitment of Netherlands Organisation for Pure Scientific Research staff results in higher research coefficients mainly for the areas of natural sciences (+ 4 percentage points), engineering (+ 2 percentage points) and behaviour and Society (+ 2 percentage points). For the other scientific areas, the effect is limited to a maximum of one percentage point. The higher research coefficients for 1982/’83 are also directly reflected by an increase in R&D expenditure in 1981, which was calculated on the basis of these research coefficients (see Figure 7.3.1). The R&D expenditure of 1980 was still based on the older and lower research coefficients of 1972/’73. Since a time use survey was not carried out each year, any gradual increase in the time spent on scientific research is not directly reflected. In the years between two time use surveys, R&D expenditure “only” fluctuates with the financing basis to which the research coefficients are applied.

The most important change occurred in 1990 when the switch was made to data pertaining to the research commitment of the academic staff of universities as collected by the Association of Universities in the Netherlands. Following this change, the research coefficient became the quotient of the research commitment referred to (numerator) and the total number of academic staff in the paid employment of universities (denominator) as specified in the Scientific Education Personnel Information (WOPI data). When specifying the research commitment in the context of University Research Key Indicators (KUOZ), the time use of academic staff is roughly distributed across the two core duties of such staff, namely education and research. There is no explicit third category covering other activities as was the case in Statistics Netherlands’ time use surveys. In the context of University Research Key Indicators, time spent on these other activities appears to be implicitly distributed across the core activities of education and research. For the time use surveys of Statistics Netherlands, this was simulated with retroactive effect in Table 7.3.2 by proportionally distributing the time spent on these other activities across the activities of education and research (and care in the case of university hospitals). The results of this simulation are given in parentheses after the research coefficients as originally derived from the time use surveys (and also actually used). As can be seen, the results thus obtained are striking. The time spent on these other activities was substantial. In 1969/’70 the figures ranged from 20 percent to 30 percent for the different scientific areas. Although the time spent on other activities decreased in 1982/’83, it still constituted between 10 percent and 20 percent. These recalculated research coefficients are closer to those of 1990, which are based on University Research Key Indicators and Scientific Education Personnel Information. The effect of the switch from the 1982/’83 research coefficients to the approach based on University Research Key Indicators/Scientific

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Education Personnel Information can clearly be seen in Figure 7.3.1. R&D expenditure increases by over 25 percent from 1989 to 1990, largely due to the switch to the new statistical sources and associated methodology referred to.

### 7.3.2 Research coefficients of academic staff at universities and colleges for higher professional education (hbo), 1969/’70–2009

<table>
<thead>
<tr>
<th>HOOP areas</th>
<th>Statistics Netherlands time use surveys</th>
<th>KUOZ/WOPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research coefficient of academic staff excluding ZWO/NWO staff (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural sciences</td>
<td>49(63)</td>
<td>50(63)</td>
</tr>
<tr>
<td>Engineering</td>
<td>36(49)</td>
<td>35(45)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>41(55)</td>
<td>36(48)</td>
</tr>
<tr>
<td>Economics</td>
<td>31(40)</td>
<td>37(47)</td>
</tr>
<tr>
<td>Law</td>
<td>32(44)</td>
<td>34(43)</td>
</tr>
<tr>
<td>Behaviour and society</td>
<td>33(44)</td>
<td>33(43)</td>
</tr>
<tr>
<td>Language and culture</td>
<td>33(45)</td>
<td>34(43)</td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td>33(41)</td>
</tr>
<tr>
<td>University hospitals/university medical centres</td>
<td></td>
<td>13(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HOOP areas</th>
<th>Research coefficient of academic staff including ZWO/NWO staff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural sciences</td>
<td>61(71) 71 73 75</td>
</tr>
<tr>
<td>Engineering</td>
<td>48(59) 62 59 60</td>
</tr>
<tr>
<td>Agriculture</td>
<td>46(56) 62 68 59</td>
</tr>
<tr>
<td>Economics</td>
<td>46(56) 45 42 52</td>
</tr>
<tr>
<td>Law</td>
<td>43(52) 45 40 40</td>
</tr>
<tr>
<td>Behaviour and society</td>
<td>49(61)</td>
</tr>
<tr>
<td>Language and culture</td>
<td>47(57)</td>
</tr>
<tr>
<td>Health</td>
<td>41(48) 59 64 69</td>
</tr>
<tr>
<td>University hospitals/university medical centres</td>
<td>13(1) 17(1) 17 36 36</td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands, Universitair onderwijs en onderzoek 1982/’83: de tijdsbesteding van het wetenschappelijk personeel van universiteiten, hogescholen en academische ziekenhuizen. Processed results of tables 21, 22 and 23 for the research coefficients of academic staff excluding ZWO staff and tables 11 and 12 for the research coefficients of academic staff including ZWO staff.

1) In the time use surveys in fact social sciences.
2) In the time use surveys in fact the arts.

The effect of including the research commitment of Netherlands Organisation for Scientific Research staff has become more pronounced through the years. The research commitment of the exact sciences in particular was substantially greater in 1999 if one includes Netherlands Organisation for Scientific Research staff insofar as such staff were working at universities: natural sciences: +8 percentage points, engineering:
+4 percentage points and agriculture: +3 percentage points. As regards the arts subjects, the inclusion of staff financed by the Netherlands Organisation for Scientific Research only has a substantial effect with respect to language and culture, namely +6 percentage points.

**The financing basis of R&D expenditure in the higher education sector**

This part discusses the financial data to which these different research coefficients were actually applied to determine the accompanying R&D expenditure. It has been agreed in an international context to estimate the R&D expenditure of the higher education sector and subdivide this expenditure into operating costs (staff costs and other operating costs) and investments. Depreciation and amortisation are expressly not included in the operating costs, since inclusion would result in double counting with the investments (OECD, 2002).

Since the different research coefficients relate to the research commitment of the total number of academic staff of universities, they have also been declared applicable to, respectively, total staff costs, the total of other operating costs (excluding depreciation and amortisation) and total investments.

In the period 1970–1998, calculations were based on financial data and the accompanying research coefficient per faculty, in respect of which the costs of general services were distributed across the different faculties. Since 1999, calculations have been based on financial data per university and therefore also on the research coefficient per university. The availability of financial data per faculty for the different universities had decreased. Data on research commitment and R&D expenditure per scientific area (faculty) are still compiled, however.

The research coefficient for university hospitals related and was therefore only applied to scientific research insofar as this research was government-funded. This aspect concerns the government grant of the Ministry of Education, Culture and Science that university hospitals received for the educational and research duties assigned to them within the faculty of medicine of the university concerned (referred to as the work placement).

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12) These are in fact scientific areas. A relatively detailed breakdown was used in the time use surveys. For the composition of R&D expenditure, eight HOOP areas were and are distinguished: agriculture, natural sciences, engineering, health, law, economics, language and culture, and behaviour and society.
In 1999 two changes occurred in the way in which, among other things, research within the higher education sector was organised:

1. The gradual transfer of the employment of the researchers financed by the Netherlands Organisation for Scientific Research to universities;
2. The gradual transfer of the employment of a proportion of the academic and supporting staff from the faculties of medicine of various universities to what are referred to as university medical centres.

Re 1. From 1999, employer status in relation to current and new researchers financed by the Netherlands Organisation for Scientific Research who were already physically working at a university or who would do so was actually vested in the university concerned. Academic staff on universities’ payrolls would increase each year as a result (WOPI data). The research commitment of these researchers was already included in University Research Key Indicators (KUOZ), however. A temporary discrepancy would consequently arise between the numerator and denominator of the research coefficient used until that time, since the research commitment included Netherlands Organisation for Scientific Research staff (the KUOZ numerator) while only a small, unknown proportion of these researchers were also in the salaried employment of universities (the WOPI denominator). Statistics Netherlands therefore decided, as from 1999, to immediately transfer all Netherlands Organisation for Scientific Research staff to the higher education sector and, as it were, treat all of them as being in the salaried employment of universities. The gradual transfer referred to is deemed to have been completed as from the 2003 reporting year.

R&D expenditure in the period 1999–2009

In 1999 two changes occurred in the way in which, among other things, research within the higher education sector was organised:

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2. The gradual transfer of the employment of a proportion of the academic and supporting staff from the faculties of medicine of various universities to what are referred to as university medical centres.

Re 1. From 1999, employer status in relation to current and new researchers financed by the Netherlands Organisation for Scientific Research who were already physically working at a university or who would do so was actually vested in the university concerned. Academic staff on universities’ payrolls would increase each year as a result (WOPI data). The research commitment of these researchers was already included in University Research Key Indicators (KUOZ), however. A temporary discrepancy would consequently arise between the numerator and denominator of the research coefficient used until that time, since the research commitment included Netherlands Organisation for Scientific Research staff (the KUOZ numerator) while only a small, unknown proportion of these researchers were also in the salaried employment of universities (the WOPI denominator). Statistics Netherlands therefore decided, as from 1999, to immediately transfer all Netherlands Organisation for Scientific Research staff to the higher education sector and, as it were, treat all of them as being in the salaried employment of universities. The gradual transfer referred to is deemed to have been completed as from the 2003 reporting year.
Re 2. From 1998, a gradual merger in fact occurred between parts of the faculties of medicine of various university hospitals to produce what are referred to as university medical centres. “Gradual” in this case means that the merger referred to did not occur for all universities and university hospitals concerned in the same year and that the merger occurred gradually per individual case. One of the consequences of this merger was that staff were transferred from the faculty of medicine of a university to the payroll of the university medical centre concerned. This would also give rise to an inconsistency between the numerator and denominator of the research coefficient for, in this case, the health HOOP area, since the academic staff in the salaried employment of a university would decrease (the WOPI denominator) while their research commitment would continue to be attributed to the higher education sector (the KUOZ numerator). It was therefore necessary to explicitly ensure that research conducted within the faculties of medicine of the different universities and therefore automatically attributed to the higher education sector prior to 1999 would be adequately estimated and “returned” to the aforesaid sector after 1999.

In addition, a number of autonomous improvements were implemented in 1999, such as the inclusion of R&D expenditure in the higher professional education (hbo) and the Dutch Open University (OU).

The differences between the results based on the old form of organisation and those in which the changes outlined above have been processed are quantified in Table 7.3.3 for the year 1999. Following revision, R&D expenditure in the higher education sector comes to 262 million euro, or over 13 percent higher than prior to revision. The autonomous addition of R&D expenditure in the higher professional education subsector, development and innovation within university medical centres¹³ and the transfer of the labour costs of Netherlands Organisation for Scientific Research staff, most of whom were in fact still employed by the Netherlands Organisation for Scientific Research in 1999, account for more than half of this increase (160 million euro). One of the biggest changes is that, following revision, 36 percent of the work placement funds¹⁴ are spent on R&D. This percentage is derived from the financing model on which the determination of the government grant for the work placement of university medical centres is based. The figure of 17 percent adhered to prior to revision was still based on the time use of the academic staff of university hospitals as determined in the last time use survey of 1982/’83. Following revision, the total number of R&D staff comes to 5,500 FTEs, or 23 percent higher than prior to revision. To a significant extent, this increase is the result of the

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¹³ This aspect concerns funds that university medical centres receive for the duties assigned to them in the area of highly specialised referral care. The development and innovation component relates to, among other things, the development and implementation of diagnosis and treatment plans for rare disorders. This expenditure was not observed in the context of R&D statistics prior to 1999.

¹⁴ The university hospital of the university medical centre performs work for medical education and research in the faculty of medicine. The university medical centres also receive a government grant for this work placement. This is a fixed part of the government grant for the university to which the university hospital belongs (Ministry of Education, Culture and Science et al., 2006).
### 7.3.3 R&D expenditure and staff in the higher education sector (including university medical centres) for 1999, before and after revision

<table>
<thead>
<tr>
<th></th>
<th>Before revision (1)</th>
<th>After revision (2)</th>
<th>Difference (2) – (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R&amp;D expenditure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financing basis of R&amp;D expenditure of universities and university medical centres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure of universities(^1)</td>
<td>3,261</td>
<td>3,332</td>
<td>71</td>
</tr>
<tr>
<td>Upward adjustment of the estimate for university medical centres</td>
<td>–</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Work placement funds</td>
<td>386</td>
<td>425</td>
<td>38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,647</td>
<td>3,803</td>
<td>156</td>
</tr>
<tr>
<td><strong>Research coefficients</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material and equipment</td>
<td>59</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Staff</td>
<td>55</td>
<td>55</td>
<td>1</td>
</tr>
<tr>
<td>University hospitals/university medical centres</td>
<td>17</td>
<td>36</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,983</td>
<td>2,085</td>
<td>103</td>
</tr>
<tr>
<td><strong>Accompanying R&amp;D expenditure (^1)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total R&amp;D expenditure in the higher education sector (including university medical centres)</strong></td>
<td>1,983</td>
<td>2,245</td>
<td>262</td>
</tr>
<tr>
<td><strong>R&amp;D staff</strong></td>
<td>1,000 FTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D staff at universities and university medical centres (^1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research commitment of academic staff</td>
<td>12.5</td>
<td>11.8</td>
<td>–0.7</td>
</tr>
<tr>
<td>Addition of NWO staff</td>
<td>–</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Research commitment of supporting staff</td>
<td>11.6</td>
<td>14.0</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24.1</td>
<td>28.7</td>
<td>4.6</td>
</tr>
<tr>
<td>Autonomously added R&amp;D staff in the higher professional education subsector and the development and innovation staff of university medical centres</td>
<td>–</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Research commitment of academic staff</td>
<td>–</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Research commitment of supporting staff</td>
<td>–</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total R&amp;D staff in the higher education sector (including university medical centres)</strong></td>
<td>12.5</td>
<td>15.1</td>
<td>2.6</td>
</tr>
</tbody>
</table>

\(^1\) The figures after revision include the Dutch Open University. These figures have only a minor effect on the totals after revision, but were not stated separately for reasons of confidentiality.
transfer of Netherlands Organisation for Scientific Research staff to the higher education sector (2,800 FTEs). This transfer is also accompanied by an increase in the research commitment of supporting and administrative staff who are deemed to support Netherlands Organisation for Scientific Research staff in their research work. The effect of the autonomous addition of the R&D staff of the higher professional education subsector and the development and innovation staff within university medical centres is minimal.

The financing basis of R&D expenditure in the higher education sector in the period 1999–2009

The box below shows a simplified version of the calculation model used with respect to R&D expenditure in the higher education sector. Upward adjustment of the estimate of the financing basis of three university medical centres was necessary because, as regards these centres, spending of the faculty of medicine government grant and contract research are not included in the annual report of the university concerned. Regarding the other five medical centres, spending of the faculty of medicine government grant and the contract research of the former faculty of medicine of the university concerned are still reported also in the university’s annual report. In addition to work placement funds, there is the financing basis of research conducted within the university medical centres. For five university medical centres this concerns the expenditure as still reported through the university and for three university medical centres this concerns the faculty of medicine government grant and contract research. The underlying idea in this regard is to make an estimate of the R&D expenditure of university medical centres that is as close as possible to the R&D expenditure of the former faculty of medicine, since only this expenditure must be attributed to the higher education sector.

Calculating the R&D expenditure of the higher education sector

To calculate R&D expenditure in the higher education sector, the total financing basis of the R&D expenditure of universities and university medical centres must first be calculated. This total is the sum of the following amounts:
- Total costs of universities (excluding depreciation and amortisation)
- Investments of universities
- Work placement funds from the government
- The faculty of medicine government grant for the “missing” university medical centres
- Contract research for the “missing” university medical centres

Multiplying this total financing basis by the research coefficient gives the total R&D expenditure of universities including university medical centres. This is not the same, however, as the total R&D expenditure of the higher education sector. This last item is calculated by adding the autonomously estimated R&D expenditure of the higher education sector to the total R&D expenditure of universities including university medical centres:
- R&D expenditure of the higher professional education subsector
- Development and innovation funds of university medical centres
- Labour costs of transferred Netherlands Organisation for Scientific Research staff (1999 until and including 2002)
A research coefficient is not used with respect to the autonomously added R&D expenditure. The R&D of the higher professional education subsector is known separately. The same applies to expenditure on development and innovation by university medical centres. The addition of the labour costs of the Netherlands Organisation for Scientific Research staff transferred in advance is only relevant for the period 1999–2002. As from 2003, all Netherlands Organisation for Scientific Research staff working at universities are also deemed to be in the salaried employment of these universities.

Figure 7.3.4 shows the development of the financing basis of the R&D expenditure of universities and university medical centres over time. The expenditure of universities remains the most important by far. The work placement funds from the government constitute approximately 10 percent of the financing basis. The “missing” financing basis for the R&D expenditure of the former faculties of medicine of three university medical centres, and therefore one in respect of which an upward adjustment was necessary, increased in the course of time from 1 percent in 1999 to approximately 5 percent in more recent years.

Figure 7.3.5 shows the total R&D expenditure of the higher education sector. The major part is determined through the calculation model outlined above, i.e. through the financing basis as outlined in Figure 7.3.4 and the accompanying research coefficients. The autonomously added R&D expenditure fluctuated around 5 percent in the period 1999–2009.

### 7.3.4 Financing basis of R&D expenditure in the higher education sector, 1999–2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Expenditure of universities</th>
<th>Work placement funds</th>
<th>Upward adjustment of the estimate for university medical centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>2,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>3,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>4,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>5,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>6,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>7,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>8,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>9,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>10,000 mln euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>11,000 mln euro</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Statistics Netherlands.
General developments in R&D expenditure in higher education in 1999–2009

A number of conclusions can be drawn based on the R&D expenditure in the higher education sector thus calculated.

1. The percentage of the financing basis spent on R&D is relatively stable and amounts to approximately 60 percent. On balance, this is the result of the research coefficients used. The increase in the R&D expenditure of the higher education sector in the period 1999–2009 was therefore not particularly caused by an increase in the time spent on research but, rather, was largely the result of an increase in the financing basis itself.

2. To an increasing extent, R&D staff are academic staff. Whereas the proportion of academic staff was 51 percent in 1999, it had risen to 58 percent by 2009. This is a reflection of a general tendency at universities of stronger increases in academic staff relative to supporting and administrative staff. A specific reason for this tendency is the transfer of employer status in relation to Netherlands Organisation for Scientific Research staff from the Netherlands Organisation for Scientific Research to the universities themselves as discussed in several instances above.

3. To an increasing extent, the higher education sector is successfully raising funds to finance research outside what is referred to as the government’s block grant funding (see

Source: Statistics Netherlands.
Figure 7.3.6). Although financing by third parties concerns contract research, it can also relate to donations, bequests and the like. Research financed by the Netherlands Organisation for Scientific Research is also included in the financing by third parties category. The share of R&D expenditure financed by third parties increased from 32 percent in 1999 to 37 percent in 2009. In this case, the government’s block grant funding is calculated as a remaining item (total R&D expenditure of the higher education sector – financing by third parties = government’s block grant funding). The higher education sector is therefore not deemed to finance research from its own resources.

7.3.6 Financing of R&D expenditure in the higher education sector, 1999–2009

4. The government is the most important external financier of R&D in the higher education sector. This aspect concerns contract research for the central government, lower tiers of government and public research institutes and research financed by the Netherlands Organisation for Scientific Research. The importance of the business sector as an external financier increased in the course of time from 16 percent to 22 percent. The share of R&D externally financed from abroad increased from 9 percent to 13 percent. Research financed by the EU accounts for a substantial part of this share.

More detailed results concerning R&D expenditure and R&D staff in the higher education sector have been published in StatLine, Statistics Netherlands’ online database.
addition, a number of results are presented in Chapter 5 of this publication. The aforesaid chapter discusses developments concerning R&D activities at companies, public research institutes and in the higher education sector.

7.3.7 Origin of third-party financing of research in the higher education sector, 1999–2009

Source: Statistics Netherlands.
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The key terms and definitions used in this publication are briefly explained below.

Automated data exchange (ADE)
Automated data exchange concerns the exchange of data between companies through the internet or another network in an agreed format (XML, EDIFACT or XBRL, for example). A manually typed e-mail message is therefore not a form of automated data exchange.

Basic qualification
A diploma awarded for the successful completion of studies at the level of at least senior general secondary education (havo), pre-university education (vwo) or the second level of senior secondary vocational education (basic vocational training).

Broadband
A high-quality communication connection with the internet such as cable, ADSL and optical fibre. Fixed, usually leased lines with high data transfer rates are also included in this category, as is UMTS (mobile broadband). The OECD defines broadband as connections with the internet that have a total data transfer rate of at least 256 Kbps. The term “high-speed internet” is sometimes used to refer to a connection that meets the minimum requirements to be classified as a broadband connection.

E-commerce
Receiving or placing orders by means of electronic networks, irrespective of the method of payment and delivery. This definition does not include orders by telephone, fax or e-mail.

Electronic shopping
The online ordering of goods and services by consumers. Electronic shopping is one of the forms of e-commerce.
European Patent Office (EPO)

The European Patent Office provides a uniform application procedure for individual inventors and companies seeking to protect knowledge by means of a patent in up to 38 European countries. For more information, visit www.epo.org.

External data communication

The capability on the part of a company of communicating with computers of third parties through one or more of its own computers.

Factor of production

The resources required in a production process. The traditional factors of production are natural resources, labour and capital. Knowledge occupies a prominent place as a factor of production in a knowledge economy.

Gross domestic product (market prices) (GDP)

Gross value added at basic prices per sector is equal to the difference between production (at basic prices) and intermediate consumption (at purchase prices). The sum of the gross value added at basic prices per sector, plus some transactions not allocated to sectors, is the gross value added of the total economy, the gross domestic product (at market prices). The other transactions include net product-related taxes and subsidies and imputed minus paid VAT. Gross here means that depreciations are not subtracted from the value added. Economic growth is the volume growth of the gross domestic product expressed as a percentage.

High-tech patent applications

Patent applications in the following areas of technology are classified as high-tech patent applications: computer and business automation requirements, micro-organisms and genetic modification, aeronautics, communications technology, semiconductors and lasers. For more information, visit http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/pat_esms_an8.pdf.

Human resources in science and technology (HRST)

The international OECD term used to refer to individuals who play an important part or could play an important part in R&D, innovation and a number of other aspects of the knowledge economy. This group is defined on the basis of two criteria: education completed at tertiary level and profession. All individuals who have completed education
at tertiary level are classified as HRST, also those who are unemployed and those who do not or no longer form part of the labour force. In addition, individuals are classified as HRST on the basis of their respective professions. This group includes, for example, specialists in physics, law, healthcare, economics, automation, journalism and many other areas. Technicians and assistants who work in a profession that requires a high level of skills are also classified as HRST.

**ICT/computer science education**

In this publication, higher education degree programmes are classified as belonging to the field of ICT/computer science on the basis of the International Standard Classification of Education (ISCED). The degree programmes concerned are those in “computing” (ISCED 48), a field that includes “informatics and information technology”, “business informatics”, “communications systems” and “technical informatics”. “Electronics and automation technology” (ISCED 523) is discussed separately in this publication.

**Information and communications technology (ICT)**

A field of study that focuses on information systems, telecommunications and computers. It includes the development and management of systems, networks, databases and websites, the maintenance of computers and software and the writing of administrative software.

**Innovators**

Companies that apply product and/or process innovations or that perform activities aimed at innovation. A product innovation is the market introduction of new or highly improved goods or services in terms of possibilities of application, for example new or improved software, user friendliness, components or subsystems. Goods are usually tangible objects like smartphones, furniture or packaged software, though music, movies and software that can be downloaded are also goods. Services are usually intangible and include insurances, education and training programmes, aviation, consulting and the like. Process innovation is the application of a new or highly improved production process, distribution method or support activity for goods or services. This definition does not include purely organisational innovation and marketing innovations. The innovation must be new for the company but does not necessarily have to be so for the sector or market. It does not matter whether the innovation was originally developed by the company in question or by other companies, including in this regard customers and suppliers. Innovation activities are taken to mean the purchase of machines, equipment, software and licences, as well as new construction and development, education and training, marketing and applied R&D if these are specifically aimed at the
development and/or implementation of a product or process innovation. Innovation activities also include fundamental R&D, even if such activity is not related to product or process innovation.

**International Standard Classification of Education (ISCED)**

UNESCO’s International Standard Classification of Education was used with respect to fields of study in senior secondary vocational education and higher education. This classification system enables international comparison of curricula. Since the ISCED was originally strongly oriented towards higher education, the names of the categories were modified when the classification system was applied to senior secondary vocational education.

**Internet users**

Most of the figures on internet users presented in this publication concern individuals who used the internet in the three months prior to the Statistics Netherlands survey and who range in age from 12 up to and including 74. In the case of international ICT data, the figures are based on results of the survey conducted among individuals aged 16 up to and including 74.

**Knowledge economy (also information society)**

A society in which knowledge occupies a crucial place as a factor of production in relation to labour, commodities and capital. In such a society, economic growth is driven to a significant extent by (technical) knowledge.

**Labour force (national definition)**

- All individuals who:
  - work for at least 12 hours a week, or
  - have accepted work as a result of which they will work for at least 12 hours a week, or
  - state that they wish to work for at least 12 hours a week, who are available to do so and who are actively looking for at least 12 hours of work a week.

*Explanation:*

This is the standard definition of labour force used in the Netherlands. For the Dutch situation, the data presented are usually based on the labour force and population aged 15 to 64.

Individuals who work for at least 12 hours a week are classified as the employed labour force, while individuals who work for less than 12 hours a week or who do not work at all are classified as the unemployed labour force.
Labour force (international definition)
All individuals above a certain age who, during a reference period, constitute the labour supply for productive activities that are within the production boundary as defined in ESA 1995, the European System of Accounts used by EU countries for national accounts and regional accounts. This definition includes everyone who meets the requirements for classification as an employed or an unemployed individual.

Labour force participation rate (net)
The proportion of the potential labour force that is in employment.

Lifelong learning and post-initial education
The lifelong learning indicator includes everyone aged 25 to 64 who is participating in a training programme or course according to the Labour Force Survey. The post-initial education indicator shows the level of participation of individuals aged 15 to 64 in training programmes after their initial period of education (the first, full-time school career). The participation rate shows the proportion of participants of the corresponding group in the population that is no longer attending initial education; in other words, exclusive of pupils and students who are still attending full-time education or completing a programme that combines working and learning and who have not interrupted their schooling for five or more years. These figures are also taken from the Labour Force Survey.

Mobile student
A student who has completed his or her prior education at a foreign institution. The student’s nationality plays no part in the determination of his or her "mobility”.

Pharming
Criminals attempt to mislead end users by violating a number of secondary services like web caches and name servers. Even when using the correct URL (Uniform Resource Locator), the user is redirected to the pharmer’s website.

Phishing
Phishing, which is based on the word “fishing”, refers to attempts to acquire – literally to fish for – sensitive user information like login names and passwords. An end user is directed to a specific website by an innocent-looking popup or e-mail alert.
**R&D expenditure**

Expenditure on R&D performed by a company’s or institution’s own staff in the Netherlands. This definition therefore does not include R&D outsourced to other companies or institutions or R&D performed abroad. R&D financing with the aid of subsidies provided under the Promotion of Research and Development Act is taken into account. This means that amounts spent by a company on subsidised R&D staff count as R&D expenditure even if a company recovers part of this expenditure through a reduction in payroll tax owed.

**R&D intensity**

R&D intensity is defined as R&D expenditure divided by GDP. This measure expresses the magnitude of R&D relative to the size of the total economy.

**Research and development (R&D)**

An activity aimed at originality and innovation and consisting of the creative and systematic search for solutions to practical problems. The activity also includes strategic and fundamental research in respect of which acquiring background knowledge and increasing (pure) scientific knowledge rather than securing direct economic gain or solving problems are the main priorities. In addition, the activity includes the development and finalisation of ideas or prototypes into usable processes and products that can readily be produced.

**Smartphone**

A type of mobile telephone that has more functionalities than “ordinary” mobile telephones. Most smartphones make it possible to use mobile internet (send and receive e-mail messages and view internet pages), listen to music and watch short films. Smartphones may have an in-built GPS receiver and be capable of synchronising with Microsoft Outlook or Lotus Notes and/or connect with business and other wireless networks.

**Tablet**

A tablet is a portable computer with a touchscreen. It can be seen as a large smartphone or as a small laptop without a keyboard.

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1) The Promotion of Research and Development Act (in Dutch: WBSO) provides for a tax facility designed to promote (private) R&D by reducing the payroll tax owed for R&D staff.
Valorisation

Valorisation is the process that converts knowledge into commercially feasible products, processes or services (money).
Contributors to this publication

Authors
M.M.P. Akkermans
M.I. Hartgers
H.N. de Heij
J.F.H. Hiethaar
A.D. Kuipers
B.H. Pegge (ICT–Office)
D. Pronk
G.P.E.A. Sleijpen
J.C.G. van Steen (Rathenau Institute/Ministry of Education, Culture and Science)
B. Stigter
V.M. van Straalen
R.A. te Velde (Dialogic)
L. Wielenga-van der Pijl
A.C. van Wijk

With the assistance of
T.B. Fielmich (Ministry of Economic Affairs, Agriculture and Innovation)
V.A. Fructuoso van der Veen
A.M. van der Giessen (Netherlands Organisation for Applied Scientific Research)
G.J.H. Linden
S.G.E. de Munck (Netherlands Organisation for Applied Scientific Research)
G.H. Wassink

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B. de Groot
L.E. Hoeksma