# ICT, knowledge and the economy

## 2012

## Explanation of symbols

| | |
|---|---|
| . | data not available |
| * | provisional figure |
| ** | revised provisional figure |
| x | publication prohibited (confidential figure) |
| – | nil |
| – | (if placed between two figures) up to and including |
| 0 (0.0) | less than half of unit used |
| blank | category not applicable |
| 2011–2012 | 2011 to 2012 inclusive |
| 2011/2012 | average over the period 2011 up to and including 2012 |
| 2011/'12 | crop year, financial year, school year, etc., beginning in 2011 and terminating in 2012 |
| 2009/'10–2011/'12 | crop year, financial year, etc., 2009/'10 up to and including 2011/'12 |

Detailed items in tables may not necessarily add to totals because of rounding.

## Colophon


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# Foreword

Innovation is essential for a knowledge economy like that of the Netherlands. The Netherlands' objective is to have more knowledge converted into new products and services. This is consistent with the European Commission's ambition of transforming Europe into not only a political and economic union, but an innovative union as well. ICT is indispensable in this regard because it accelerates the spread of knowledge. A solid ICT infrastructure that is used efficiently produces a head start on competing economies.
In its publication series *ICT, knowledge and the economy*, Statistics Netherlands (CBS) describes the Dutch knowledge economy, focusing on the pillars of ICT, innovation and research & development (R&D). This edition extensively covers the subjects of telecommunications, the use of ICT by companies and households, and innovation. In addition, it focuses on the role of the ICT sector in the Dutch economy, R&D and the use of patents as a means of protecting knowledge. Several capita selecta that explore these subjects in greater depth form the concluding part of this publication.
Almost half of Dutch companies are innovative in some respect: 48 percent. The ICT sector fulfils a pioneering role in this regard. ICT consequently is not only of major importance to innovation due to its facilitating role; ICT companies themselves are exceptionally innovative as well. The application of ICT in the Dutch business sector is at a high level compared to other European countries. Dutch companies use high-speed internet connections and are heavily engaged in electronic sales. In 2011, 20 percent of Dutch companies received orders via a website, whereas the EU average was 12 percent. In terms of making electronic purchases, Dutch companies somewhat lag behind the leading countries.
Thanks to the cooperation with the Netherlands Organisation for Applied Scientific Research (TNO) and financial support from the Ministry of Economic Affairs, Agriculture and Innovation, this publication also provides elaborate information about the telecommunications infrastructure in the Netherlands and makes numerous international comparisons. During preparation, use was also made of information available at other organisations. 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).

Director-General of Statistics Netherlands
G. van der Veen

# Summary

This publication comprises an introductory chapter, six statistically substantive chapters and several special contributions in a concluding chapter. This summary includes the most important findings contained in the publication. The sequence of the chapters is used as a guideline in presenting this information here.

**Introduction**

In a knowledge economy, investments in knowledge are made through research and education. Innovation makes it possible to develop new products or processes and thereby secure a competitive advantage over other market parties. Dutch government policy is sharply focused on realising a top level competitive knowledge economy in Europe. This objective is to be achieved by transforming knowledge on a larger scale into new products and services. The increase in R&D expenditure and in ICT investments over the past decade was lower than the economic growth in the Netherlands. However, R&D intensity has recovered starting in 2009. The national target is for R&D expenditure to be 2.5 percent of the gross domestic product by 2020. The European Commission is aiming for a target of 3 percent of GDP in the EU within the framework of the Europe 2020 Strategy. Key spearheads of the Dutch knowledge policy are the focus on the innovative capacity of the economic top sectors and the further development of the broadband network.
This publication uses a model that revolves around knowledge development, flows and products as its basis. This model 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.

**ICT and the economy**

Following a sharp contraction of 3.5 percent in 2009, the Dutch economy experienced a slight recovery in 2010. International trade in particular provided a positive impulse. The importance of ICT to economic development in the Netherlands has been significant in the last twenty to twenty-five years. During the period 1985–2009, on average almost 16 percent of GDP growth was based on the deployment of ICT capital.
The ICT manufacturing industry's value of production grew by 9.9 percent in 2010. This meant a recovery, since the value of production reached a low point in 2009, shrinking by 8.7 percent compared to the previous year. The gross value added of the ICT manufacturing

industry also shrank sharply in 2009 followed by a recovery in 2010. The ICT services sector also experienced a contraction in production and value added in 2009. The production value continued to decline slightly in 2010. The gross value added showed some degree of recovery that year.
In 2010, 4 percent of Dutch companies were active in the ICT sector. This represents an increase of over one half percentage point compared to 2006. In 2010, the Dutch telecom sector added approximately 1.6 percent to the gross domestic product. This contribution has been dropping slowly since 2005. Employment in the telecom sector declined each year during the period 2005–2010.
The economic downturn resulted in decreased investments in the Netherlands in 2009 and 2010. ICT investments also declined in 2009. Investments in computer hardware were an exception to this. More than half of ICT investments in the Netherlands are investments in software. The intermediate consumption and the consumption of ICT goods and services remained roughly the same in 2010 in comparison to 2009.
The volume of ICT imports and exports declined across its full breadth in 2009. The export value of Dutch ICT goods decreased by over 16 percent between 2007 and 2009. The export of ICT services as a percentage of total Dutch exports (including re-export) rose slightly in the period 2005–2009. However, it once again declined somewhat in 2010.
Internationally, the ICT services market is much smaller than the market for ICT goods. However, the market for ICT services is growing fast. The export of ICT services from the Netherlands rose by 20 percent per year between 2002 and 2009. Germany is an important trading partner for the Netherlands, in terms of imports as well as exports.
The number of ICT job openings rose to 8,600 in the second quarter of 2011. The number of job openings then once again fell to 6,600 in the fourth quarter of 2011. The number of self-employed ICT workers has grown sharply in recent years. In 1998, five percent of employed ICT workers were self-employed, whereas this proportion had risen to fourteen percent by 2011. Compared to other European countries, the Netherlands has a relatively high number of ICT workers.

### Telecommunications

A solid infrastructure is indispensable for the efficient application of ICT. Users are making increasingly higher demands. The volume of internet traffic has been increasing sharply for years and also further increased in 2011. The explosive growth evidenced in recent years however did not persist in 2011. Smartphones and tablets are driving tremendous growth in mobile data traffic.
The Netherlands had the highest number of broadband connections per 100 inhabitants of OECD countries in 2011. This has been the case for several years now. In technical terms, almost all households in the Netherlands have the option of acquiring a broadband connection. The Netherlands also has the highest penetration of 50+ Mbps broadband

connections in Europe. In 2011, almost everyone in the Netherlands lived in a region with sufficient signal for high-speed mobile internet. In mid-2011, there were 44 mobile broadband subscribers per 100 inhabitants in the Netherlands.
VoIP (telephony over a broadband internet connection) once again experienced strong growth in 2011 and accounted for 4.1 million connections by the third quarter of 2011. The total number of VoIP connections has since exceeded the total number of ISDN and regular analogue (PSTN) telephone connections combined. At the end of 2011, there were 19.9 million mobile telephone connections in the Netherlands; an increase of 3 percent relative to the end of 2010. In international terms, the Netherlands has a relatively high number of mobile telephone connections.
In the third quarter of 2011 there were a total of 5.9 million digital television connections. This is 6 percent higher than the year before. Almost 68 percent of all active TV connections at the end of 2010 consisted of a connection for digital television. In the third quarter of 2011, there were 853,000 subscribers of terrestrially broadcast digital television in the Netherlands. The corresponding figure for the preceding year was 898,000. In the third quarter of 2011, 817,000 households in the Netherlands were watching digital television through satellite. The use of this form of watching digital TV has therefore decreased as well. The number of households with digital television through cable rose in the third quarter of 2011 to 3.3 million. At the end of 2010, the corresponding figure was 3.0 million. This form of digital television therefore again achieved the largest absolute increase in the number of subscribers in the first three quarters of 2011. This has been the case since 2005. RTV cable has accounted for the largest share of digital TV connections since 2006. In the third quarter of 2011, cable television had a market share of over 56 percent. Digital TV over an internet connection (IPTV) once again experienced growth in 2011. In the third quarter of 2011, there were 894,000 subscribers.
Terrestrial Digital Audio Broadcasting (T-DAB) in the Netherlands is used far less than digital TV. While T-DAB transmitting stations reached approximately 70 percent of the Dutch population in 2011, only just over 3 percent in fact had a device capable of receiving digital radio over T-DAB.
Prices for telephone and internet services displayed a declining trend over the period 2004–2009. The rising quality of the products (the internet connection available in 2012 is many times faster than the connection in 2000) plays a role in this regard. However, prices once again rose starting in 2010. The price of telephone equipment has sharply decreased in recent years.

## ICT use by households and individuals

It is no longer possible to imagine a Dutch household without a PC. In 2011, 94 percent of households had a desktop or laptop and 83 percent of households had a broadband internet connection. The Netherlands ranked among the top in Europe in 2011 in terms of the share of households with a broadband internet connection. Dutch citizens increasingly more often use a laptop or mobile telephone to access the internet. In 2011, almost three quarters of households used a laptop to access the internet. The corresponding figure for 2005 was a mere 27 percent. In 2011, half of households with internet access used a mobile telephone for this purpose. In spite of the increasing use of laptops, mobile telephones and other devices, the desktop remained the most common means of accessing the internet in 2011 (76 percent). In 2011, half of internet users had access to the web through mobile devices. Devices for mobile internet were most commonly used by young internet users (aged 12 to 25). Eighty-six percent of internet users used the internet every day or almost every day in 2011.

Communicating has been the most important internet activity of individuals for many years. This was also the case in 2011. Virtually every user communicated in one form or another over the internet. Almost nine in ten internet users used the internet in 2011 to search for information on goods and services. The internet was also frequently used to listen to radio or watch television (60 percent). Almost two thirds of internet users were active in a social network (64 percent). In 2011, 95 percent of young internet users were active in social networks.

The number of individuals shopping online increased to 9.5 million in 2011. The Netherlands, together with Sweden, Denmark and the United Kingdom had the highest number of e-shoppers in relative terms. As was the case in previous years, the purchasing of 'trips, holidays and accommodation' was the most common type of online purchase made in 2011. Other products frequently purchased online were clothing items, tickets for events and literature. New goods are sold far more often over the internet than second-hand goods. Four in ten frequent e-shoppers in total spent 100 to 500 euro on new goods purchased over the internet in the three months prior to the survey. During that period over a quarter spent a total of 50 to 100 euro on new goods. The larger proportion of frequent e-shoppers made online purchases from individuals or companies in the Netherlands in 2011.

Almost a third of Dutch computer users had many computer skills in 2011. Over four in ten had average computer skills. Approximately one fifth had few computer skills and 9 percent had no computer skills. Men are more skilled in their use of computers than women. Almost a quarter of internet users had many internet skills in 2011. Thirty percent had average internet skills. The remaining internet users had few internet skills (46 percent). Men also score higher than women in terms of internet skills, although the differences are smaller than in the case of computer skills. In 2011, the internet skills of the Dutch population increased considerably relative to 2006. Internet skills especially increased between 2006 and 2009.

## ICT use by companies

Over two thirds of employed persons used a computer at work in 2010. This percentage has been at a stable level for years. The use of the internet at work presents a similar picture. The Netherlands is substantially above the EU average as regards the share of employed persons who use the internet at work. In 2010, 91 percent of companies had a fixed broadband connection and 41 percent had a mobile broadband connection. The use of mobile broadband has experienced rapid growth. Large companies are in the lead in terms of the use of mobile broadband. In comparison to other European countries, Dutch companies use fast internet connections. Furthermore, many Dutch companies have a website. More and more companies are offering their employees the option of teleworking. This share once again increased in 2010, reaching 62 percent.

Half of all companies used software for recording sales orders in 2010. Over 45 percent of all companies used purchase order processing software. Small companies are less apt to use software for the purpose of recording sales orders than are large companies. The same applies to purchase order processing software. In 2010, 54 percent of companies used some form of open source software. Open source internet browsers are the form of open source software most often used (43 percent of companies). Open source versions of office and business applications were also used relatively frequently (26 percent).

Seventy percent of all companies used some form of Automated Data Exchange (ADE) in 2010. Large companies used this service more frequently than small companies, although the difference is not that large (85 versus 65 percent). In 2010, 28 percent of companies used e-mail to send out invoices electronically. A smaller share of companies used a fully automated system (11 percent). It is more common for companies to receive invoices electronically than it is for them to send them out electronically.

Ninety-two percent of all companies had contact with government over the internet in 2010. The electronic submission of forms in particular was an often used application. In 2010, few companies had reason to limit their electronic contact with government: 4 percent. Limiting contact with government over the internet occurred least among financial institutions. Large companies relatively often found reasons for limiting this type of contact. In comparison to other European countries, the Netherlands scores very low in terms of the share of companies that limits electronic contact with government.

In 2010, 19 percent of companies sold goods or services via a website and 7 percent via EDI. There are significant differences between sectors and between large and small companies. The share of Dutch companies that received orders via a website is well above the average of the EU-27. This is also true of selling via EDI. Companies most often received electronic orders from buyers located in their own country. The share of e-commerce as a percentage of total company sales increased from 5 percent over the period 1999–2000 to 13 percent over the period 2009–2010. In 2010, one third of Dutch companies made purchases via e-commerce. In comparison to the top performing European countries in this domain, this share is not high, although it is higher than the EU average.

By strategically deploying ICT, companies can achieve energy savings in various areas. In 2010, almost one fifth of companies used ICT to reduce the energy consumed by business processes, such as the optimisation of work procedures and logistics processes. The Netherlands in this respect significantly lags behind the EU average.
ICT is often considered a driver of innovation. Many companies consider the use of ICT for innovations to be of major importance. This applies to product and process innovations, as well as to organisational and marketing innovations. ICT was (very) important to 80 percent of the large product innovators and to 92 percent of the large process innovators. An ample majority of innovators among the smaller companies also considered ICT important. Two thirds of the innovators who considered ICT as (very) important said that in 2010 ICT was important in terms of searching for information sources. Over half considered ICT important in terms of commissioning the innovation (54 percent). In addition, many innovators assigned a great deal of importance to ICT for exchanging knowledge with their partners (53 percent).

**Innovation**

Almost half of Dutch companies were innovative in some respect during the period 2008–2010 (48 percent). The share of companies involved in technologically innovative activities amounted to 38 percent. Sixty-three percent of companies with at least 250 employed persons were technologically innovative. As regards small companies with 10 to 50 employed persons, this share was 34 percent. Fifty-three percent of companies in the manufacturing industry were technologically innovative versus 36 percent in the services sector. The pharmaceutical industry and the oil industry are the most technologically innovative industries. Within the services sector, the telecommunication and IT industry are especially innovative. More than two in three companies in the ICT sector (ICT manufacturing industry and ICT services combined) were engaged in technologically innovative activities in the period 2008–2010.
Seventy-two percent of innovative companies realised a product innovation in the period 2008–2010. Approximately the same number of companies realised a process innovation. The share in the company sales achieved with innovative products on average was 26 percent in 2010 among the group of product innovators. The differences between various sectors are minimal in this regard. Smaller companies on average obtained a larger share of their sales from new or vastly improved products than larger companies. The share in the sales of all companies in the Netherlands realised with innovative products was 9 percent. About half of this was products that were new to the market and therefore not only new to the company.
An average innovator spends almost one third of its innovation expenditure on in-house R&D (31 percent). The other major cost item is the purchase of machines, equipment and software (36 percent). Companies in the manufacturing industry allocate a larger share of

their innovation expenditures on in-house R&D than companies in other sectors, that spend more on machines, equipment and software.
Over 30 percent of innovators worked in partnership with other parties in the period 2008–2010. Among the larger companies, this figure rose as high as 50 percent. Companies most often partnered with their suppliers on innovation.
Thirty-eight percent of companies in the manufacturing industry implemented a non-technological innovation in the period 2008–2010. The corresponding figure for the services sector was 33 percent. Organisational innovations occurred somewhat more frequently than marketing innovations. The ICT sector is not only strong in technological innovation, but in organisational and marketing innovation as well. More than half of companies in the ICT sector implemented a non-technological innovation in the period 2008–2010.
Of all companies, 13 percent experienced issues with innovation in the period 2008–2010. Twenty-one percent of innovators experienced delays in their innovative activities due to issues. Fourteen percent of innovators reduced the scope of their innovative activities due to these issues. Companies that experience issues with innovation most often cited costs as the issue.
Companies can promote innovation by stimulating the creativity of their employees. In the period 2008–2010, almost one in three companies held brainstorming sessions on innovation. A fifth of all companies experienced such brainstorming sessions as successful. Companies with technological innovations more often applied innovation stimulating methods than companies without such innovations in the period 2008–2010. Such methods more often led to success among innovators than among non-innovators. Nevertheless, the methods used for stimulating creativity were often successful for non-innovators as well.

### R&D and patents

R&D expenditure in the Netherlands amounted to almost 11 billion euro in 2010. Following a minor decline from 2008 to 2009, R&D expenditure once again rose in 2010, by 5 percent. The business sector performed almost half of all R&D in 2010 (48 percent). In 2010, company expenditures on R&D rose by 6 percent in relation to the year before. Most R&D is carried out in large companies and in the manufacturing industry. The number of companies with their own R&D activities was significantly higher in 2010 compared to previous years. The services sector showed the highest increase, but the number of companies engaged in R&D also increased significantly in the manufacturing sector. In comparison with many other EU countries, the Dutch business sector spends a relatively small amount on R&D, whereas the higher education sector spends a relatively large amount. More than 100,000 working years were spent on R&D in the Netherlands in 2010. Following a sharp decline in 2008 and 2009, the working years devoted by companies to

R&D sharply increased in 2010. The R&D intensity of the Netherlands fell from 1.97 percent in 1995 to 1.85 percent in 2010. In comparison to 2009 however, R&D intensity in the Netherlands rose slightly in 2010. R&D intensity in the Netherlands has been lower than average in the EU for a number of years.
In 2008, Dutch parties filed 294 patent applications with the EPO for each billion euro of R&D expenditure. The Netherlands scores high in comparison with other countries. Nevertheless, the number of patent applications per billion euro declined in the Netherlands in comparison to previous years. Measured as a function of the size of the population, the Netherlands ranks lower in terms of the number of patent applications. A small group of large companies account for a large proportion of Dutch patent applications. Twenty-nine percent of all patent applications filed with the EPO by Dutch parties in 2008 concerned ICT. In the ICT categories 'other ICT' and 'telecommunications', the Netherlands in 2008 was among the top three benchmark countries. The number of high-tech patent applications filed with the EPO by Dutch parties has been declining since 2004. This trend is evident in almost all benchmark countries. Eighteen percent of innovators used at least one of the forms of intellectual property protection during the period 2008–2010. The ICT sector scores high in this area.

**Capita selecta**

The last chapter in this publication contains three contributions that deal in greater depth and in broader terms with the subjects addressed elsewhere.

- *Continuing vocational training*. This article describes the findings of the five-yearly Statistics Netherlands survey that measures the way in which, and the degree to which companies invest in training and courses for their own personnel.
- *The internet as a data source for developing statistics*. This article describes the key results of the Statistics Netherlands research programme that explores opportunities for using the internet as a source of data for developing statistics.
- *Explaining productivity growth, the Solow residual disentangled*. This article provides an analysis of the Solow residual: the part of labour productivity growth that remains after the contribution of the growth in the amount of physical capital per unit of labour has been deducted from it.

## Key indicators, national

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| **ICT and the economy**[1] | *% volume change on previous year* | | | | | | |
| ICT investments | 9.3 | 11.7 | 6.4 | 4.2 | –1.6 | . | . |
| ICT sector production value | 4.3 | 4.5 | 4.0 | 2.3 | –4.8 | 1.8 | . |
| ICT sector labour volume of employed persons | 2.4 | 3.8 | 3.6 | 4.1 | –2.4 | –1.1 | . |
| ICT sector gross value added | 6.4 | 6.0 | 7.1 | 3.4 | –4.1 | 2.2 | . |
| *of which:* | | | | | | | |
| ICT manufacturing sector | 9.8 | –1.1 | 6.0 | 0.6 | –10.7 | 22.7 | . |
| ICT services sector | 6.1 | 6.7 | 7.2 | 3.6 | –3.5 | 0.5 | . |
| **Companies in the ICT sector** | *number* | | | | | | |
| Total | 25,220 | 24,880 | 27,670 | 30,210 | 33,385 | 34,725 | |
| **ICT and labour** | *number x 1,000* | | | | | | |
| Employed labour force with an ICT position | 262 | 251 | 256 | 272 | 268 | 283 | |
| Job openings in the ICT sector | 8.2 | 11.4 | 11.5 | 12.2 | 5.3 | 7.0 | |
| **Telecommunications infrastructure** | *number x million* | | | | | | |
| Fixed telephone connections: PSTN | 5.5 | 4.5 | 3.4 | 2.9 | 2.5 | 2.3 | . |
| Fixed telephone connections: ISDN[2] | 1.4 | 1.3 | 1.2 | 1.0 | 0.9 | 0.7 | . |
| Fixed telephone connections: VoIP | 0.5 | 1.6 | 2.4 | 2.9 | 3.4 | 3.8 | . |
| Mobile telephone connections | 16.3 | 17.1 | 18.5 | 19.7 | 19.7 | 19.2 | 19.9 |
| Broadband connections: Cable | 1.6 | 1.9 | 2.1 | 2.2 | 2.4 | 2.6 | . |
| Broadband connections: ADSL | 2.5 | 3.0 | 3.4 | 3.6 | 3.6 | 3.6 | . |
| Broadband connections: Optical fibre | . | . | . | . | 0.1 | 0.2 | . |
| Digital television connections: Satellite | 0.7 | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | . |
| Digital television connections: Cable | 0.4 | 1.0 | 1.6 | 2.0 | 2.5 | 3.0 | . |
| Digital television connections: Over the air | 0.2 | 0.3 | 0.5 | 0.7 | 0.9 | 0.9 | . |
| Digital television connections: IPTV | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.7 | . |
| **ICT use by households and individuals** | *%* | | | | | | |
| PC ownership - households[3] | 83 | 84 | 86 | 88 | 91 | 92 | 94 |
| Internet access - households[3] | 78 | 80 | 83 | 86 | 90 | 91 | 94 |
| Broadband access - households[3] | 54 | 66 | 74 | 74 | 77 | 84 | 83 |
| Electronic shopping - individuals[4] | 55 | 61 | 66 | 67 | 75 | 77 | 79 |
| **ICT use by companies**[5][6] | *% of companies* | | | | | | |
| Companies with internet access | 97 | 99 | 99 | 96 | 98 | 100 | . |
| Companies with broadband internet | 81 | 87 | 85 | 86 | 90 | 93 | . |
| Companies with a website | 79 | 80 | 86 | 84 | 82 | 83 | . |
| Placing electronic orders for goods and services | 45 | 42 | 44 | 41 | 43 | 33 | . |
| Receipt of electronic orders | 27 | 28 | 31 | 25 | 23 | 21 | . |
| **Research & Development (R&D)** | *million euro* | | | | | | |
| R&D expenditure[7] | 9,772 | 10,175 | 10,343 | 10,502 | 10,408 | 10,892 | . |
| | *% of GDP* | | | | | | |
| R&D intensity[8] | 1.90 | 1.88 | 1.81 | 1.77 | 1.82 | 1.85 | . |

Source: Statistics Netherlands; TNO for telecommunications infrastructure.

1) Figures for 2009 and 2010 are provisional.
2) The number of ISDN connections is displayed. An ISDN connection can comprise 2 or more lines.
3) Private households with at least one person aged 12 up to and including 74 years.
4) Of individuals with internet use.
5) Companies with 10 or more employed persons.
6) Due to a change in methodology, the figures from 2008 onwards are not easily comparable to the figures for earlier years.
7) R&D performed by in-house personnel.
8) R&D expenditure divided by the gross domestic product (GDP).

## Key indicators, international

| | EU-15 | EU-27 | Belgium | Denmark | Germany | Finland | France | Ireland | Netherlands | United Kingdom | Sweden | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ICT and the economy** | % | | | | | | | | | | | |
| Contribution of ICT capital to GDP growth, 1985–2009[1] | . | . | 0.5 | 0.6 | 0.3 | 0.2 | 0.3 | 0.2 | 0.4 | 0.6 | 0.6 | 0.6 |
| Share of employed ICT workers, 2009[2] | . | . | 23 | 27 | 23 | 26 | 21 | . | 24 | 28 | 27 | 20 |
| **Telecommunications infrastructure** | *per 100 inhabitants* | | | | | | | | | | | |
| Fixed telephone connections, 2009[3] | . | . | . | 38 | 59 | 27 | 57 | . | 44 | 52 | . | 45 |
| Mobile telephone connections, 2009 | . | . | . | 126 | 128 | 129 | 96 | . | 128 | 130 | . | 92 |
| Broadband connections, June 2011[4] | . | . | 32 | 38 | 33 | 29 | 34 | 22 | 38 | 33 | 32 | 27 |
| Optical fibre connections, 2011 | . | . | . | 3 | 1 | 1 | 1 | . | 1 | 1 | . | 3 |
| **ICT use by households and individuals, 2011** | % | | | | | | | | | | | |
| Households with internet access | . | 73 | 77 | 90 | 83 | 84 | 76 | 78 | 94 | 83 | 91 | . |
| Households with broadband access | . | 67 | 74 | 84 | 78 | 81 | 70 | 65 | 83 | 80 | 86 | . |
| Individuals with many internet skills[5] | . | 11 | 10 | 15 | 5 | 19 | 13 | 7 | 19 | 11 | 20 | . |
| Individuals making online purchases[6] | . | 43 | 43 | 70 | 64 | 62 | 53 | 43 | 69 | 71 | 71 | . |
| **ICT use by companies, 2011[7]** | % | | | | | | | | | | | |
| Companies with broadband internet | 92 | 89 | 87 | 95 | 91 | 99 | 94 | 91 | 92 | 93 | 95 | . |
| Companies engaged in electronic selling[8] | 14 | 13 | 22 | 23 | 20 | 17 | 11 | 23 | 19 | 15 | 24 | . |
| Companies making electronic purchases[9][10] | 30 | 19 | 51 | 48 | 40 | 33 | 20 | 49 | 28 | 45 | 38 | . |
| Share of sales generated via electronic receipt of orders[11] | 14 | 14 | 13 | 17 | 17 | 20 | 14 | 17 | 11 | 17 | 19 | . |
| **Research & Development (R&D)** | *% of GDP* | | | | | | | | | | | |
| R&D intensity, 2010* | 2.06 | 1.91 | 1.99 | 3.06 | 2.82 | 3.87 | 2.26 | 1.79 | 1.85 | 1.77 | 3.43 | 2.90[12] |
| **Patents** | *per million inhabitants* | | | | | | | | | | | |
| Applications for ICT patents filed with the EPO, 2008* | . | 24 | 30 | 38 | 54 | 81 | 33 | 21 | 55 | 21 | 91 | 26 |

Sources: Eurostat for ICT patent applications filed with the EPO; TNO for telecommunications infrastructure; OECD for R&D intensity and ICT and the economy.

1) Average annual contribution in percentage points.
2) As a proportion of the employed labour force.
3) Including ISDN and VoIP connections.
4) Excluding mobile connections.
5) Individuals aged 16 up to and including 74 years who performed five or six internet activities in the three months prior to the survey.
6) Individuals aged 16 up to and including 74 years who made online purchases in the three months prior to the survey.
7) Companies with 10 or more employed persons.
8) Electronic sales of 1 percent or more of the company's total sales value.
9) Electronic purchases of 1 percent or more of the company's total purchase value.
10) EU-15, Belgium, Denmark, Germany and the United Kingdom: 2010 instead of 2011.
11) Denmark: 2010 instead of 2011.
12) United States: 2009 instead of 2010.

# Contents

# Introduction

# 1

# Introduction

## 1.1 ICT, R&D and innovation policy framework

- Towards open innovation
- European policy: Europe 2020 Strategy
- National policy
- Recovery of R&D intensity

## 1.2 Purpose of the publication

## 1.3 Structure of the publication

- ICT foundation, rotating section on R&D and innovation
- Interrelatedness of ICT, R&D and innovation
- Knowledge and innovation model

**The goal of ensuring that the Netherlands is among the top five most competitive knowledge economies by 2020 is widely supported in Dutch political circles. A key component of a knowledge-intensive economy is a highly developed ICT infrastructure that enables companies and households to make intensive use of ICT. In addition, the realisation of this goal requires an innovative business sector. This second edition of the *ICT, knowledge and the economy* publication series provides an overview of the development and application of knowledge and technology in the Netherlands.**

# 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, 2010). In a knowledge economy, investments in knowledge are made through research and education. In addition, national and international companies, knowledge institutes, government organisations 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 collaborative 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, e.g. low-cost air carriers in commercial aviation. In a process referred to as ‘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, more than 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. Various large companies have reorganised or, partially or fully, divested their R&D departments, which means that R&D is sometimes being taken over by suppliers or knowledge institutes. Innovation is increasingly taking place in networks of private and public parties. This ‘open innovation’ is increasingly being used 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. When companies try to survive the economic crisis by adjusting priorities, cutting costs and, in that context, reorganising R&D, this will have an impact on the sectoral, regional or national system for knowledge development (AWT, 2009).
The *ICT, knowledge and the economy 2012* publication provides an overview of the development and application of knowledge in the Netherlands. Descriptions are based on subjects like the renewal 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 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, R&D intensity in the Netherlands was lower than average in the EU (OECD, 2012). This section briefly summarises the Netherlands’ key knowledge-related targets on European and national levels.

The European Commission (EC) launched the 'Europe 2020 Strategy' in March 2010 (European Commission, 2010a). 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. In 2010, this R&D intensity was only 1.9 percent (OECD, 2012). 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. The European ICT policy is addressed in 'A Digital Agenda for Europe' (European Commission, 2010b). The European Union's objective of this policy is to maximise the economic and social potential of ICT, particularly the internet: 'The overall aim of the Digital Agenda is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications.' The European Union's policy is focused on creating conditions that transform ICT into an enabler for economic growth. One of the objectives is to promote the internal digital market in the EU so that consumers have more options and products benefit from a greater sales area. The European policy also focuses on the security and reliability of digital networks and services. If there are any doubts concerning security or protection of privacy on the internet, people will resist making further use of the internet. Access to fast or very fast internet is viewed as a necessary condition for facilitating new services as a means of realising economic growth. The objective consequently is for every European to have access to fast internet at a reasonable price. The policy's progress and the impact of measures are gauged each year using the 'Digital Agenda Scoreboard' and the 'Annual Progress Report'.

**National policy**

The national-level commitments concerning the main objectives of the Europe 2020 Strategy are contained in the National Reform Programme. The Netherlands' objective is to have more knowledge 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 works 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).
Dutch ICT policy is derived from the European policy as described in ‘A Digital Agenda for Europe’. The ‘Digitale Agenda.nl‘ (Ministry of Economic Affairs, Agriculture and Innovation, 2011c) describes the Dutch ICT policy for 2011–2015. The policy’s emphasis is on how ICT can be used to achieve or maintain economic growth by giving entrepreneurs more room for entrepreneurship and innovation. Smart ICT-driven entrepreneurship is a contributing factor in this respect, as is an open, accessible and fast infrastructure that can be used with confidence, and the sufficient availability and leverage of ICT knowledge. The supply of a fixed and mobile telecommunications network with sufficient capacity and an adequate ICT knowledge infrastructure are important to a good business environment. The government auctions additional mobile frequencies since October 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 telephony will then also be re-auctioned.

# The Netherlands: transforming more knowledge into new products

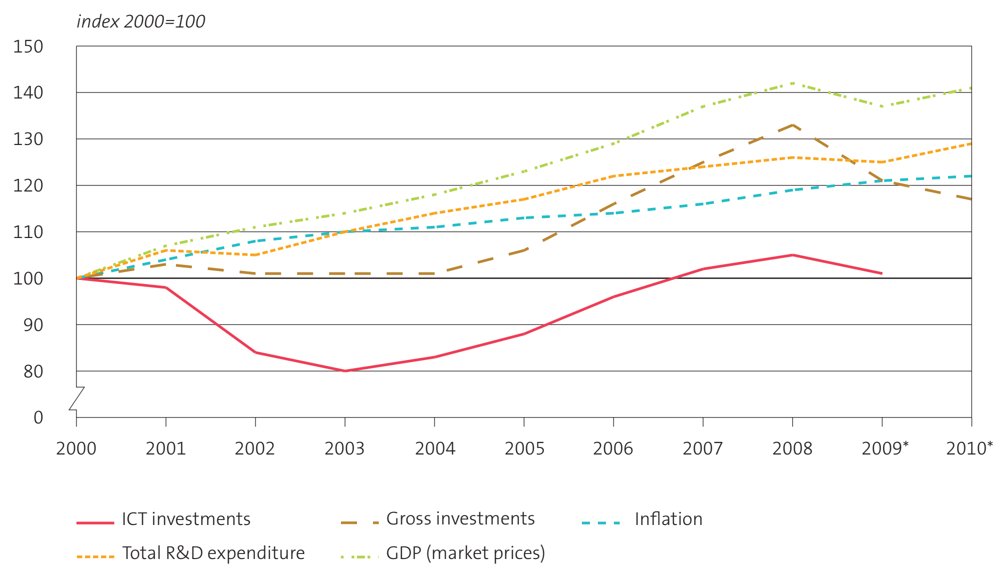
Sufficient confidence in the security of ICT is a prerequisite for making extensive use of ICT. This is why the government is focused on measures designed to increase confidence in ICT, as well as its security. In addition, policymakers want to give entrepreneurs the room they need to use ICT as a basis for creating smart business operations. This is evident in the desire to reduce the government’s degree of regulation, for example, by making it easier for companies to electronically exchange information with the government. The government also wants to increasingly make government data available to entrepreneurs as a means of enabling them to use this data for supplying new products and services. The government also believes that there is room for increased scale by working within a common European market. ICT can facilitate such increase in scale to a significant degree. The ‘Digitale Implementatie Agenda.nl’ proposes specific measures designed to achieve the objectives in each of these areas.
The central government drew up the ‘Kennisinvesteringsagenda (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 well 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. The reason cited was that not enough is being invested in education, research and innovation for this 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

**1.1.1 R&D expenditure and ICT investments in economic perspective, 2000–2010**




Source: Statistics Netherlands, National Accounts and R&D surveys.

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).

**Recovery of R&D intensity**

The steady economic growth experienced during an extended period ended in 2009. The economic decline manifested itself in various facets of the Dutch economy. In 2009, GDP fell by around 4 percent relative to 2008, and a sharp drop occurred in investments, while inflation gradually increased. The GDP and R&D expenditure recovered in 2010. However, gross investments continued to decline. 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.
Over the years 2005–2008, the increase in total R&D expenditure lagged behind GDP growth. The business sector's R&D expenditure increased by an average of 2.6 percent a year in the period 2000–2010, whereas GDP grew by an average of 3.5 percent a year. This partly explains the decrease in R&D intensity. However, in 2009, R&D expenditure did not drop as fast as the GDP and in fact rose faster than the GDP in 2010. The R&D intensity consequently recovered starting in 2009.

# R&D intensity has been recovering since 2009

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 2000 level for the first time. This growth was driven by substantially increased investments in software (Statistics Netherlands, 2011). ICT investments once again declined in 2009.
The fact that R&D expenditure and ICT investments lagged behind GDP growth for a long period of time 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 2005 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 this figure, 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 production factor, 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 economic and social role of knowledge and technology. Developments in the Netherlands are frequently compared with those in other countries. This publication is the second edition of an annual series and 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 about the ICT, R&D and innovation themes, and the description of the interfaces between them. 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 European figures as much as possible remain in keeping with the 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 documents that supplement this publication. One of these documents is a statistical annex that, arranged according to chapter, contains a few tables that provide additional information.

# 1.3 Structure of the publication

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 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 'Telecommunications' 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. Telecommunications concerns a cooperative arrangement with TNO. The ICT infrastructure described in the chapter on telecommunications is a necessary condition for ICT use. These ICT-related subjects are featured in this publication series each year.

The section of the publication that deals with R&D and innovation changes each year in connection with the availability of statistics. In terms of content, this 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 the first edition in 2011, 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 mentioned, this series also focuses on knowledge potential in the Netherlands. This subject, as well as the related R&D theme is extensively discussed in odd years. In even years, as is the case for this edition, the knowledge potential subject does not form part of the publication. The rotation described above will result in a publication series in which the emphasis will be on knowledge and knowledge development in odd years and on technology and its application in even years.

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

This publication deals with the subjects ICT, R&D and innovation and explains their interrelationship. This is manifested in a specific focus on ICT and the ICT sector in sections dealing with patents, R&D and innovation on the one hand and, on the other, on the ICT use of R&D-intensive sectors and innovators within the ICT theme. The contents of the chapters are briefly described in the following.

Chapter 2 deals with the contribution of ICT to the Dutch economy. The subjects addressed in this chapter include general trends in the Dutch economy, the ICT sector, ICT expenditures, international trade in ICT and ICT-related employment opportunities. The chapter also describes the relationship between ICT, R&D/innovation and productivity.

Chapter 3 discusses supply, use and trends with respect to telecommunications. Sections 3.1 up to and including 3.3 focus on the most important services of the telecommunications sector, namely internet, telephony, radio and television. The trend in consumer prices for telecommunications is dealt with at the end of this chapter.

Chapters 4 and 5 describe the use of ICT. 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. This chapter concludes with a section about the ICT skills of Dutch people.

Chapter 5 focuses on ICT use by companies. Figures organised according to company size and sector are frequently used in this regard. Following an overview of ICT infrastructure at companies given in section 5.1, internal data communication is discussed in section 5.2. 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 e-commerce theme and a section on the environmental impacts of ICT use. While ICT requires energy, companies can make their processes considerably more environmentally friendly by strategically deploying ICT. This chapter concludes with a section on the importance of ICT for innovations. This section once again underlines the fact that ICT and innovation go hand in hand and thus provides a natural lead-in to the chapter on innovation.

Chapter 6 on innovation describes the findings of the most recent Statistics Netherlands survey on innovation among Dutch companies, with 2008–2010 as the reference period. The chapter focuses on innovative companies, broken down into technological and non-technological innovation. Issues and obstacles to innovation are also addressed, as are the creativity and skills of companies and their personnel. Companies can promote innovation by introducing measures that stimulate the creativity of their personnel.

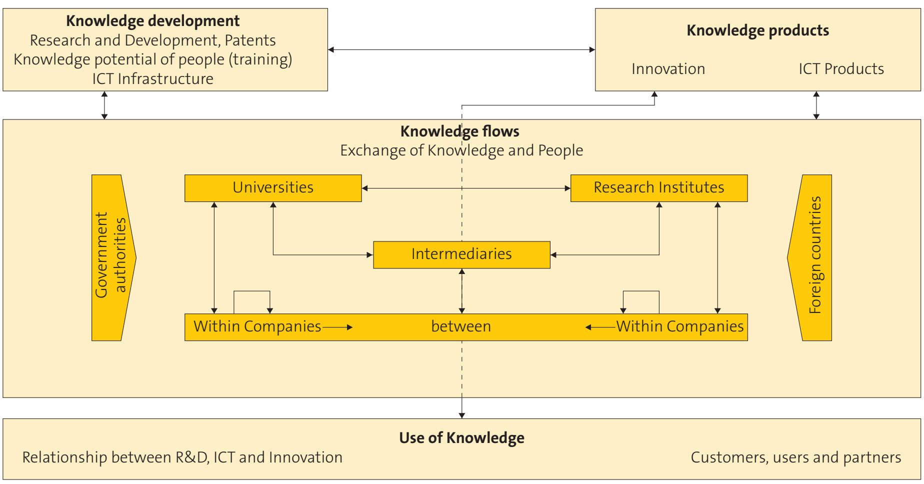
Chapter 7 on R&D and patents stresses the importance of knowledge to innovation, ICT and technology. Section 7.1 describes the development of knowledge by Dutch companies and research institutes. Section 7.2 on patents discusses the protection of this newly developed knowledge.

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 organisations, 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

### 1.3.1 National Innovation System[1)]




Source: TNO, Statistics Netherlands.

1) The NIS has been adapted. The upper 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); two types of throughput are displayed in the lower block. Knowledge products are related to outputs.

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.
Diagram 1.3.1 shows the building blocks used to describe the knowledge economy, including aspects that are dealt with in greater detail in the rest of this publication. 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 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 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, 2010).

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 in companies (OECD, 2005). Chapter 6 of this publication deals extensively with innovation.

# Innovation: not only technological

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 by 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 organisations 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 organisations. 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 also that the partners jointly produce knowledge (Statistics Netherlands, 2010).

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 plays 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.

# ICT
# and the economy

# 2

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# ICT and the economy

## 2.1

**The Dutch economy**
- Expenditure shows some recovery
- Wave-like movement is evident
- Growth in productivity due to more efficient use of production factors
- ICT capital is a key production factor

## 2.2

**The ICT sector**
- Scope of the ICT sector
- ICT manufacturing sector: recovery in 2010 following a sharp contraction in 2009
- Crisis also affects IT services
- Production in the telecommunications sector declined
- ICT sector is a growing component of the Dutch business sector
- Value added of the Dutch ICT sector limited internationally
- Telecom sector’s contribution to GDP shrinks

## 2.3

**ICT expenditure**
- Investments continue to decline in 2010
- Investments in ICT capital declined
- Software comprises more than half of ICT investments
- ICT investments primarily in communications sector
- The Netherlands just behind the world’s leading countries
- Intermediate consumption and household consumption fairly stable

## 2.4

**International trade in ICT**
- The trade in ICT products is affected by the crisis
- Sharp global increase in trade on ICT markets
- Shift from OECD countries to new growth markets
- Rapid emergence of Eastern European countries
- Rapid growth in the trade of ICT services
- Germany key in terms of ICT imports as well as ICT exports

# 2.5 ICT and employment

- Number of job openings in ICT sector shows recovery
- Increasingly more independent ICT workers
- Few female ICT workers
- ICT workers primarily employed in business services
- From a European perspective the Netherlands has many ICT workers

**In 2010 the Dutch economy showed some signs of recovery from the economic crisis that began in 2008 and experienced its low point in 2009 (for the time being). ICT capital expenditure over the last two decades made a significant contribution to economic growth in the Netherlands. ICT also plays an important role in a number of other areas of the Dutch economy, such as employment, investment and international trade.**

# 2.1 The Dutch economy

Following a sharp contraction of 3.5 percent in 2009, the Dutch economy experienced a slight recovery in 2010. The gross domestic product (GDP) grew by 1.7 percent. The previous decrease in the economy has affected many business sectors. The manufacturing sector, transportation and storage, trade and the hospitality sectors were especially hard hit by the crisis. The construction industry also showed significantly lower production in 2009 compared to the previous year. During the years 2005–2010, GDP growth reached a peak of 3.9 percent in 2007 (Table 2.1.1). Growth subsequently declined.
The European Union experienced a similar economic trend. In 2010, the EU-27 economy grew by 1.8 percent following a contraction of 4.3 percent in 2009. Following years of steady growth between 2003 and 2007, growth declined in 2008 and even more in 2009.

### Expenditure shows some recovery

Various expenditure categories showed signs of recovery in 2010. Especially international trade provided a positive impulse. In 2009, the import and export of goods and services still experienced a sharp slump. In fact, the Dutch export volume was over 8 percent lower than in 2008. This is consistent with the global picture. Since the Dutch economy is highly dependent on exports, the collapse of global trade in 2009 adversely affected the Dutch GDP. Due to the open character of the Dutch economy, international trade relations are essential to the Netherlands.
In 2009, investments in fixed assets declined sharply; by over 10 percent compared to 2008, while investments between 2005 and 2008 still showed stable growth.
Total consumer expenditure did not increase sharply in 2009 and 2010. The reduced household expenditure on durable goods was to a significant degree responsible for the reduction in total consumer expenditure starting in 2008. In addition to a decrease in the purchase of new cars and expenditure on home furnishings, households spent significantly less on consumer electronics.

### 2.1.1 GDP final expenditure categories trends, 2005–2010

| | 2005 | 2006 | 2007 | 2008 | 2009** | 2010* |
|---|---|---|---|---|---|---|
| | *year-on-year volume changes in %* | | | | | |
| Consumer expenditure | 0.8 | 2.9 | 2.4 | 1.8 | 0.1 | 0.6 |
| Households[1] | 1.0 | –0.3 | 1.8 | 1.3 | –2.6 | 0.4 |
| Government | 0.5 | 9.5 | 3.5 | 2.8 | 4.8 | 1.0 |
| Investments in fixed assets (gross) | 3.7 | 7.5 | 5.5 | 4.5 | –10.2 | –4.4 |
| Export of goods and services | 6.0 | 7.3 | 6.4 | 2.0 | –8.1 | 10.8 |
| Import of goods and services | 5.4 | 8.8 | 5.6 | 2.3 | –8.0 | 10.6 |
| Gross Domestic Product (market prices) | 2.0 | 3.4 | 3.9 | 1.8 | –3.5 | 1.7 |

Source: Statistics Netherlands, National Accounts 2010.

1) Consumption by households and non-profit institutions serving households.

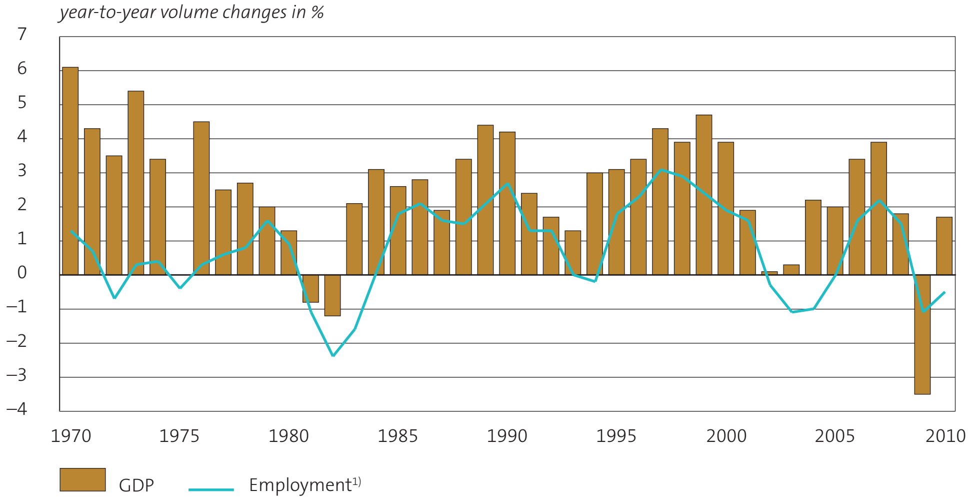
Government consumption was characterised by an erratic growth pattern. The government's consumption volume in 2009 was 4.8 percent higher than the previous year. As such, the government expenditure category was the only category that experienced growth in 2009. By contrast, the rate of growth declined in the two years prior to this, after a conspicuous peak in 2006.

#### Wave-like movement is evident

Figure 2.1.2 illustrates the GDP and employment trends over several decades. Starting in 1970, the Dutch economy has been characterised by periods of strong economic growth, alternated by years of decline. A cautious recovery occurred in 2010 after a contraction of the GDP in 2009 by 3.5 percent compared to the previous year. This was a historic decline caused by the persistent economic crisis that started with problems in the financial sector. The highest peak in the economic cycle occurred towards the end of the nineties. The average economic growth during the period 1996–2000 was 4 percent per year. The ICT sector (information and communications technology), partially due to the emergence of the internet and mobile telephony, was a key driver of this strong growth during that period. Economic growth came to a standstill in the years following the year 2000. Investments in the ICT sector declined at the beginning of this century, partly due to the disappointing performance of internet companies. Furthermore, telecommunication companies were faced with high debts resulting from the purchase of Universal Mobile Telecommunications System (UMTS) licenses and expensive takeovers. ICT consuming sectors (commerce and business services) in particular profited from – and also contributed to – the pick-up in the Dutch economy. Employment increased during the period 2006 to

2008 inclusive. In 2009 there was a decline in employment that persisted in 2010 as well. The number of employee jobs declined in 2009 and 2010 by 1.1 and 0.5 percent, respectively, compared to the previous year.

### 2.1.2 GDP and employment trend, 1970–2010[1)]




Source: Statistics Netherlands, National Accounts.

[1)] 2009 and 2010: provisional figures.
[2)] Labour volume of employed persons (in full-time equivalents).

### Growth in productivity due to more efficient use of production factors

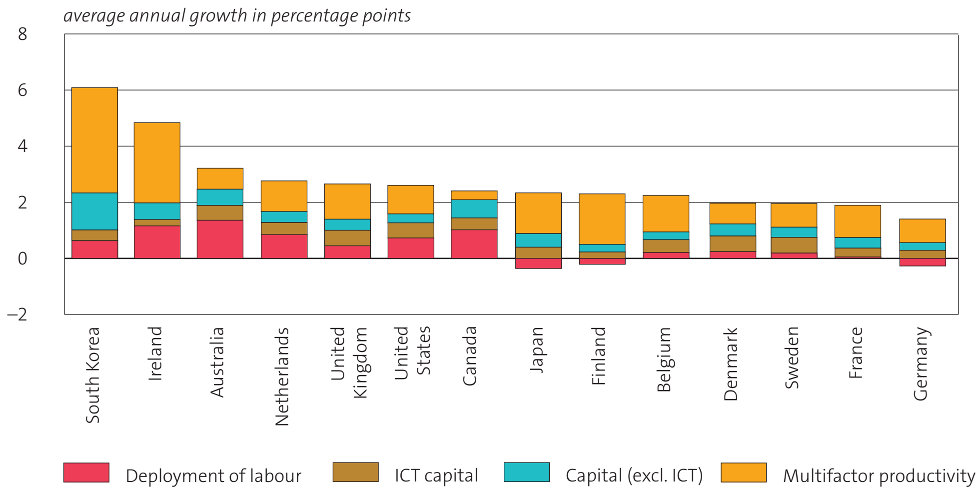
The production and application of ICT is and remains a driving force of innovation, productivity and ultimately economic growth. First, the ICT producing business sectors directly contribute to productivity and growth due to their own rapid technological progress. In addition, ICT use increases the productivity of other production factors. For example, ICT can be used to create a better organisation and division of tasks within a company. This results in the more efficient use of the factors capital and labour. Finally, there are spillover effects on the rest of the economy because ICT diffusion results in innovation and productivity gains in ICT consuming sectors (European Commission, 2009a). One strategy to improve the Netherlands' international competitive position is the redesign of production processes with the objective of increasing labour productivity (value added per hour worked). Effective investments in ICT applications play an important role in this respect. In addition, major investments in ICT strengthen the Netherlands' potential innovation capacity.

When GDP growth is higher than the rate of increase in the employed labour force (in full-time equivalents), there is an increase in labour productivity, assuming the same volume of an fte. Figure 2.1.2 implicitly illustrates labour productivity through means of the space between the GDP (bars) and the employment curve. Analyses primarily focus on the labour productivity of the business sector. The growth in labour productivity can fluctuate sharply. This is related to various factors, including the fact that the labour market responds to economic trends with some delay and also because capital, ICT and other investments (for example R&D) contribute to the growth in GDP.
The real output of the Dutch commercial sector increased by 2.7 percent in 2010. The total input of the production factors (capital, labour, energy, materials and services) increased by 1.3 percent in the same year. This results in an increase of 1.4 percent in the output per unit of production factor. This represents an increase in multifactor productivity: the productivity gain achieved by efficiently combining various production factors (labour, capital, ICT capital, energy, materials and services) (Statistics Netherlands, 2012).

**ICT capital is a key production factor**

During the period 1985–2009, South Korea achieved an average annual GDP growth rate of over 6 percent (Figure 2.1.3). Over 60 percent of this was attributable to multifactor productivity. These efficiency benefits are often accompanied by a growing capital intensity and a decrease in labour input. During this same period, Ireland experienced an average annual growth rate of 4.8 percent, of which almost 60 percent was due to multifactor productivity here as well. In addition, the use of labour also made an above average contribution to economic growth. For example, in Canada and Australia, the use of labour constitutes the most important growth factor.
The United States is often referred to as a country in which the efficient use of production factors results in high economic growth. This is partly true. From Figure 2.1.3 it is evident that almost 40 percent of that country's economic growth is due to growth in productivity. Nevertheless, there are countries where growth in productivity is a greater factor of significance. For example, in Finland almost all economic growth is due to the efficient combination of production factors.
The importance of ICT to economic development in the Netherlands has been significant in the last twenty to twenty-five years. During the period 1985–2009 on average almost 16 percent of GDP growth was based on the deployment of ICT capital (Figure 2.1.3). By comparison, ICT capital in, for example, Sweden (29 percent), Denmark (28 percent) and Germany (25 percent), makes an even greater contribution to economic growth than in the Netherlands.

**2.1.3 Contribution of production factors to GDP growth, international, 1985–2009[1)]**




Source: OECD, Factbook 2011.

1) Or nearest comparable period.

# 2.2 The ICT sector

This section provides an outline of the Dutch ICT sector. The first part contains a macroeconomic description that reviews the sector's value added, production and investments. The figures here are placed in an international context. The last part provides a more detailed analysis of the telecom sector.

### Scope of the ICT sector

ICT is a profession that focuses on information systems, telecommunications and computers. The ICT sector comprises the ICT manufacturing sector and ICT services sector, including the telecommunications sector. The ICT manufacturing sector produces products that store, process and exchange electronic information. The design and production of information and communication equipment form the mainstay of its activities. The service providing ICT activities support the electronic processing and communication processes. The precise scope of these two components of the ICT sector has been defined in an international context and is described in Table 2.2.1. The development and use of ICT form the core of the business process within the referenced sectors. The next sub-section deals with recent economic developments in the ICT sector.

### 2.2.1 Definition of the ICT sector in accordance with the SIC 2008

| SIC 2008 | Description of Activity |
|---|---|
| **ICT industry sector** | |
| 261 | Manufacture of electronic components and printed circuit boards |
| 262 | Manufacture of computers and peripheral equipment |
| 263 | Manufacture of communication equipment |
| 264 | Manufacture of consumer electronics |
| 268 | Manufacture of information carriers |
| **ICT services sector** | |
| 465 | Wholesale of ICT equipment |
| 582 | Software publishing |
| 61 | Telecommunications |
| 6201 | Developing, producing and publishing of software |
| 6202 | Information technology consultancy activities |
| 6209 | Other information technology service activities |
| 631 | Data processing, web hosting and related activities, web portals |
| 951 | Repair of computers and communication equipment |

Source: OECD/Statistics Netherlands.

**ICT manufacturing sector: recovery in 2010 following a sharp contraction in 2009**

The production value and the gross value added in the ICT manufacturing sector showed an erratic pattern between 2005 and 2010. The production value grew by 9.9 percent in 2010. This meant a recovery, after the value of production due to the economic crisis reached a low point in 2009, shrinking by 8.7 percent compared to the previous year. The gross value added also shrank sharply in 2009 by over 10 percent, followed by a recovery in 2010 (Table 2.2.2). In 2010 the volume of labour in the ICT manufacturing sector once again increased slightly after experiencing a decline of 2.7 percent in 2009.
The picture of the Dutch ICT manufacturing sector, to a greater extent than the ICT services sector, is influenced by a number of multinational enterprises. These companies partly form part of the Dutch manufacturing sector, but partly also fall outside the description of the national economy because some business units are vested abroad. Elements such as production, investments and employment are only attributed to the domestic ICT sector if they are related to companies or business units vested in the Netherlands. Whether the company is owned by Dutch parties is not a consideration in this regard. Consequently not all expenses and revenues are reported as part of the performance of the Dutch ICT manufacturing sector reflected here. This can result in a distorted picture when for example, R&D is conducted in Dutch business units and the revenues, through means of the actual production of improved or new ICT goods, are earned elsewhere.

## 2.2.2 The ICT sector compared with the Dutch economy, 2005–2010

| | 2005 | 2006 | 2007 | 2008 | 2009* | 2010* |
|---|---|---|---|---|---|---|
| | *year-on-year volume changes in %* | | | | | |
| **Production value (sales)** | | | | | | |
| ICT manufacturing sector | 2.3 | 1.5 | –3.8 | 1.6 | –8.7 | 9.9 |
| ICT services sector | 5.0 | 5.5 | 6.6 | 2.5 | –3.7 | –0.6 |
| of which | | | | | | |
| telecommunications | 3.4 | 2.8 | 5.5 | –0.3 | –3.3 | –0.1 |
| IT and information services | 7.2 | 9.0 | 7.8 | 5.5 | –4.0 | –1.1 |
| Total ICT sector | 4.3 | 4.5 | 4.0 | 2.3 | –4.8 | 1.8 |
| Netherlands | 2.1 | 3.6 | 4.1 | 2.0 | –3.9 | 1.2 |
| **Gross value added** | | | | | | |
| ICT manufacturing sector | 9.8 | –1.1 | 6.0 | 0.6 | –10.7 | 22.7 |
| ICT services sector | 6.1 | 6.7 | 7.2 | 3.6 | –3.5 | 0.5 |
| of which | | | | | | |
| telecommunications | 5.1 | 4.5 | 6.2 | 1.3 | –2.2 | 1.5 |
| IT and information services | 7.2 | 9.2 | 8.2 | 5.5 | –4.5 | –0.2 |
| Total ICT sector | 6.4 | 6.0 | 7.1 | 3.4 | –4.1 | 2.2 |
| Netherlands | 2.1 | 3.3 | 4.0 | 2.1 | –3.1 | 1.9 |
| **Investments** | | | | | | |
| ICT manufacturing sector[1)] | 10.3 | 2.8 | –18.3 | 8.6 | –13.9 | . |
| ICT services sector | 16.6 | 8.4 | 2.8 | 3.7 | –6.6 | . |
| of which | | | | | | |
| telecommunications | 16.8 | 7.5 | –5.8 | 0.9 | –6.0 | . |
| IT and information services | 15.7 | 12.1 | 35.0 | 11.2 | –8.1 | . |
| Total ICT sector | 15.5 | 7.5 | –0.5 | 4.4 | –7.6 | . |
| Netherlands | 3.7 | 7.5 | 5.5 | 4.5 | –10.2 | –4.4 |
| **Labour volume of employed persons** | | | | | | |
| ICT manufacturing sector | –3.9 | 0.0 | –1.4 | 1.2 | –2.7 | 0.9 |
| ICT services sector | 4.4 | 4.9 | 4.9 | 4.8 | –2.3 | –1.6 |
| of which | | | | | | |
| telecommunications | –3.3 | –1.4 | –3.2 | –5.9 | –7.2 | –6.3 |
| IT and information services | 7.2 | 7.0 | 7.4 | 7.7 | –1.2 | –0.6 |
| Total ICT sector | 2.4 | 3.8 | 3.6 | 4.1 | –2.4 | –1.1 |
| Netherlands | 0.0 | 1.6 | 2.2 | 1.5 | –1.1 | –0.5 |

Source: Statistics Netherlands, National Accounts.

1) In terms of investments, the ICT manufacturing sector is defined as SIC code 26. The data related to these investments is not detailed enough to be able to display it in accordance with the internationally agreed upon definition of the ICT manufacturing sector.

### Crisis also affects IT services

The ICT services sector was also hit by the economic crisis. The production value and the value added did not exhibit the same strong growth in 2008 and decreased in 2009. Production decreased by 3.7 percent in 2009, while the value added decreased by 3.5 percent compared to 2008. The production value still showed a slight negative growth in 2010, while the gross value added slightly recovered in the same year. The production value and the value added of IT and information service providers decreased relatively sharply; production went from a positive growth of 5.5 percent in 2008 to a decline of

4 percent in 2009. The gross value added went from a positive growth of 5.5 percent in 2008 to a decline of 4.5 percent in 2009. The decrease in the production value persisted in 2010, although at a reduced rate. The investments in IT and information services decreased in 2009, after years of double digit growth figures. Investments in the total IT services sector also decreased in 2009.
Up to an including 2009, IT and information services were the drivers of growth in the services sector. IT services expanded significantly between 2005 and 2008 (Table 2.2.2). Companies that offer services in the field of computers and information technology in particular generate revenues from consultancy, the development and implementation of information systems, management and operations. Revenues in 2008 grew for the fifth consecutive year. In addition, value added experienced accelerated growth during 2005–2007. However, here too growth slackened in 2008 and became negative in 2009 and 2010.

# Investments in ICT services sector declined

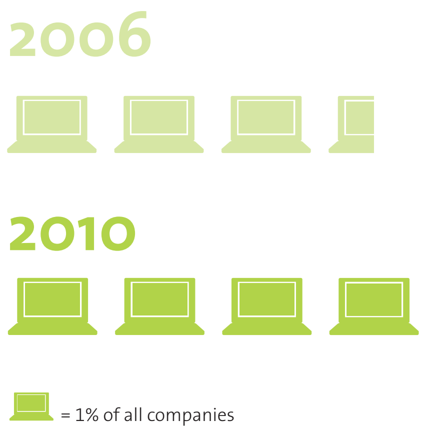
**Production in the telecommunications sector declined**

Following a decline in 2009 and 2008, the production value in the telecommunications sector experienced a slight decline in 2010 as well. This sector for a long time experienced growth in production value (sales) and value added in spite of the economic downturn following the turn of the century. Growth in recent years was characterised by a slowdown, however (Table 2.2.2). The gross value added once again increased in 2010, following a decline of 2.2 percent in 2009. Employment in the telecommunications sector has been showing a declining trend for many years. Investments started to decline in 2007, recovered slightly in 2008, only to drop again in 2009. Capital intensity in telecommunication companies is high, due to relatively high investments. These consist of purchases of fixed assets, such as buildings, machines, installations and computers.

### ICT sector is a growing component of the Dutch business sector

The trend in the number of ICT companies in comparison to the total number of companies, provides an indication of the ICT sector's state of affairs. In 2010, 4 percent of Dutch companies were active in the ICT sector. This represents an increase of over one half percentage point compared to 2006 (Figure 2.2.3).

**ICT sector's share of Dutch business sector is increasing**

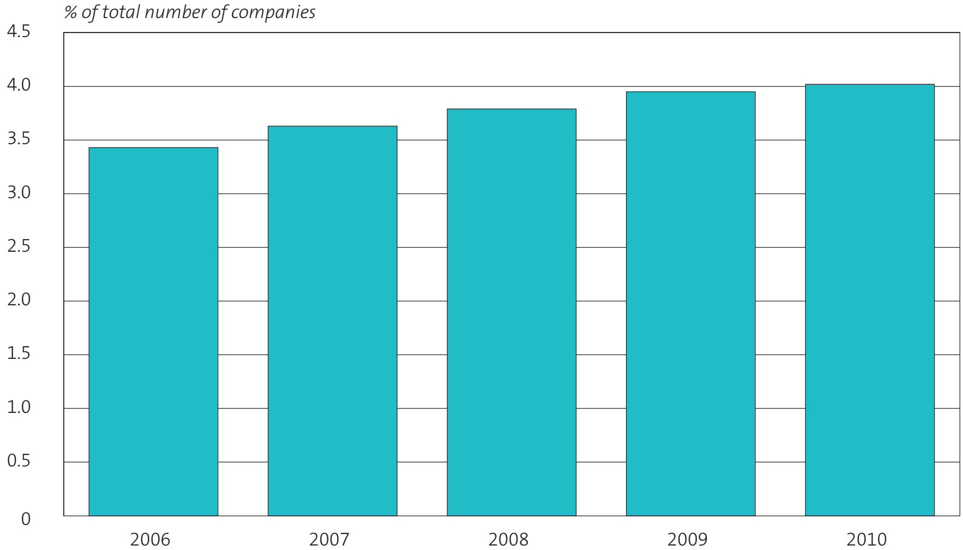



The number of ICT services companies especially rose quickly. The high number of start-ups in the ICT sector can be partially explained by the low entry threshold of the ICT services sector. Start-up costs are generally lower for a services company than for a manufacturing company. However, such start-ups do not automatically translate into economic growth. Indeed, new ICT companies often employ few people and the employment opportunities created this way do not always offset the loss of ICT jobs in larger companies.

### Value added of the Dutch ICT sector limited internationally

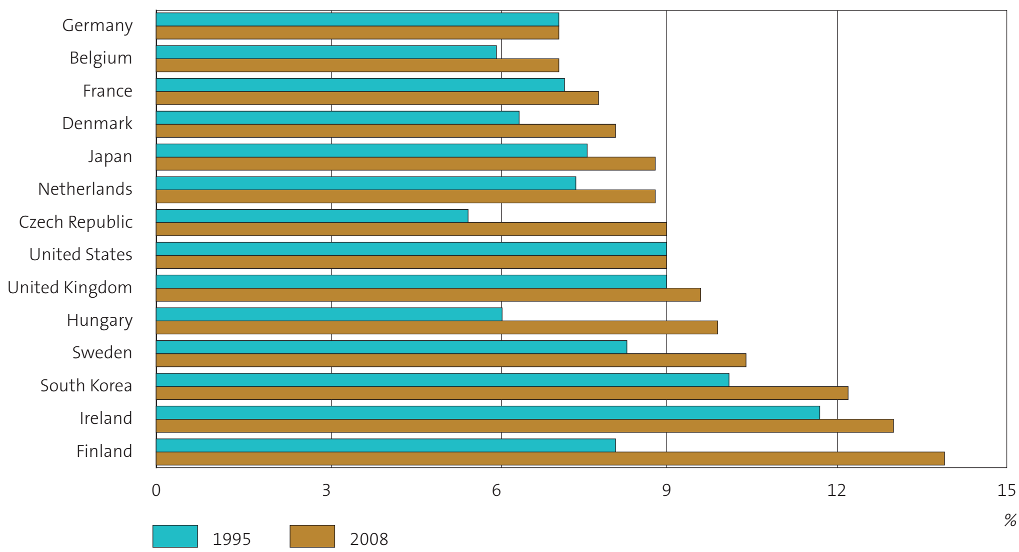
In 2008, the Dutch ICT sector accounted for 8.8 percent of the business sector's value added (Figure 2.2.4). As such the Netherlands considerably lagged behind the leading country, Finland (13.9 percent), and also clearly lagged behind, for example, Sweden, the United Kingdom and South Korea. Between 1995 and 2008, the economic significance of the ICT sector grew steadily in all countries, with the exception of the United States and Germany. Furthermore, the leading countries Finland and South Korea also experienced the fastest growth among the 'traditional ICT countries' during 1995–2008. Hardware production has been an important source of income for these countries for years.

### 2.2.3 ICT companies as a percentage of total number of companies, 2006–2010




Source: Statistics Netherlands.

### 2.2.4 ICT sector percentage of value added in business sector, international, 1995 and 2008




Source: OECD, Information Technology Outlook 2010.

In addition to these countries, China and India have since become the home-base for various leading ICT companies (OECD, 2010). This, together with the relative slowdown in the United Kingdom and the United States, is consistent with the ICT market's shift on the world map. This is further discussed in section 2.4 on international trade in ICT. The rapid emergence of some Eastern European countries is also consistent with this picture. The ICT sector's share increased by 3.8 and 3.5 percentage points in Hungary and the Czech Republic, respectively, between 1995 and 2008.

### 2.2.5 Telecommunication sector key figures, 2005–2010[1)]

| | 2005 | 2006 | 2007 | 2008 | 2009* | 2010* |
|---|---|---|---|---|---|---|
| | *million euro (current prices)* | | | | | |
| **Telecommunication sector** | | | | | | |
| Production (basic prices) | 19,543 | 19,616 | 20,249 | 19,460 | 18,415 | 18,368 |
| Gross value added (basic prices) | 9,393 | 9,299 | 9,423 | 8,781 | 8,196 | 8,223 |
| Investments in fixed assets | 2,462 | 2,666 | 2,555 | 2,632 | 2,463 | . |
| | *full-time equivalents (x 1,000)* | | | | | |
| Labour volume of employed persons | 39 | 38 | 37 | 35 | 32 | 30 |
| | % | | | | | |
| **Share of the total economy** | | | | | | |
| Gross value added (basic prices) | 2.06 | 1.94 | 1.86 | 1.66 | 1.61 | 1.56 |
| Investments in fixed assets | 2.54 | 2.51 | 2.23 | 2.16 | 2.22 | . |
| Labour volume of employed persons | 0.60 | 0.58 | 0.55 | 0.51 | 0.47 | 0.45 |

Source: Statistics Netherlands, National Accounts.

1) SIC 2008 code 61 (Telecommunications).

#### Telecom sector's contribution to GDP shrinks

The telecom sector comprises the physical infrastructure (for example, telephone cables, masts) and services related to telephony and mobile telephony, the internet, radio and television. The telecom sector includes, among others, telephony companies, internet providers, and cable companies that transmit radio and television signals.

In 2010, the Dutch telecom sector added approximately 1.6 percent to the gross domestic product. This contribution has been dropping slowly since 2005 (Table 2.2.5). Employment (labour volume) in the telecom sector amounted to over 30 thousand full-time equivalents in 2010. The annual drop in employment from 2005 onwards persisted up to and including 2010. Employment in the telecom sector declined by over 23 percent during this period.

Investments by the telecom sector fluctuated between 2005 and 2009. The share of investments by the telecom sector in the total economy rose slightly in 2009, following a declining trend during the period 2005–2008.

# 2.3 ICT expenditure

The economic significance of the ICT sector from a supply side perspective was a key theme in section 2.2. The perspective in this section shifts to the ICT sector's customers. Domestic expenditure on ICT goods and services is divided into the following three categories:

- Investments in ICT capital by companies and government;
- Intermediate consumption by companies and government;
- Household consumption.

Investments in ICT capital are addressed first. Aside from this, investments over time and in the various business sectors are reviewed. In addition, the findings for the Netherlands are compared to other countries. Finally, attention is devoted to intermediate consumption by companies and government and household consumption.
Domestic expenditure on ICT goods and services partly benefits the national ICT sector. The ICT services market is predominantly a domestic market. This means that companies, households and governments generally acquire ICT services from companies vested in the Netherlands. The situation in terms of ICT goods is quite different. The domestic ICT manufacturing sector has lost increasing market share to the import of foreign products since 1995.

**Investments continue to decline in 2010**

Table 2.1.1 (in section 2.1) shows that in 2009 almost all expenditure categories had a negative trend compared to the previous year. The decline was the greatest for investments in fixed assets. This deterioration in investments in fixed assets continued in 2010: –4.4 percent. In 2008, investments were the only expenditure category in which growth stayed up to par. All other expenditure categories that year already showed a clearly lower growth rate than that of previous years. This is because investments generally respond with a delay to the economic cycle. Investments in fixed assets in 2008 still grew by 4.5 percent, somewhat less than in 2007 (5.5 percent). In 2009, the consequences of the economic crisis also became evident in the investment figures.

### Investments in ICT capital declined

The economic malaise resulted in decreased investments in the Netherlands in 2009 and 2010 (Table 2.3.1). This was also reflected in ICT investments. ICT investments between 2005 and 2008 increased by 19 percent to almost 16 billion euro. This rapid growth in ICT investments was driven by substantially increased investments in software. The growth rate of ICT investments slightly lagged behind total investments (almost 26 percent between 2005 and 2008) in the Dutch economy. The largest increase in investments in ICT capital occurred between 1995 and 2000: from 6.7 billion to 15.1 billion euro (Statistics Netherlands, 2006). This growth was to a large extent driven by the major investments made by telecommunication companies in the construction, expansion and modernisation of electronic networks for services such as the internet/broadband internet and mobile telephony. This was followed by a brief, but fairly substantive collapse caused by a decrease in investments in electronic networks. Between 2005 and 2008, investments in ICT once again picked up. However, this period of growth ended in 2009.

### 2.3.1 Investments in ICT capital, 2005–2010

| | 2005 | 2006 | 2007 | 2008 | 2009* | 2010* |
|---|---|---|---|---|---|---|
| | *million euro (current prices)* | | | | | |
| Computer hardware | 4,334 | 4,545 | 4,896 | 4,557 | 4,658 | . |
| Software | 7,004 | 7,710 | 8,343 | 9,120 | 8,553 | . |
| Electronic networks | 2,033 | 2,334 | 2,277 | 2,218 | 2,123 | . |
| Total ICT | 13,371 | 14,589 | 15,516 | 15,895 | 15,334 | . |
| Total investments Netherlands | 97,016 | 106,373 | 114,340 | 121,849 | 111,080 | 107,205 |
| | *%* | | | | | |
| Computer hardware | 32 | 31 | 32 | 29 | 30 | . |
| Software | 52 | 53 | 54 | 57 | 56 | . |
| Electronic networks | 15 | 16 | 15 | 14 | 14 | . |
| Total ICT | 100 | 100 | 100 | 100 | 100 | . |
| % of total investments Netherlands | 13.8 | 13.7 | 13.6 | 13.0 | 13.8 | . |
| | *year-on-year volume changes in %* | | | | | |
| Computer hardware | 13.2 | 16.4 | 14.8 | 4.0 | 9.2 | . |
| Software | 6.7 | 7.5 | 4.1 | 7.0 | –6.7 | . |
| Electronic networks | 9.4 | 15.9 | –2.7 | –5.5 | –2.7 | . |
| Total ICT | 9.3 | 11.7 | 6.4 | 4.2 | –1.6 | . |
| Total investments Netherlands | 3.7 | 7.5 | 5.5 | 4.5 | –10.2 | –4.4 |

Source: Statistics Netherlands, National Accounts.

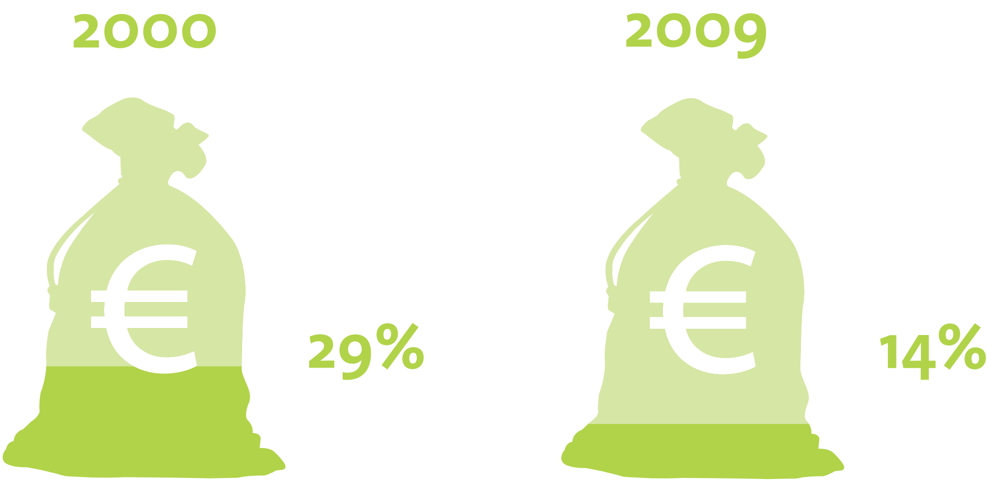
### Software comprises more than half of ICT investments

More than half of ICT investments in the Netherlands are investments in software (Table 2.3.1). New software enhances development opportunities for new or improved ICT applications and consequently represents an important investment opportunity for companies. Software investments as a percentage of ICT investments rose from 52 percent in 2005 to 57 percent in 2008. After this, investments in software declined somewhat in favour of investments in hardware.

Following a decline in 2008, investments in hardware once again increased in 2009. Investments in hardware also rose in 2007; by 7.7 percent compared to the previous year. In fact, this represented an acceleration in the growth of these investments, particularly in computers, compared to 2006. Hardware investments as a percentage of total ICT investments were 30 percent in 2009. This represented a slight recovery following a low point of 29 percent in 2008.

Investments in electronic networks declined steadily since 2006. This type of ICT capital represented 14 percent of total ICT investments in 2009. The corresponding figure for 2000 was 29 percent.

### Investments in electronic networks declined



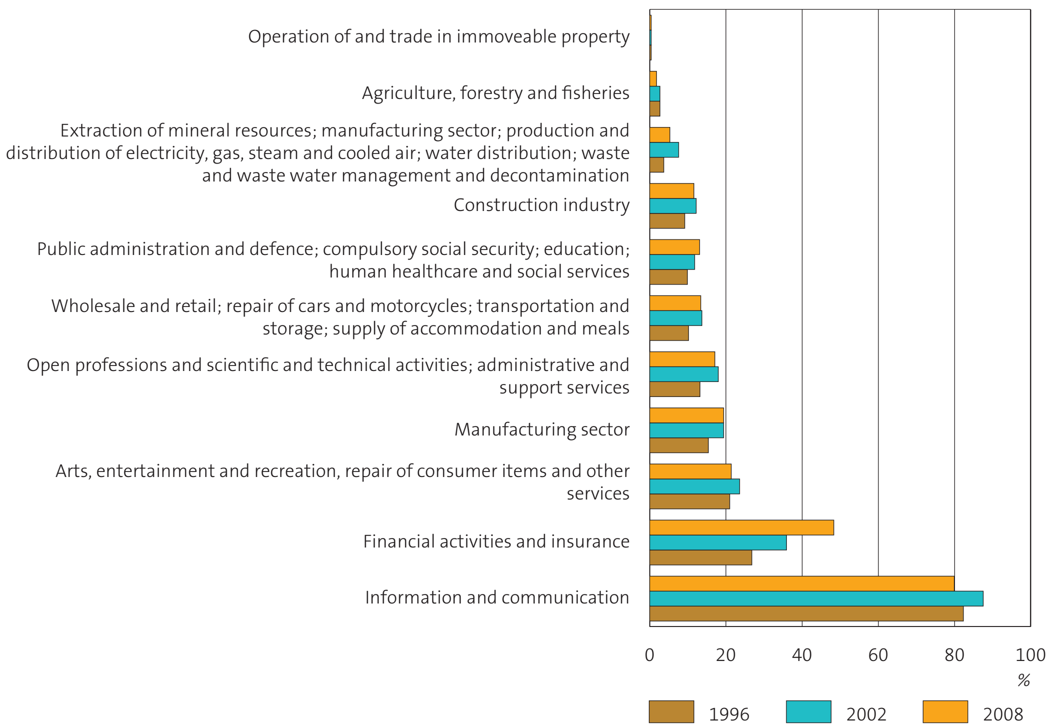

% of ICT investments

## ICT investments primarily in communications sector

The proportion of investments in ICT varies from sector to sector. At a business sector level 'information and communication' had the highest percentage level of investments in the period 1996–2008. 'Agriculture, forestry and fisheries' and 'operation of and trade in immoveable property' clearly lagged in 2008. With the exception of a few business sectors, ICT investments as a percentage of total investments declined between 2002 and 2008. The high 'information and communication' ICT investments are largely due to the well-represented ICT services in this business sector (Figure 2.3.2).

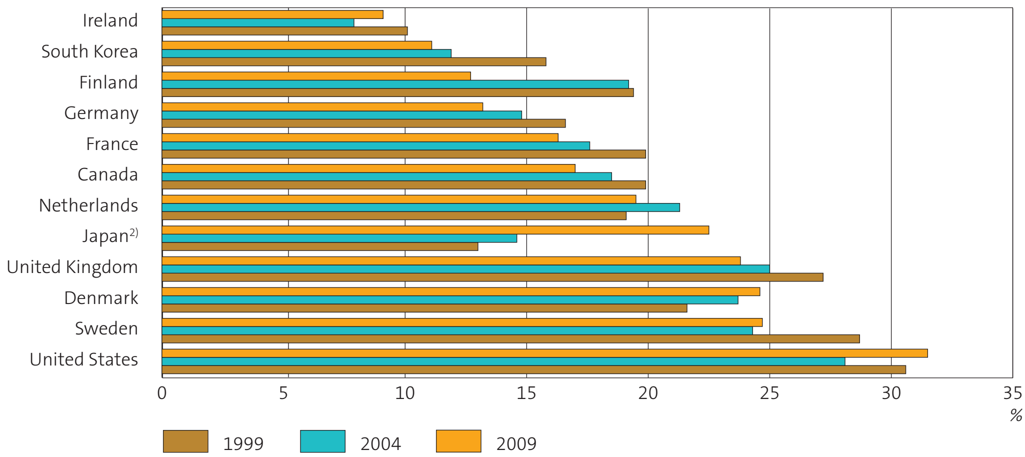
The peak in ICT investments occurred around the turn of the century. The 'financial activities and insurances' business sector exhibited the strongest growth between 1996 and 2008, increasing by 21.5 percentage points. The level of investment in ICT by banks and insurance companies during this period was relatively very high.

### 2.3.2 ICT investments as a percentage of total investments, by business sector, 1996, 2002 and 2008




Source: Statistics Netherlands, National Accounts.

## 2.3.3 ICT investments as a percentage of total investments, international, 1999, 2004 and 2009[1)]




Source: OECD, Factbook 2011.

1) International gross fixed assets formation, excluding dwellings.
2) Japan: 2008 instead of 2009.

### The Netherlands just behind the world's leading countries

The percentage of ICT investments declined in more than half of the countries displayed in Figure 2.3.3 after the boom period that ended in 2001. By contrast, ICT investments as a percentage of total investments rose in Japan and the United States, as well as in Denmark. In the Netherlands the percentage of ICT investments declined between 2004 and 2009, while it increased slightly over the entire period 1999–2009. The Netherlands ranks in the middle in this respect and lags behind the leading countries (United States, Sweden, Denmark and the United Kingdom). The percentage of ICT investments declined in the United Kingdom. Denmark, as well as Sweden, invests a relatively high amount in ICT, but the influence of this on the average EU investments level is limited because these are small economies. Furthermore, investments are not an indicator of returns.
The difference in industrial specialisation is an important explanatory factor for the gap in ICT investments between the United States and the EU. ICT-intensive sectors, such as electrical engineering, are better represented in the American economy. The economic life cycle of ICT investments is short compared to other capital goods. It is therefore not possible for a business sector to continue to live off past ICT investments. In the current competitive global economy it is necessary each time to re-invest in ICT in order to have access to the newest hardware and software.

Differences in economic performance between industrialised countries appear to be largely related to the level of ICT investments and the competitive strength of the ICT sector. The use of ICT alone, however, appears to be insufficient for raising productivity. ICT investments must be accompanied by additional measures, such as the adaptation of the business organisation and the continued training of employees (European Commission, 2008). In other words, organisations require ICT resources and skills, as well as communicative and organisational expertise.

### Intermediate consumption and household consumption fairly stable

ICT expenditure by companies and governments that is not classified as investments does not form part of ICT capital. Indeed, ICT expenditure also includes ICT services used by companies and government, hardware maintenance and household consumption. Consumer expenditure on ICT goods and services consists of the acquisition of items such as computers, printers, mobile telephones and digital cameras, as well as the costs of telephone, mobile telephone and internet traffic.

**2.3.4 Intermediate consumption and household consumption of ICT goods and services, 2005–2010**

| | 2005 | 2006 | 2007 | 2008 | 2009* | 2010* |
|---|---|---|---|---|---|---|
| | *million euro (current prices)* | | | | | |
| *Total ICT expenditure* | 45,855 | 47,990 | 50,045 | 49,828 | 46,745 | 47,117 |
| Intermediate consumption | 32,761 | 34,431 | 36,127 | 36,223 | 34,148 | 34,558 |
| Consumption | 13,094 | 13,559 | 13,918 | 13,605 | 12,597 | 12,559 |
| *Total ICT goods* | 14,155 | 15,034 | 15,667 | 15,610 | 14,063 | 14,486 |
| Intermediate consumption | 10,669 | 11,263 | 11,667 | 11,606 | 10,511 | 10,933 |
| Consumption | 3,486 | 3,771 | 4,000 | 4,004 | 3,552 | 3,553 |
| *Total ICT services* | 31,700 | 32,956 | 34,378 | 34,218 | 32,682 | 32,631 |
| Intermediate consumption | 22,092 | 23,168 | 24,460 | 24,617 | 23,637 | 23,625 |
| Consumption | 9,608 | 9,788 | 9,918 | 9,601 | 9,045 | 9,006 |

Source: Statistics Netherlands, National Accounts.

Intermediate consumption as a percentage of total ICT expenditure rose by 2 percentage points to over 73 percent between 2005 and 2010. The consumption share therefore declined (Table 2.3.4). This change is primarily due to ICT services trends. Between 2005 and 2010, intermediate consumption as a percentage of total services rose, while the share of household consumption declined.

Following a contraction of virtually all categories in 2008 and 2009, intermediate consumption experienced cautious recovery in 2010. Expenditure on ICT goods and services sharply declined particularly in 2009. Household consumption in this regard declined more sharply on a percentage basis than intermediate consumption by companies and government.

# 2.4 International trade in ICT

Having covered the situation in the Netherlands, this section focuses on the international trade in ICT. The size of international trade flows in ICT products is an indication of the international dynamics in this market. The Dutch export and import of ICT goods and services are addressed first. The Dutch performance is subsequently compared to the trade figures of other countries. The section concludes with a review of the Netherlands' most important trade partners.

**The trade in ICT products is affected by the crisis**

The volume of ICT imports and exports declined across its full breadth in 2009. After a number of years of flourishing trade in ICT goods and services, signs of a reversal began to appear in 2007. Due to the financial and economic crisis that manifested itself globally, companies were faced with financial limitations, for example in relation to trade credits. Consumer confidence dropped as a result of which the demand for durable consumer goods declined. The lack of confidence on the part of the business sector affected its willingness to invest. As a result of all of these factors, the export value of Dutch ICT goods decreased by over 16 percent between 2007 and 2009. The export of ICT services continued to grow up to and including 2008, although the growth rate slowed and in fact turned negative in 2009. Other categories displayed the same pattern: growth during the years 2005 and 2006 followed by a slowdown in the rate of growth or a (sharp) contraction. This is illustrated in Table 2.4.1.
The import value of ICT goods and services increased by 19 percent over the period 2005–2010. The ICT export surplus, approximately 1.8 billion euro in 2005, increased to almost 2 billion euro in 2010, having reached a peak in 2008.
The international trade in ICT services has increased considerably in the last ten years, globally, as well as specifically between the Netherlands and foreign countries. The import volume of ICT services in the Netherlands is, however, still many times smaller than that of ICT goods. ICT goods have been traded on an international scale much longer than ICT services. By contrast, between 2005 and 2010 the Netherlands exported more ICT services

than ICT goods when re-exports are left out of consideration. The export of ICT services as a percentage of total Dutch exports (including re-export) rose slightly in the period 2005–2009. However, it once again declined somewhat in 2010.

The major share of the ICT goods imported by the Netherlands is destined for re-export. This mostly concerns standard goods that are subjected to minimal processing in the Netherlands and that are subsequently re-exported to the ultimate country of destination. The Netherlands in this respect fulfils the role of distributor of ICT goods for the rest of Europe. The total export of ICT goods consisted of over 93 percent of re-exports in 2010. The value added of re-exports is often significantly lower than that of exports; nevertheless, re-exports are of importance to the Dutch economy (Netherlands Bureau for Economic Policy Analysis (CPB), 2007). Services display an entirely different picture; there is barely any re-export of services.

### 2.4.1 Import and export of ICT goods and services, 2005–2010

| | 2005 | 2006 | 2007 | 2008 | 2009* | 2010* |
|---|---|---|---|---|---|---|
| | *million euro (current prices)* | | | | | |
| **Import** | | | | | | |
| ICT goods | 54,898 | 57,706 | 59,829 | 60,213 | 53,974 | 65,894 |
| ICT services | 5,985 | 6,166 | 6,291 | 6,204 | 5,990 | 6,376 |
| Total ICT import NL | 60,883 | 63,872 | 66,120 | 66,417 | 59,964 | 72,270 |
| Total import NL | 313,688 | 351,669 | 377,234 | 404,047 | 354,094 | 415,316 |
| **Export** | | | | | | |
| ICT goods | 4,470 | 4,963 | 5,038 | 4,974 | 4,218 | 4,541 |
| ICT services | 6,668 | 6,903 | 7,643 | 7,799 | 7,369 | 7,639 |
| Total ICT export NL | 11,138 | 11,866 | 12,681 | 12,773 | 11,587 | 12,180 |
| Total export NL | 357,453 | 393,475 | 424,229 | 453,442 | 392,879 | 459,246 |
| **Re-export** | | | | | | |
| ICT goods | 50,971 | 53,713 | 55,716 | 56,565 | 51,178 | 61,700 |
| ICT services | 592 | 557 | 509 | 531 | 406 | 355 |
| Total ICT re-export NL | 51,563 | 54,270 | 56,225 | 57,096 | 51,584 | 62,055 |
| Total re-export NL | 132,849 | 151,881 | 166,795 | 178,053 | 158,091 | 191,518 |
| Total ICT export (goods, services and re-export) | 62,701 | 66,136 | 68,906 | 69,869 | 63,171 | 74,235 |
| | *%* | | | | | |
| **Breakdown of the export of ICT goods and services** | | | | | | |
| ICT goods | 7 | 8 | 7 | 7 | 7 | 6 |
| ICT services | 11 | 10 | 11 | 11 | 12 | 10 |
| Re-export | 82 | 82 | 82 | 82 | 82 | 84 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Percentage of ICT goods and services in** | | | | | | |
| Total import | 19.4 | 18.2 | 17.5 | 16.4 | 16.9 | 17.4 |
| Total export | 3.1 | 3.0 | 3.0 | 2.8 | 2.9 | 2.7 |
| Total re-export | 38.8 | 35.7 | 33.7 | 32.1 | 32.6 | 32.4 |

Source: Statistics Netherlands, National Accounts.

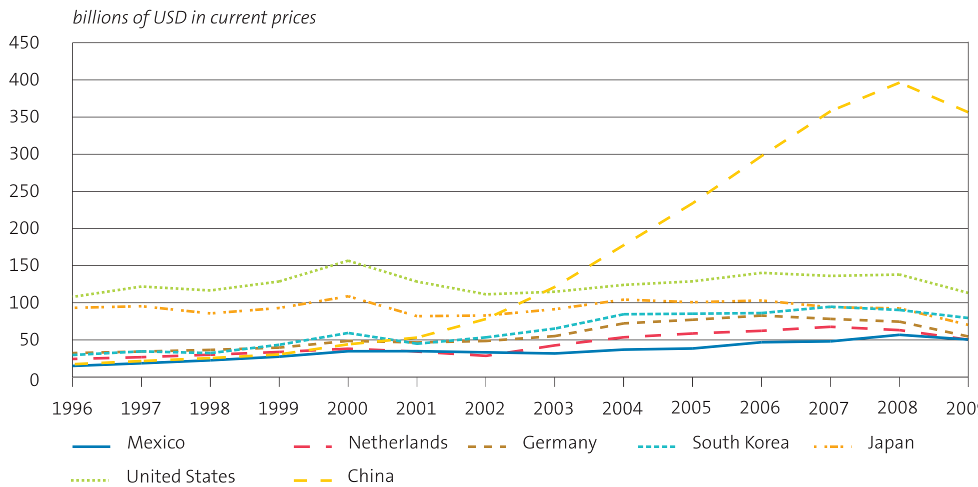
### Sharp global increase in trade on ICT markets

The follow-on to this section sketches out the trends of international trade in ICT goods and services between 1996 and 2009. The global trade in these products sharply increased during this period. The volume of the international trade in ICT goods is many times greater than the value of traded ICT services.
The world economy has clearly experienced a globalisation process. The ICT sector has played a key role in this regard since the nineteen nineties. Indeed, this sector is itself globalising at a high rate and in addition, supports the globalisation of other sectors. ICT developments have lowered communication and coordination costs to such an extent that international outsourcing of business operations is occurring on an ever increasing scale. The direction of trading transactions is changing since the ICT manufacturing sector and to a lesser extent ICT services, are shifting to, for example, countries in Asia. The focus in the emerging countries is on routine process and assembly activities focused on export. However, international investment patterns also point to a shift towards the 'offshoring' of high-quality industrial and service functions (CPB, 2007).

### Shift from OECD countries to new growth markets

At a global level, ICT production activities grew quickly in emerging countries, such as China and India and – within Europe – in Eastern Europe (OECD, 2010). This is also reflected in the ICT trade figures. In 2008, the percentage of total ICT trade accounted for by OECD

**2.4.2 Export of ICT goods, international, 1996–2009**




Source: OECD, International Trade by Commodity Statistics.

countries declined to 53 percent. The corresponding figure for 1996 was 71 percent. Asian and Eastern European countries have increasingly become producers of and sales markets for ICT goods and services. This globalisation is primarily being fuelled by production-related price competition and the rapid growth in the diversity of goods and services. Emerging countries can produce ICT goods and supply ICT services relatively cheaply. In addition, they constitute an attractive sales market for western companies.
In the second half of 2008 and the first quarter of 2009, the worldwide trade in ICT declined as a result of the general economic downturn that began with the crisis in the financial world (OECD, 2010). However, there was a recovery during the course of 2009, primarily driven by the renewed trade and economic growth in Asian countries. The shift to emerging countries is continuing, with these countries developing from low-wage countries, primarily engaged in assembly for export, to countries that also manufacture advanced products for the domestic market.
Figure 2.4.2 displays the impact of the financial crisis on the trade in ICT goods. The export of ICT goods by OECD countries declined sharply in 2009. Exports by China also declined that year. Nevertheless, China remained by far the largest exporter of ICT goods in 2009 also, with an export value of 356 billion US dollars. The value of China's ICT goods exports was over three times as high as that of the first runner up, the United States, and almost as high as that of numbers two to six combined (368 billion US dollars). In 2009, South Korea was a third key exporter of ICT goods. The Netherlands came in seventh place with an export value of 50 billion US dollars.

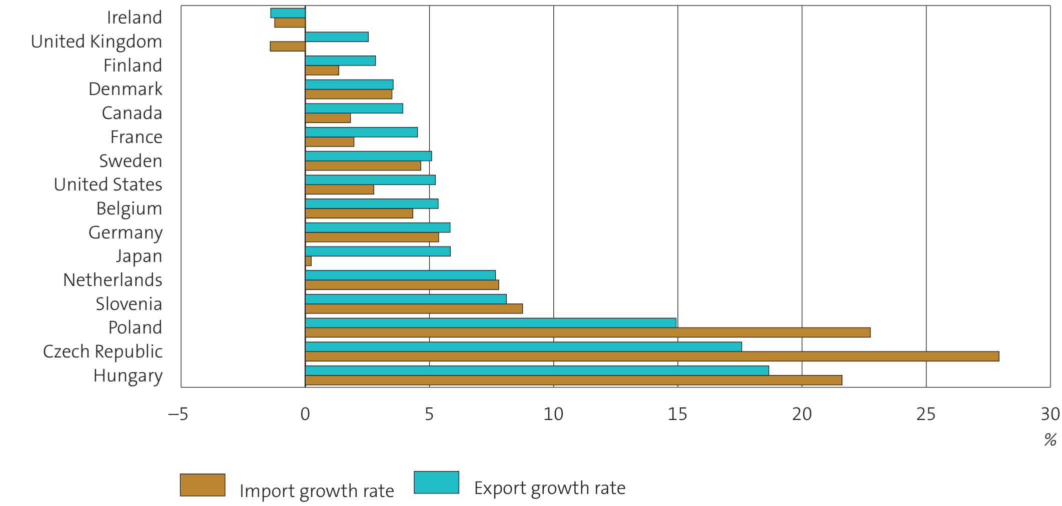
**Rapid emergence of Eastern European countries**

Figure 2.4.3 displays the rapid emergence of Eastern European countries. The export of ICT goods from these countries grew by an average of 15 to 20 percent per year between 1995 and 2010, while imports increased by an average of 20 percent per year. In addition to being relatively cheap production countries, these countries also form a new sales market. The Dutch export of ICT goods in this period grew by an average of 7.7 percent per year, while imports rose by 7.8 percent per year.

**Rapid growth in the trade of ICT services**

The marketability of ICT services has increased due to the rapid technological developments. It is now possible to supply ICT services that do not require direct personal contact from remote locations. The international trade in ICT services consists of hiring in foreign computer service agencies, the use of networks of foreign telephony and mobile telephony providers, as well as other services.

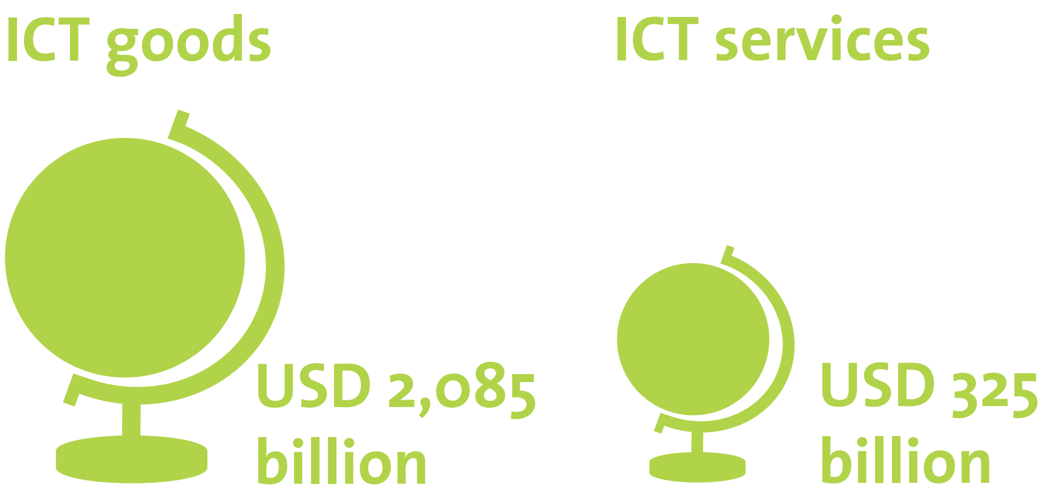
**2.4.3 Average annual growth in the import and export of ICT goods, international, 1995–2010**




Source: OECD, International Trade by Commodity Statistics.

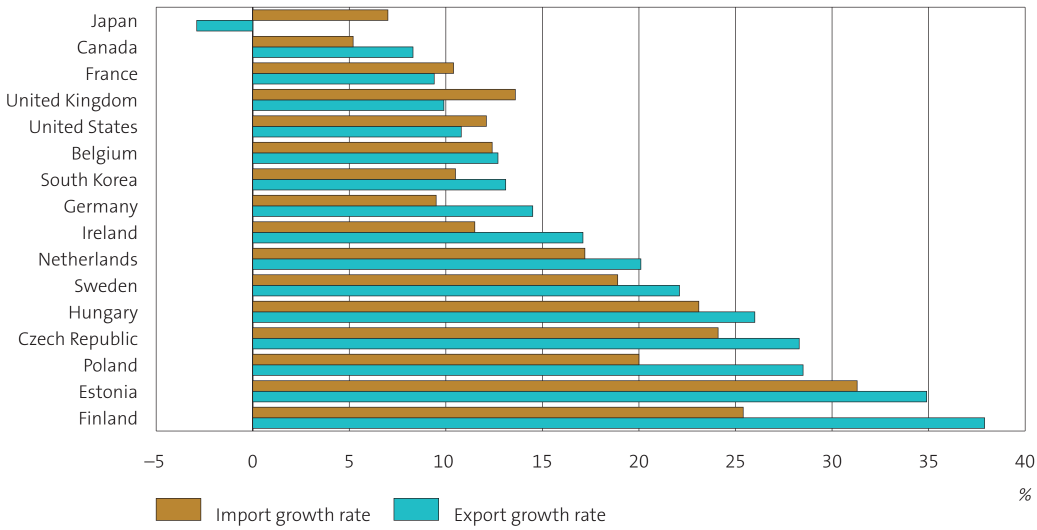
Internationally, the ICT services market is much smaller than the market for ICT goods. In 2008, the total trade in ICT services from and to OECD countries amounted to approximately 325 billion US dollars, while the trade in ICT goods that year amounted to over 2,085 billion US dollars (including the trade among OECD countries). However, the

**International ICT services market smaller than ICT goods market**



market for ICT services is growing fast. The rapid emergence of Eastern European countries is also evident for ICT services (Figure 2.4.4). The export of ICT services from these countries grew by an average of 25 to 30 percent per year between 2002 and 2009. The export of ICT services from the Netherlands rose by 20 percent per year during this period. Finland displayed the strongest annual growth in the export of ICT services: 38 percent.

**2.4.4 Average annual growth in the import and export of ICT services, international, 2002–2009**

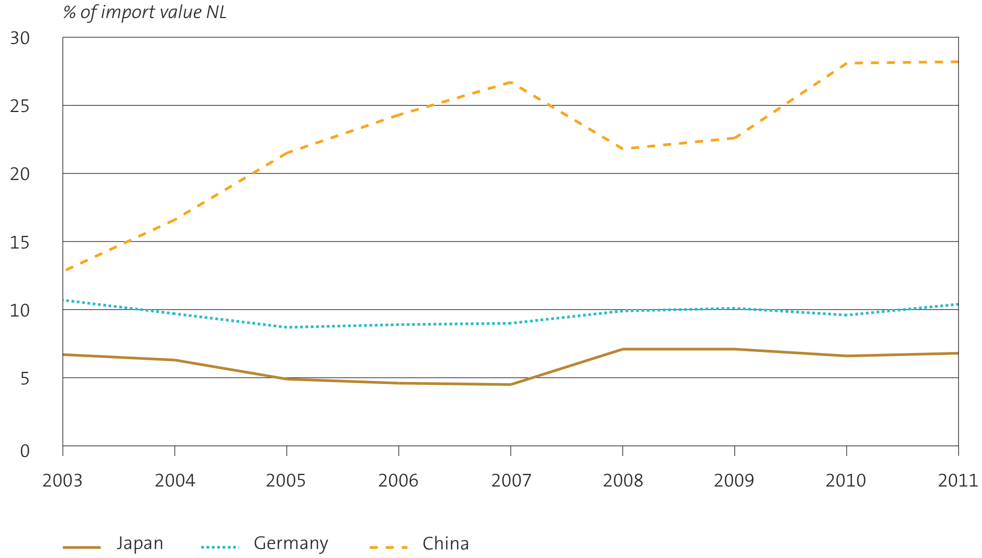



Source: OECD, Trade in Services database.

## Germany key in terms of ICT imports as well as ICT exports

The key trading partners for the Netherlands in terms of ICT imports are China, Germany and Japan. In 2011, these three countries accounted for over 45 percent of the Dutch import value of ICT goods. The rapid emergence of China as a trading partner is striking; see Figure 2.4.5. Over 28 percent of imported ICT goods came from China in 2011, while China's share of Dutch ICT imports in 1996 was still a mere 2 percent. Another emerging region in the area of ICT is Eastern Europe. The Eastern European countries that have been part of the European Union for the past few years function as 'low-wage countries' close to home for Western Europe. The cultural differences with these countries are not as big, which makes it easier to conduct business.

### 2.4.5 Countries with the highest share of the import of ICT goods, 2003–2011



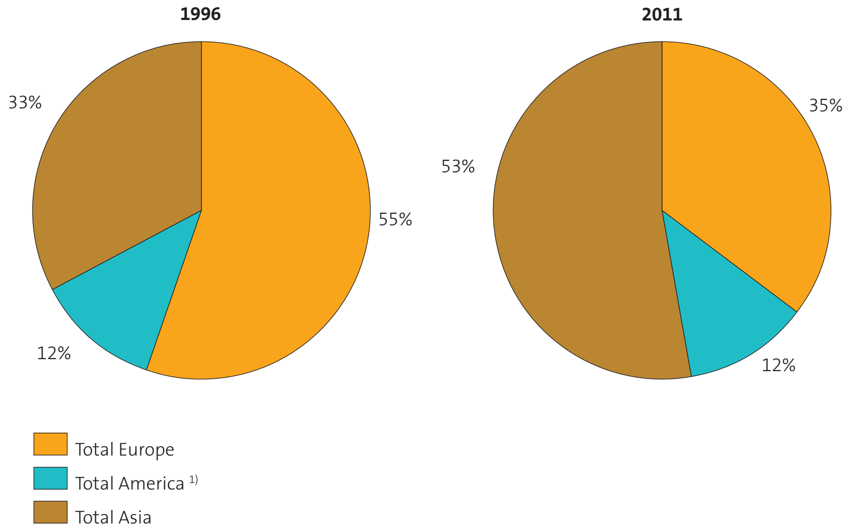

Source: Statistics Netherlands, International Trade.

In proportion, the Netherlands imported less ICT from Western Europe than it did during the years prior to the change of the century, while by contrast, imports from Eastern Europe increased since 2000. The import of ICT from Asian countries also increased over the last decade, especially due to the sharp increase in the import from China. In addition, there were strong shifts among Asian countries themselves. These shifts are occurring because manufacturers are always looking for the cheapest production locations. Figure 2.4.6 illustrates the shift from Europe and the United States to Asia.

The key countries to which the Netherlands exported ICT goods in 2011 were Germany, the United Kingdom and France. Germany has been the most important export destination for ICT goods for the Netherlands for years. Germany accounts for over one fifth of the Dutch ICT-related export value.

Over the past decade, Dutch ICT exports have shifted somewhat from Western to Eastern Europe. Poland and Hungary in particular have increased their share. Over the years a somewhat lower percentage of exports went to the United States. India's and China's share of Dutch ICT-related exports have increased over the past decade, but are still relatively small compared to other countries.

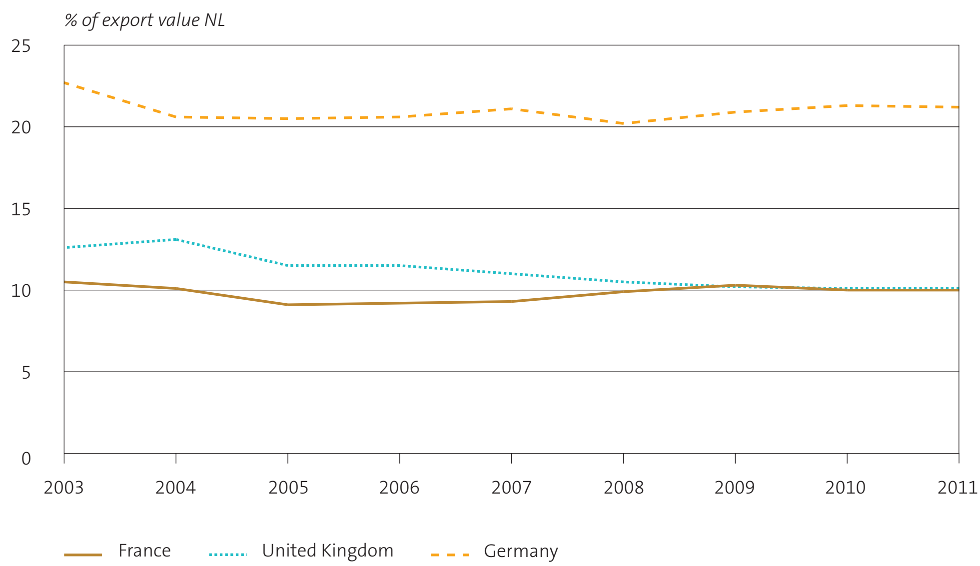
## 2.4.6 Breakdown of Dutch imports by continent, 1996 and 2011




Source: Statistics Netherlands, International Trade.

[1] America here is defined as North and South America.

## 2.4.7 Countries with the highest share of the export of ICT goods, 2003–2011




Source: Statistics Netherlands, International Trade.

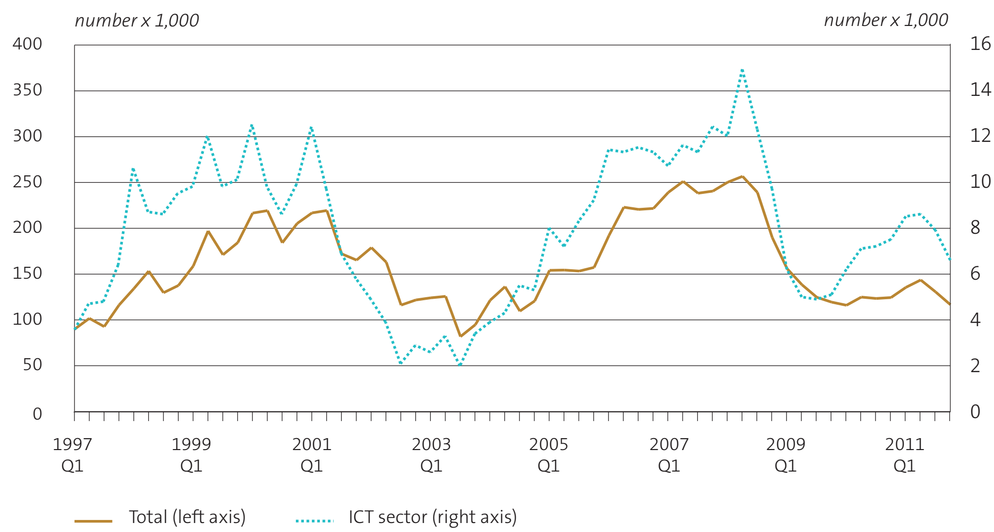
# 2.5 ICT and employment

This section discusses the trend in the number of job openings in the ICT sector, in part using the recent economic crisis as a backdrop. In addition, this section identifies the business sectors in which ICT workers are primarily employed and analyses the background characteristics of these individuals. These characteristics are compared with the rest of the labour force. The section concludes with the international figures concerning the percentage of employed ICT workers in the labour force.

### Number of job openings in ICT sector shows recovery

After reaching a low point in the third quarter of 2009, the number of ICT job openings rose once again to 8.6 thousand in the second quarter of 2011 (Figure 2.5.1). The number of job openings then once again fell to 6.6 thousand in the fourth quarter of 2011. In the second quarter of 2008, the number of job openings in the ICT sector reached a peak. After this, the economic crisis occurred and the number of job openings quickly declined.

**2.5.1 Job openings in the ICT sector and in the rest of the economy, 1997–2011[1)]**




Source: Statistics Netherlands, Survey of Job Openings.

[1)] The ICT sector here is defined as comprising the SIC 2008 61, 62 and 63 groups.

The total number of job openings in the economy reached a low point in the first quarter of 2010, followed by a cautious recovery. However, the number of job openings in the overall economy once again declined as of the second half of 2011.
Although the trend in the number of job openings in the ICT sector shows strong similarities with the trend of job openings in the rest of the economy, there are some differences as well. At key points, the ICT sector ran somewhat ahead of the rest of the economy. After its low point in 2009, the ICT sector ran ahead in terms of the increase in the number of job openings. Indeed, the number of job openings in the ICT sector already started to increase at the end of 2009, while the job market in the rest of the economy only started to revive during the course of 2010. A similar pattern was evident around the turn of the century. Immediately after the end of the internet hype, the number of ICT job openings declined ahead of the decline in the number of job openings in the rest of the economy. The ICT sector at these points in time served as an early indicator of the trend of the entire economy.

# ICT sector precursor on job market

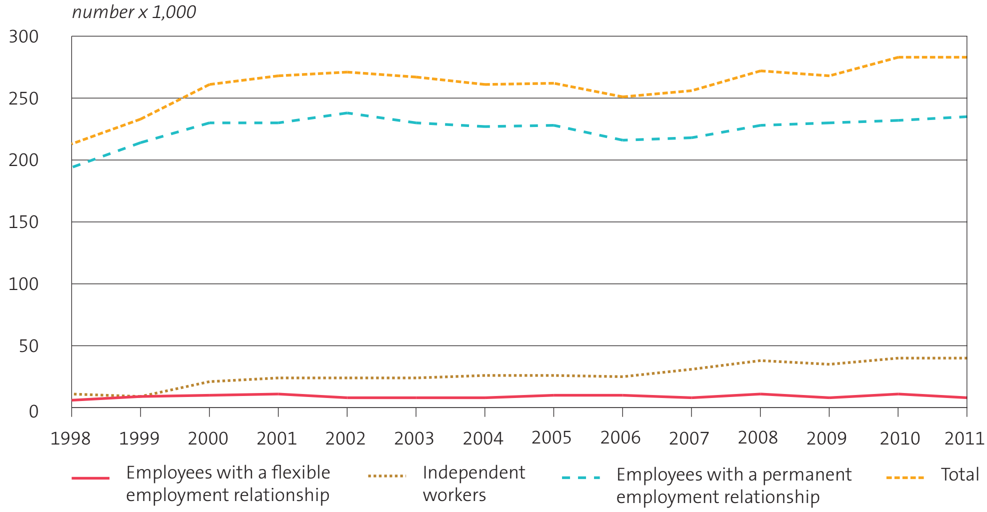
### Increasingly more independent ICT workers

In 2011, there were 283 thousand ICT workers in various business sectors of the Dutch economy, the same number as in 2010. By far most of them were in a permanent employment relationship; however, the number of independent ICT workers has grown sharply in recent years. In 1998, 5 percent of employed ICT workers were independent, whereas it had risen to 14 percent by 2011 (Figure 2.5.2).

### Few female ICT workers

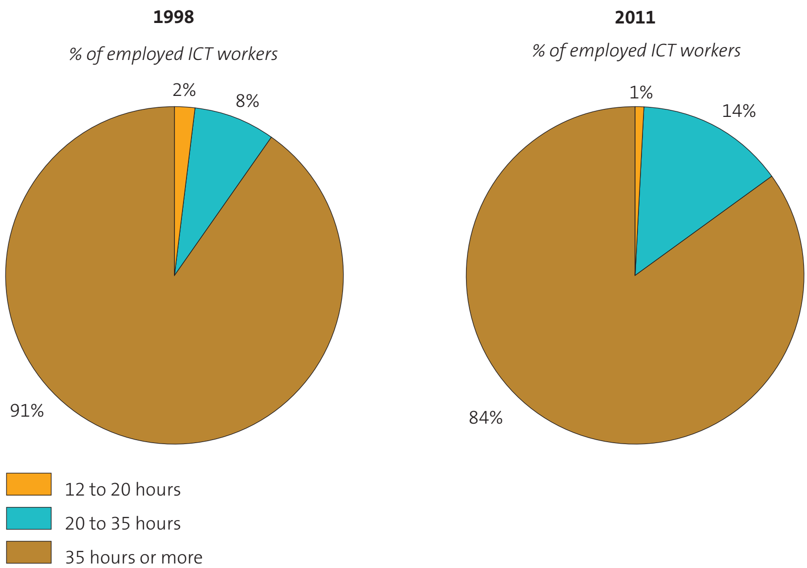
Most ICT workers are men. The proportion of female ICT workers fluctuates around 11 percent. This is significantly lower than the proportion of women working in the economy as a whole, which was 45 percent in 2011. The proportion of women employed in the ICT sector during 1998–2011 remained virtually constant, while the proportion in the rest of the economy increased by 5 percentage points.
The proportion of part-time workers in the employed labour force grew in recent years. This is also true for the ICT sector. The percentage of part-time jobs (less than 35 hours per

### 2.5.2 Employed ICT workers, 1998–2011




Source: Statistics Netherlands, Labour Force Survey.

### 2.5.3 Working hours per week, 1998 and 2011

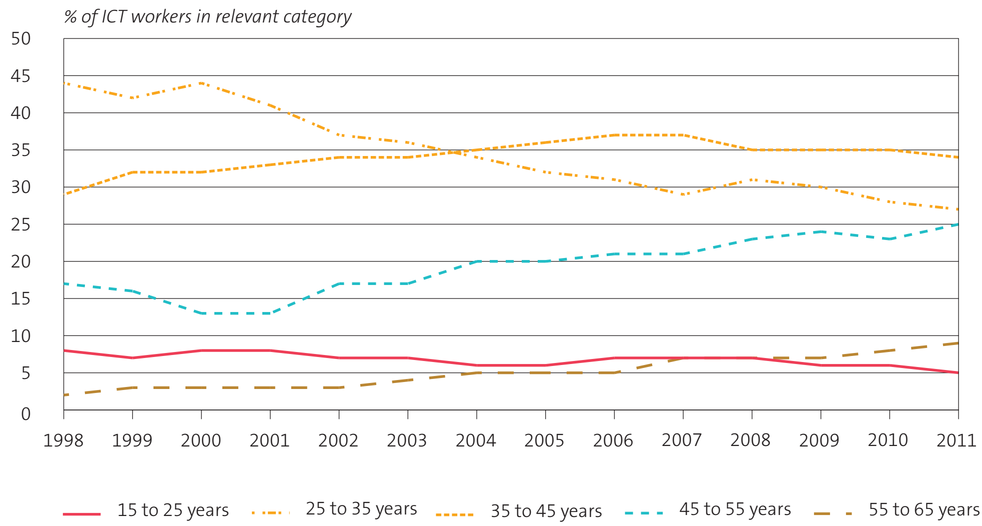



Source: Statistics Netherlands, Labour Force Survey.

week) in the ICT sector rose from 10 percent in 1998 to 15 percent in 2011 (Figure 2.5.3). This proportion is significantly higher in the total economy: 41 percent in 2011. This variance is also related to the larger proportion of men in the ICT sector, as men do not work part-time as often as women do.

Over the years there have been only minor shifts in the characteristics of ICT workers. The most common ICT worker is still male, highly educated, 25 to 45 years of age, and employed full-time as a salaried worker. Figure 2.5.4 shows that ICT workers are slowly but surely migrating to a different age category. The proportion of ICT workers in the 25 to 35 age group has been showing a declining trend for years. The group of ICT workers aged 45 to 65 is growing, especially as of the beginning of this century. The increase in young ICT workers has therefore been lagging since this time.

### 2.5.4 Age of ICT workers, 1998–2011




Source: Statistics Netherlands, Labour Force Survey.

Detailed figures concerning the characteristics of ICT workers are contained in the statistical annex to this publication. The statistical annex can be consulted online at www.cbs.nl/ICT-knowledge-economy.

### ICT workers primarily employed in business services

In 2010, almost half of employed ICT workers were active in the 'information and communication' business sector. The majority worked for ICT service providers. The absolute number of ICT workers working in public administration, manufacturing sector and financial institutions is also very high (Table 2.5.5).
In 2010 employed ICT workers represented 3.8 percent of the total employed labour force. Table 2.5.5 shows that ICT workers are highly over-represented in a number of sectors. In addition to ICT service providers, this also concerns telecommunications and to a lesser extent financial services.

### 2.5.5 Employed ICT workers by business sector, 2008–2010[1)]

| | 2008 | 2009 | 2010 | 2010 |
|---|---|---|---|---|
| | *number (x 1,000)* | | | *ICT workers as a % of the total employed labour force* |
| Total employed ICT workers | 276 | 273 | 283 | 3.8 |
| Agriculture, forestry and fisheries | 0 | 0 | 0 | 0.2 |
| Extraction of mineral resources | 0 | 0 | 0 | 4.3 |
| Manufacturing sector | 22 | 20 | 21 | 2.5 |
| Production and distribution of and trade in electricity, natural gas | 3 | 3 | 3 | 7.7 |
| Extraction/distribution of water; waste/waste water management and decontamination | 0 | 0 | 2 | 4.0 |
| Construction industry | 4 | 5 | 4 | 0.8 |
| Wholesale and retail; car repair | 14 | 15 | 15 | 1.5 |
| Transportation and storage | 5 | 6 | 6 | 1.8 |
| Accommodation, provision of food and beverages | 0 | 0 | 0 | 0.1 |
| Information and communication | 131 | 127 | 134 | 45.2 |
| of which: | | | | |
| Publishers, production and distribution of films and television programmes | 3 | 2 | 2 | 2.9 |
| Telecommunications | 8 | 8 | 8 | 15.7 |
| Service-related activities in the area of information technology | 120 | 117 | 124 | 67.8 |
| Financial institutions | 19 | 19 | 19 | 8.1 |
| Lease of and trade in immoveable property | 0 | 2 | 0 | 2.0 |
| Consultancy, research and other specialised business services | 19 | 17 | 17 | 3.2 |
| Lease of moveable goods and other business services | 9 | 8 | 8 | 2.6 |
| Public administration, government services and compulsory social security | 23 | 24 | 21 | 3.9 |
| Education | 12 | 9 | 10 | 1.8 |
| Healthcare and welfare | 9 | 11 | 12 | 0.9 |
| Culture, sport and recreation | 2 | 0 | 0 | 0.9 |
| Other services | 3 | 3 | 4 | 2.4 |
| Extraterritorial organisations and bodies | 0 | 0 | 0 | 0.0 |

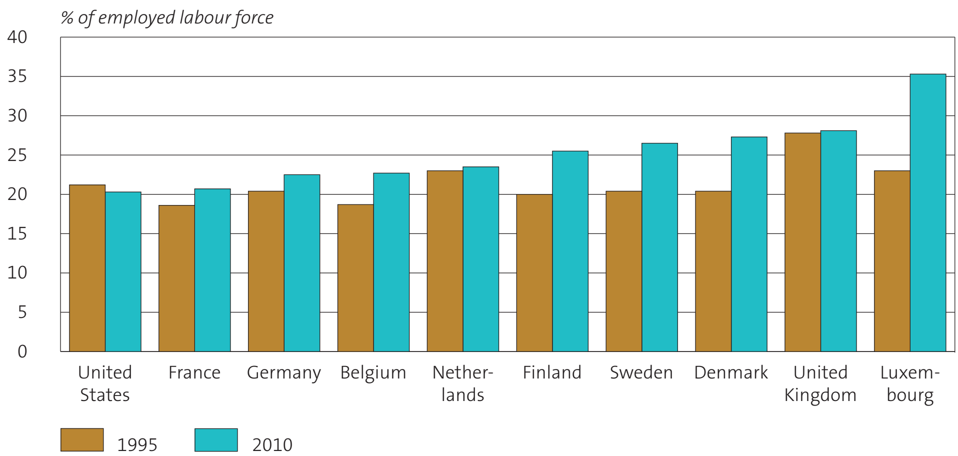
Source: Statistics Netherlands, Labour Force Survey.

1) ICT workers are defined here as codes 514, 666, 714 and 914 of the International Standard Classification of Occupations (ISCO).

### From a European perspective the Netherlands has many ICT workers

Various definitions of the 'ICT worker' concept are in common use in various international discussion forums. In a narrow sense, ICT workers are ICT specialists who develop, operate and maintain ICT systems. ICT is the focal point of their work. In addition, a broader definition is in use that also includes advanced and basic users of ICT and software tools. Figure 2.5.6 displays the proportion of employed ICT workers using this broader definition (in other words including ICT users) as a percentage of the labour force. In 2010, at 35 percent, Luxembourg had the highest percentage of ICT users among its labour force. Other leading countries are the United Kingdom, Denmark, Sweden and Finland. The Netherlands ranks in sixth place on this list. The percentage of ICT workers defined in a broad sense increased in most countries in relation to 1995. The United States is an exception to this rule.

**2.5.6 Employed ICT workers (broad definition) in relation to the employed labour force, 1995 and 2010[1)2)]**




Source: OECD, Factbook 2011.

1) The broad definition of ICT workers is based on the methodology described by OECD (2004, Chapter 6; 2006). The percentages of non-European countries are not directly comparable with the percentages of European countries because the classifications have not been harmonised.
2) Finland and Sweden: 1997 instead of 1995.

# Telecom-munications

# 3

# Telecommunications

## 3.1 Internet
- The volume of data traffic through mobile internet is growing rapidly
- The Netherlands is a world leader in 50+ Mbps broadband coverage
- High-speed mobile internet is available almost everywhere

## 3.2 Telephony
- Fixed telephony is stabilising
- A high number of mobile telephone connections

## 3.3 Television and radio
- Scarcity 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 over the internet (IPTV)
- Digital television through cable most widely used
- Digital radio provides solution to scarcity of frequency
- Digital radio not yet very well known
- Many broadcasters provide digital radio over the internet

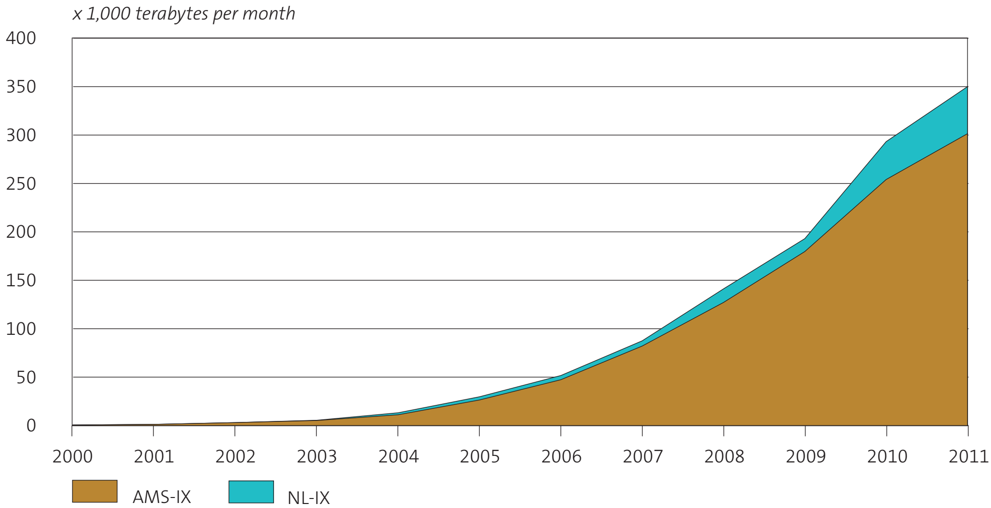
## 3.4 Telecommunications pricing trends
- Telephony and internet prices are once again on the rise
- The cost of telephones has sharply declined
- Prices are not increasing in all countries
- The price of a broadband connection in the Netherlands is average in international terms

**A solid infrastructure is indispensable for the efficient application of ICT. The general availability of broadband internet, for example, facilitates quick interaction between business partners. Media, such as television and radio also benefit from a proper ICT infrastructure. New applications are increasingly availing themselves of telecommunication networks and consequently stimulate telecommunication developments.**

# 3.1 Internet

This section describes telecommunications 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 telecommunications services. An example in this regard is IP telephony (VoIP). 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, VoIP is discussed in the section on telephony, even though the underlying technology is based on the internet.
The volume of internet traffic has been increasing sharply for years and also further increased in 2011. This is an important indication of both an increase in the number of internet users and the traffic generated by 'heavier applications'. Figure 3.1.1 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. Over 300,000 terabytes (on average, this is 25 times the contents of a normal DVD per second) of traffic were registered by AMS-IX in December 2011. This constitutes an increase of over 20 percent relative to December 2010, when over 250,000 terabytes were registered. The growth in the year prior this was over 40 percent, however. The decreased growth of the AMS-IX is in part explained by the increase in traffic via another Dutch internet exchange: NL-IX. The collective growth of both exchanges levelled off somewhat in 2011, but in spite of this was still significant. Internet traffic also continues to increase in volume globally. The DE-CIX – the Internet Exchange in Frankfurt – is the largest internet hub in the world. In December 2011, the traffic registered in Frankfurt exceeded the amount registered at AMS-IX by approximately 15 percent (DE-CIX, 2012).
The continuing strong growth in internet traffic is being driven primarily by the growth of services that require large capacity, such as video traffic (in terms of the volume as well as the quality of video), the use of cloud services (such as the online backup and storage of files) and cloud gaming. The expectation is that this traffic will undergo substantial further growth in the coming years due to the advent of HDTV and 3DTV (CISCO, 2010).

## 3.1.1 Volume of internet traffic via AMS-IX and NL-IX, 2000–2011[1)]




Source: AMS-IX; NL-IX.

1) AMS-IX: Measured in December of the year specified. NL-IX: Measured in the last quarter of the year specified.

**Overview of internet connection types**

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

**Fixed connections**

*Dial-in connection* (max. 128 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 from the home or office to the local exchange by a telephone line (copper wire), 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 the telephone and internet can be used simultaneously. The term 'asymmetric' refers to the difference in upload and download speed. A limitation in using the telephone line in this way is that the maximum speed achievable decreases with the length of copper wire used, which means that a user's internet speed depends on the distance to the local exchange.

*ADSL2, ADSL2+* (max. 24 Mbps download, 1.3 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. 300 Mbps download, 13 Mbps upload). Subscriptions up to 50 Mbps are currently being offered on an almost national scale. 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 or the office and the street node, after which the signal is further transported by optical fibre cables.

*Cable internet* (max. 4.5 Gbps download, 575 Mbps upload). Subscriptions up to 120 Mbps are currently being offered on an almost national scale. In this case, internet traffic is transported from the home or the office to the local exchange by the RTV coaxial cable 'alongside' the radio and television signals, after which it is further transported by optical fibre.

*Satellite internet* (max. 10 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.

*Optical fibre to the home (max*. 10 Gbps download and upload). Subscriptions up to 500 Mbps are currently being offered on a limited scale. The optical fibre in this case runs to, or even into, the home or the office. There are two widely used methods. The first of these is optical fibre cables continuing into individual homes: Fibre to the Home (FttH). The alternative is to lay an optical fibre cable up to an outer wall of the building: Fibre to the Building (FttB). In that case, the internet traffic is then transported into the building by means of an internal network (LAN) or through the traditional telephone cable, for example.

*WiFi* (max. 540 Mbps). This type of connection is used as wireless internet in the home, office or in the vicinity of 'hot spots' (antennas placed at busy locations such as stations). Its range is limited: with a regular antenna, signals can be received up to approximately 30 metres away. WiFi uses a fixed internet connection that is converted to a wireless signal via a router, and does not make use of mobile telephone networks. For that reason, WiFi here is covered under fixed connections rather than mobile connections.

**Mobile connections**
*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). This type of connection is also known as 3G (third generation mobile network). Internet traffic is likewise sent and received through the network of UMTS antennas.

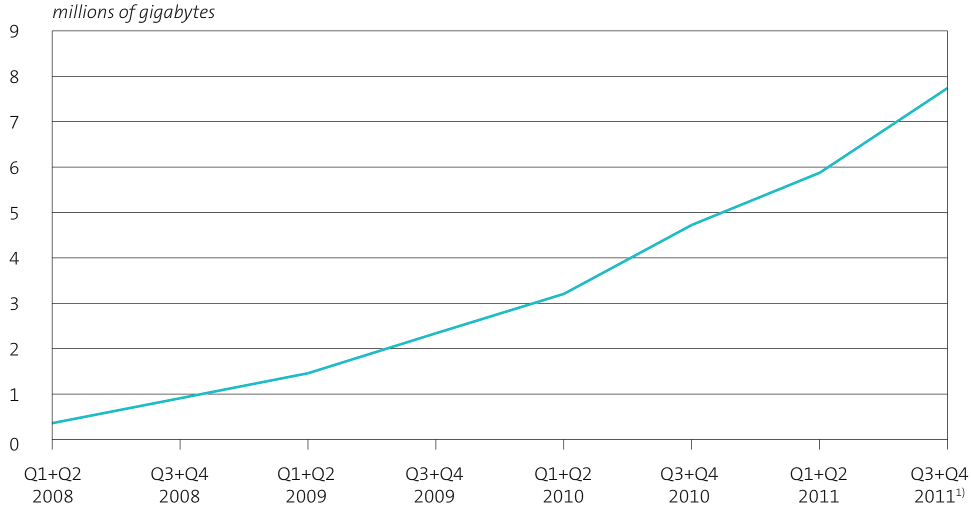
*High-Speed Downlink Packet Access, HSDPA and High-Speed Uplink Packet Access, HSUPA* (max. 14.4 Mbps download, 2 Mbps upload). This type of connection is also known as 3.5G and 3.75G. Internet traffic is likewise sent and received through the network of UMTS antennas. A higher speed is achieved due to the use of newer technologies, however.

*Long Term Evolution*, *LTE* (max. 125 Mbps download, 50 Mbps upload). Although this technology is often referred to as 4G, it does not as yet meet 4G conditions. Its successor, *LTE Advanced*, with a maximum download speed of 1 Gbps, does meet these conditions. The Netherlands has not yet commissioned any commercial LTE networks. LTE can to a large extent use existing GSM and UMTS networks.

## The volume of data traffic through mobile internet is growing rapidly

Smartphones and tablets are driving tremendous growth in mobile data traffic. Figure 3.1.2 shows that the total volume of mobile data traffic in the Netherlands was as low as 360,000 gigabytes in the first two quarters of 2008. In the same period of 2010, this volume had increased almost tenfold to 3.2 million gigabytes. In the third quarter of 2011 alone, mobile data traffic was 3.9 million gigabytes and the projection is that mobile data traffic in the last two quarters of 2011 was approximately 8 million gigabytes. It must be noted that this figure still only accounts for a few tenths of a percent of the total volume of data traffic registered at AMS-IX during the same period.
A global survey of data use through mobile internet based on a combined total of 210 million subscribers revealed that, at 35 percent in 2010, video streaming accounted for the highest data use, followed by web browsing at 29 percent (Allot Mobile Trends, 2011).

**3.1.2 Mobile internet data volume, 2008–2011**




[1)] Based on an estimate for 2011 Q4.

Source: OPTA.

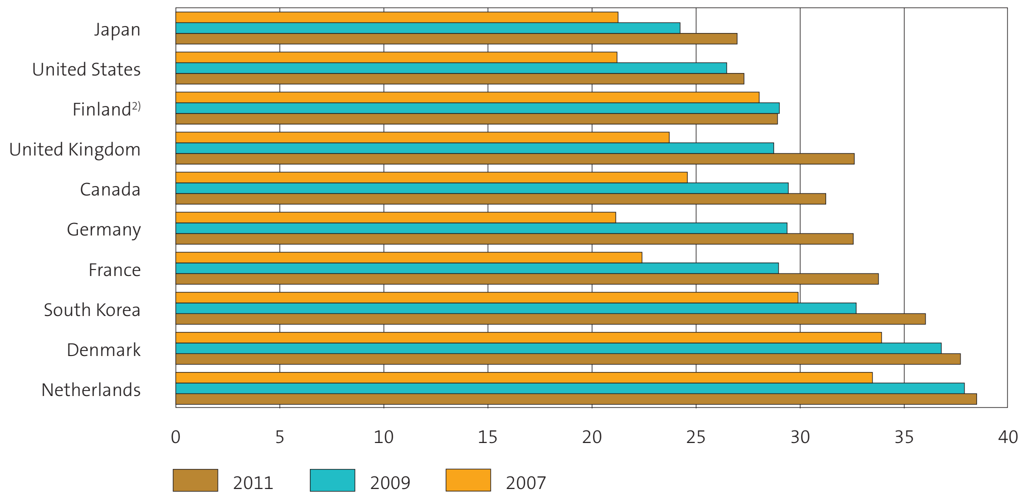
# Mobile internet is growing rapidly

### The Netherlands is a 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' (Ministry of Economic Affairs, 2004). 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 most of the 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 these definitions.

Nevertheless, the figures on broadband internet presented in the rest of this section do not include mobile connections.
Virtually all households and companies in the Netherlands currently (2012) use only broadband internet connections. Figure 3.1.3 shows that in 2011 the Netherlands had the highest number of broadband connections per 100 inhabitants of OECD countries, just ahead of Denmark. This has been the case for several years now. The number of broadband connections is still increasing every year. However, growth has slowed in recent years, particularly in countries where broadband penetration is already high.

**3.1.3 Number of broadband connections per 100 inhabitants, international, 2007–2011[1)]**




Source: OECD.

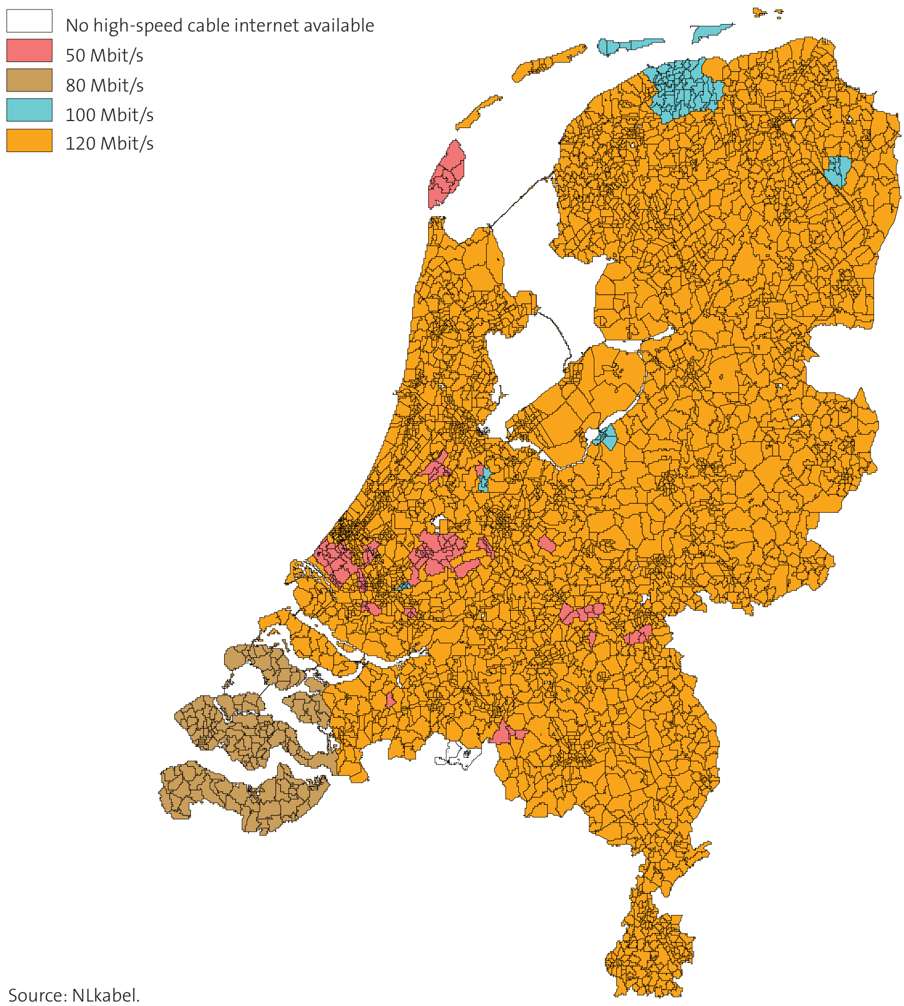
1) Situation in June of the relevant year. Excluding mobile connections.
2) After 2009 fixed wireless connections and satellite connection are no longer included in the figures. Finland's figure is consequently lower in 2011.

In technical terms, almost all households in the Netherlands have the option of acquiring a broadband connection. For example, ADSL is available to over 99 percent of the population (KPN, 2008), and cable internet is available to approximately 98 percent of the population (Statistics Netherlands, 2009a).[1)] All cable operators currently dispose of a Hybrid Fibre Coax (HFC) network that almost entirely consists of optical fibre. On average,

1) Some households cannot be connected on a cost-effective basis, e.g. due to the distance separating them from the local exchange or the distance to the existing network.

coaxial cable is used for the last three hundred metres, up to the home or the office. All cable operators now apply the new EuroDOCSIS 3.0 standard to this coaxial cable, which makes very high-speed connections possible. As a result, high-speed cable internet with download speeds from 100 Mbps already provides significant coverage (Figure 3.1.4). This means that the Netherlands has the highest coverage of 50+ Mbps broadband connections in Europe and is only surpassed by South Korea, Hong Kong and Singapore (NLkabel, 2011). In addition, investments are also being made in other networks designed to enable high-speed internet, such as VDSL and Fibre to the Home (FttH).

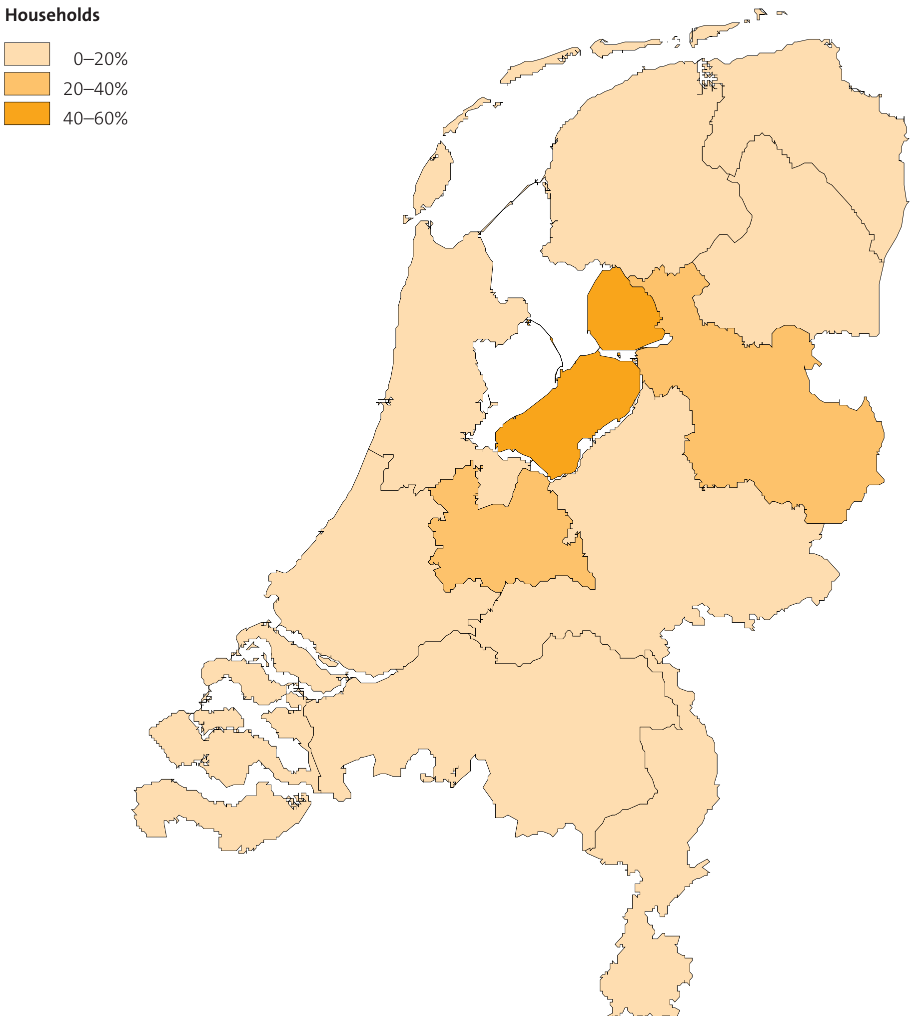
### 3.1.4 Cable internet coverage, 2012




Source: NLkabel.

The installation of optical fibre cables up to or continuing into the home is progressing; however, not all households in the Netherlands can opt for an optical fibre connection in 2012. Figure 3.1.5 shows the coverage of optical fibre per province in December 2011. Especially in Flevoland, many homes (57 percent) are now connected to the optical fibre network. In that province, 13 percent of households had actually taken out a subscription for internet over an optical fibre connection. In terms of the figures per province it should be noted that the coverage within a province is often limited to several cities.

### 3.1.5 Optical fibre coverage




Source: Stratix Glasmonitor 2012.

From an international perspective, the Netherlands is not in the lead in terms of the use of optical fibre networks. South Korea and Japan, with 22 and 17 connections per 100 inhabitants respectively, have a strong lead over all other countries (Figure 3.1.6). In 2011, the Netherlands had a mere 1.4 connections per 100 inhabitants. The increase in the number of optical fibre connections that occurred in the Netherlands in 2006 and 2007 did not continue in subsequent years. The number in recent years grew by 5 percent per year.

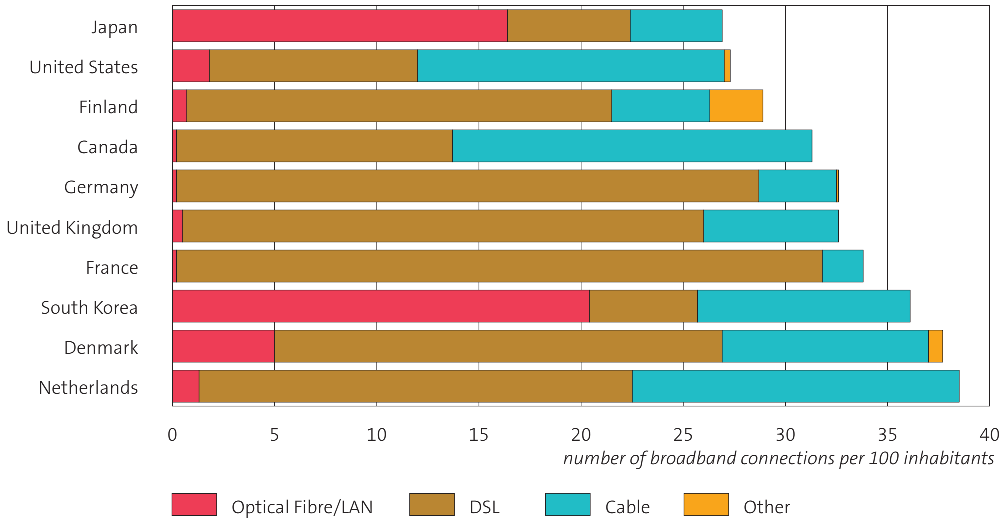
### 3.1.6 Optical fibre connections, 2005–2011


Source: Point-Topic.

Figure 3.1.7 presents an international comparison of the access technology used for broadband in June 2011. The figure concerns only fixed connections and does not include mobile broadband access. In the middle of 2011, the internet was used in the Netherlands primarily by means of ADSL (55 percent of internet connections) and RTV cable (42 percent of internet connections). In comparison to 2010, the proportion of RTV cable connections rose by 3 percentage points, while the proportion of ADSL connections dropped by 3 percentage points.
Internationally there are major differences in terms of the access technology used. 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 through cable 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. As mentioned earlier, Japan and South Korea make extensive use of optical fibre connections, while cable and DSL connections are used on a smaller scale. More than 50 percent of broadband connections in these countries is currently provided over fibre to the home. At over 3 percent, the corresponding figure for the Netherlands is much lower.

### 3.1.7 Broadband internet access technology, international, June 2011[1)]




Source: OECD.

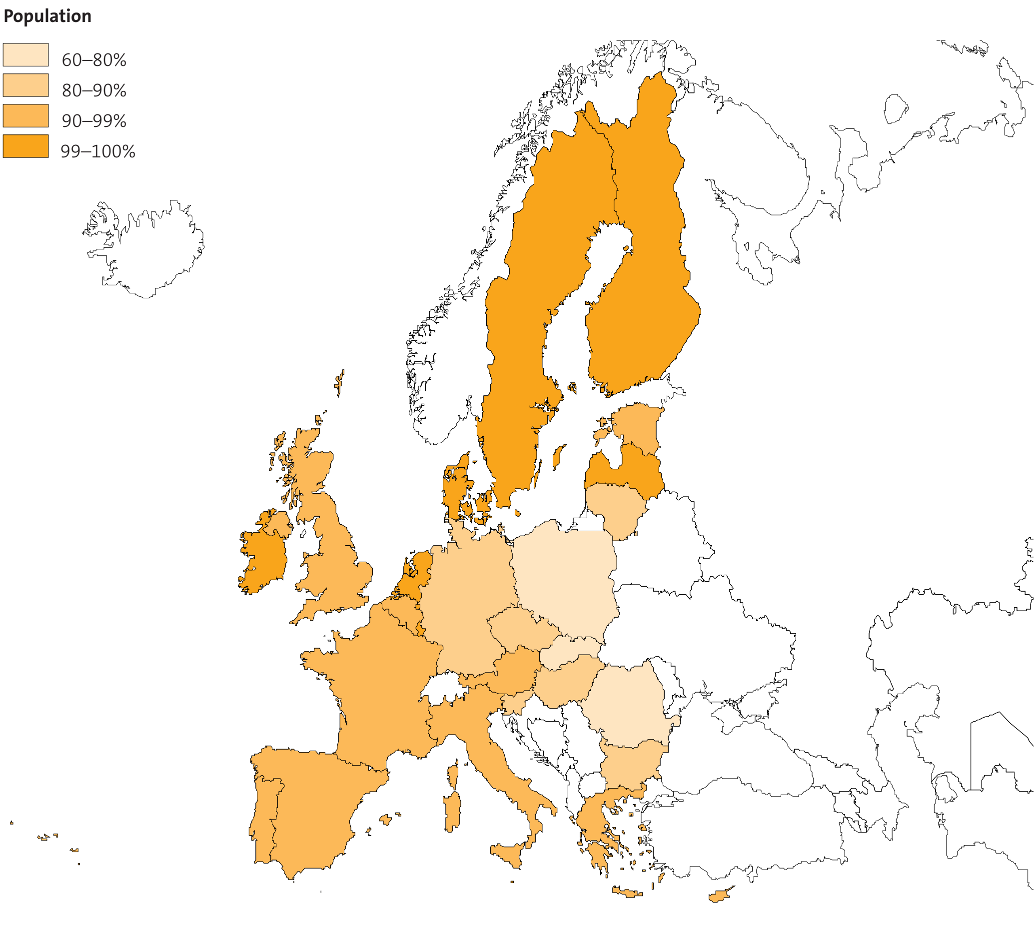
[1)] Excluding mobile connections.

### High-speed mobile internet is available almost everywhere

3G coverage in the Netherlands is almost 100 percent. This means that almost everyone in the Netherlands lives in a region with sufficient signal for high-speed mobile internet. Actual access is, however, dependent on various factors, such as the distance to the UMTS tower and the number of users on the network. At 95%, 3G coverage was somewhat less extensive in France and the United Kingdom in 2011. The coverage in Germany was 89 percent. 3G coverage for the EU as a whole was 90 percent in 2011 (Figure 3.1.8).
In mid-2011, there were 44 mobile broadband subscribers per 100 inhabitants in the Netherlands (Figure 3.1.9). A quarter of these were dedicated mobile data subscriptions used, for example, by a laptop or tablet. The relative number of mobile broadband

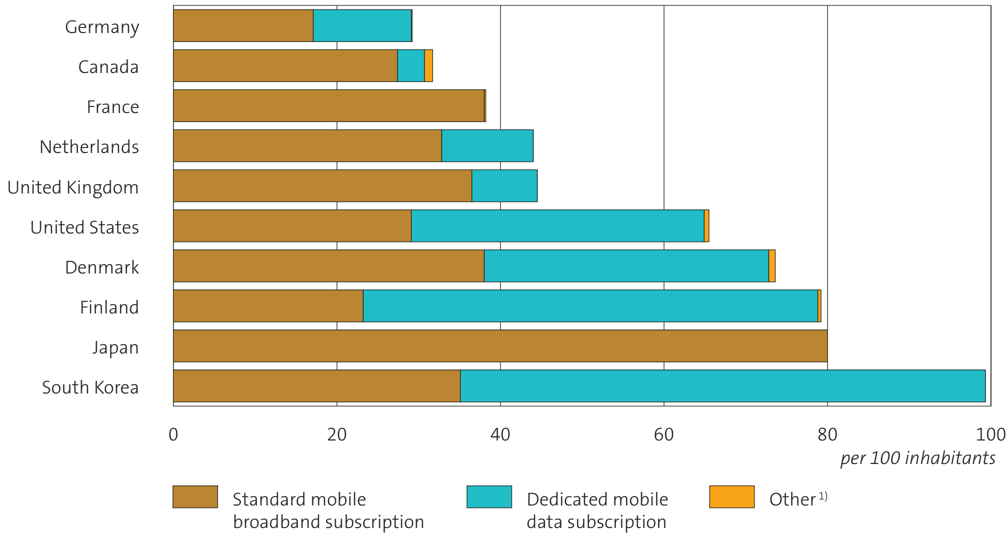
subscriptions in the United Kingdom was just as high as in the Netherlands. France is lagging somewhat (38) and Germany scored still lower (29 per 100 inhabitants). South Korea had the largest relative number of mobile broadband subscriptions: 99 per 100 inhabitants. Two thirds of these were dedicated mobile data subscriptions.

### 3.1.8 3G Coverage in the EU




Source: European Commission, Digital Agenda Scoreboard 2011.

### 3.1.9 Mobile broadband internet, June 2011




Source: OECD.

[1] This includes mobile broadband internet over satellite and over fixed wireless connections.

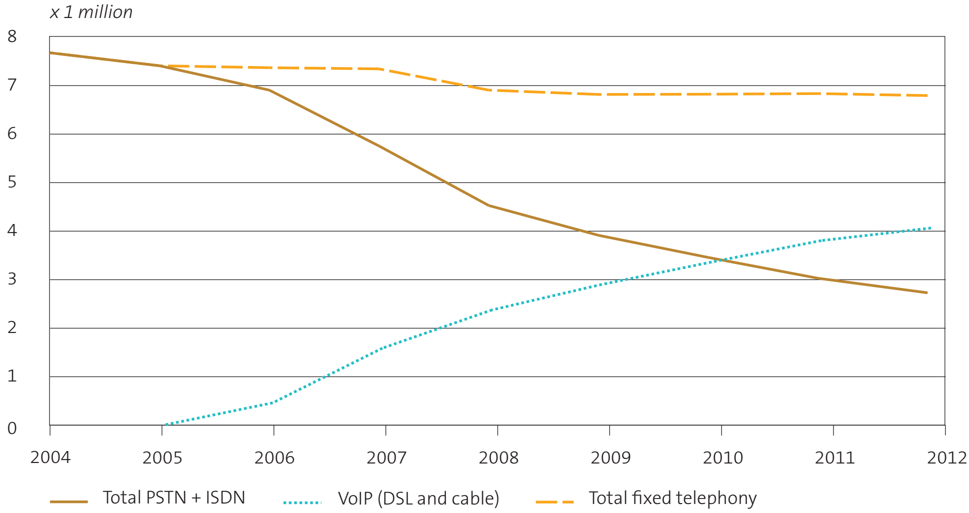
# 3.2 Telephony

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 (VoIP) are coming increasingly to the fore. This section will first present figures on fixed telephone connections, including VoIP, and subsequently discuss mobile telephony.

### Fixed telephony is stabilising

In technical terms, practically all households in the Netherlands can be connected to the 'fixed' telephone network (PSTN). The fixed network is very extensive and provides full 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 and dropped down to 6.8 million by the third quarter of 2011.

### 3.2.1 Fixed telephone connections, by access technology, 2004–2012




Source: TNO, Electronic Communications Market Report.

1) 2004 relates to the end of the fourth quarter 2003.

Telephony over a broadband internet connection (VoIP) was introduced in 2005. Figure 3.2.1 shows the emergence of VoIP. VoIP once again experienced strong growth in 2011 and accounted for 4.1 million connections by the third quarter of 2011. At the beginning of 2010, the total number of VoIP connections exceeded the combined total of ISDN and regular analogue (PSTN) telephone connections for the first time. Until the end of 2007, a significant 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 acquisition of a VoIP subscription.

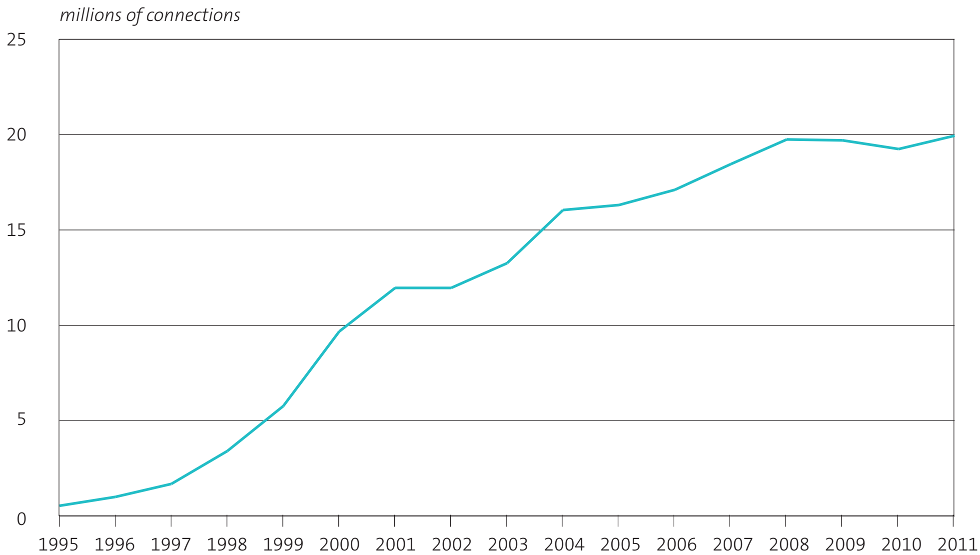
At the end of 2011, half of VoIP connections (52 percent) were provided over RTV cable and 43 percent over a DSL connection. Almost 5 percent of VoIP connections were provided over an optical fibre connection (FttX).

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 portion of households opted to use only mobile telephone services.

### A high number of mobile telephone connections

Mobile telephony in the Netherlands began to emerge in the mid-nineties. The number of mobile telephone connections grew sharply at the end of the nineties to almost 10 million in 2000 (Figure 3.2.2). The number of connections continued to grow after the year 2000, albeit in accordance with a less stable pattern. 2008 saw a slight decline due to the clean-up of the prepaid customer base by a number of mobile telephony providers. At the end of 2011 there were 19.9 million mobile telephone connections (both prepaid and subscriptions), an increase of 3 percent relative to the end of 2010. The number of mobile telephone connections exceeds the number of inhabitants in the Netherlands. Some people have two or more mobile telephones, for example one for work and one for personal 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 or tablets 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, especially considering the increasing speeds provided by the mobile data network.

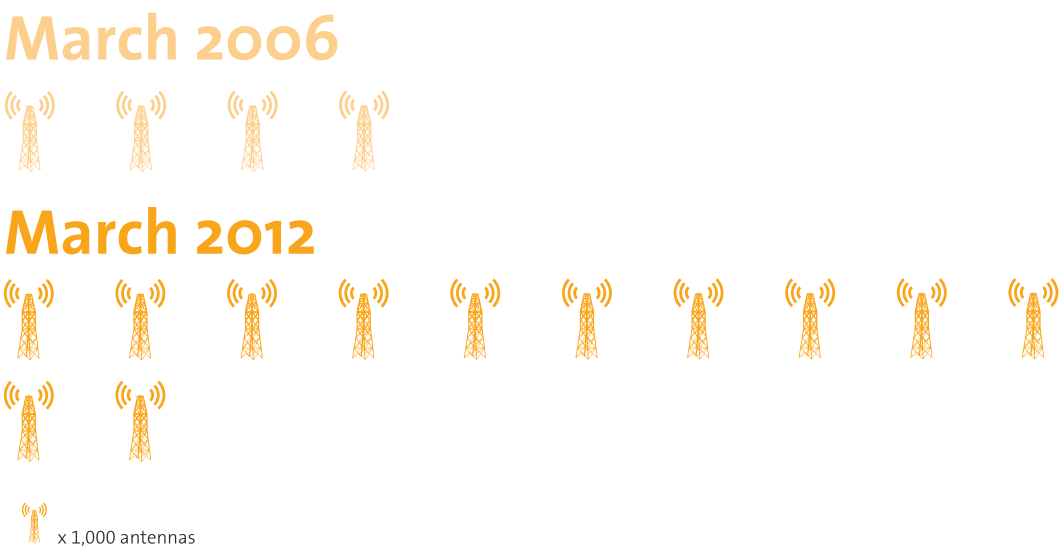
**3.2.2 Trend in the number of mobile telephone connections in the Netherlands**




Source: TNO.

In international terms, the Netherlands has a relatively high number of mobile telephone connections. 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. In terms of absolute numbers, the Netherlands only plays a minor role, with almost 20 million connections. For example, in China there were almost 1 billion mobile connections at the end of 2011 (National Bureau of Statistics of China, 2012).
The mobile telephone network in the Netherlands almost provides full national coverage. In March 2012, there were 13,507 antennas for GSM services, the most widely used mobile telephony standard, throughout the country. This is 237 more than in March 2011 (Antennebureau, 2012). The number of antennas for UMTS services, the successor of the GSM standard, increased even more sharply in the same period by 1,373. In March 2012, there were 11,653 UMTS antennas in the Netherlands.

**Number of UMTS antennas tripled**




# 3.3 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 over-the-air broadcasting. RTV cables were first connected to households in the 1960s. The cable provided better visual and audio quality than over-the-air broadcasting and also made it possible to receive more channels. The cable currently remains the most common way to receive television. In 2009, it was possible for 98 percent of Dutch households to take out a subscription for cable radio and television reception (Statistics Netherlands, 2009a). This means that the Netherlands has one of the densest cable networks in the world.

**Scarcity of frequencies for analogue radio and television**

Although the reception of analogue television through over-the-air broadcasting is a thing of the past (analogue broadcasts ended on 11 December 2006), analogue radio through over-the-air broadcasting still remains popular. Many car radios still use this technology, for example, as do mobile telephones with built-in radio receivers. The scarcity of frequencies is a major problem for current FM over-the-air broadcasters. The demand for terrestrial frequencies for radio broadcasting exceeds the available supply. For this reason, the government manages analogue terrestrial radio licences. Developing Terrestrial Digital Audio Broadcasting (T-DAB), which enables the frequency spectrum to be used more efficiently, 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 over-the-air 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 consisted of a connection 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 things, the digital data can be compressed. This makes it possible to transmit more

digital than analogue channels through the same transport 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 more channels.
The standard most often used in Europe for digital television signals is 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. Aside from DVB, Europe also uses the IPTV standard.
In addition to a standard package of channels, digital television also offers more extensive packages for an added fee. Generally, a special digital receiver (also referred to as a decoder, tuner or set-top box) with a smart card is required. 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. 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 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 as 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 (2012), 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.

In the third quarter of 2011, there were 853,000 subscribers of terrestrially broadcast digital television in the Netherlands. The corresponding figure for the preceding year was 898,000. After several years of strong growth, this form of digital television has therefore become somewhat less popular.

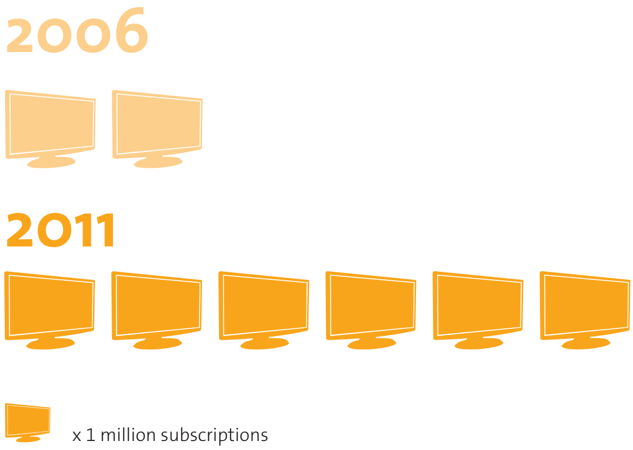
**Social television**

To an increasing extent, internet technology is transforming passive television viewing into a social event. The internet makes it possible for a television viewer to see what his or her friends are watching and thereby remain aware of the most interesting programmes, for example. Individuals discuss programmes prior to, during and after broadcasts with friends, other viewers and producers through social networks (Facebook, Hyves, Twitter).
Licensed broadcasters frequently respond to the need for communication about their programmes by setting up special pages about them on social media networks. This allows viewers to, for example, watch a broadcast or parts of it again, view additional videos and see previews of the coming episode. They can also read the comments of other viewers, express their own opinions and, if applicable, vote on participants in programmes. This kind of 'social television viewing' is becoming increasingly easier due to the advent of smartphones and tablets. Television sets that feature built-in social media technology have also become available. Further innovative applications in this area will probably be introduced in the coming years.

## 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 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; a single satellite 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. In the third quarter of 2011, 817,000 households were watching digital television through satellite. At the end of 2010, the corresponding figure was 941,000. The use of this form of watching digital TV has therefore decreased as well.

**Number of digital TV subscriptions has tripled**




### Digital television through cable

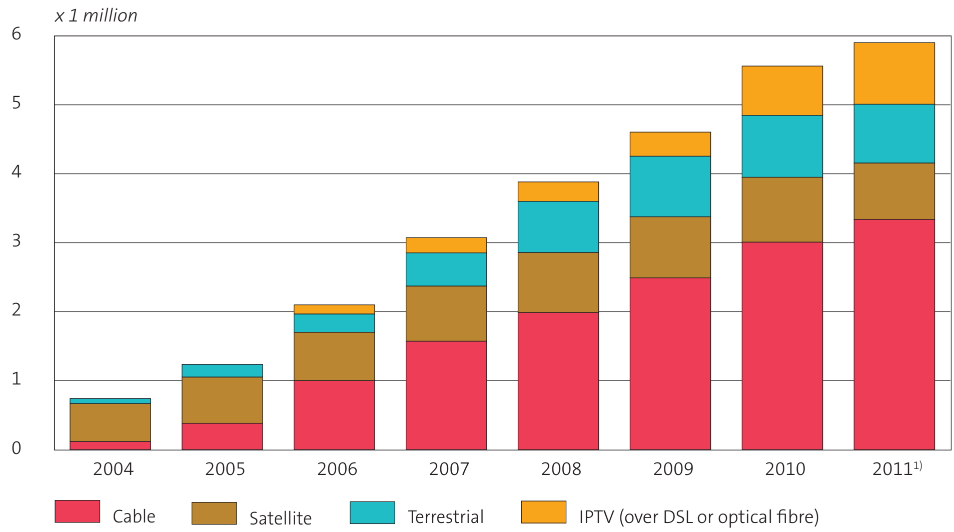
In the case of digital television through cable, signals are received by means of the RTV cable (coaxial cable). Additional antennas or dishes are not required. The standard used to transmit digital television through RTV cable is referred to as DVB-C (Digital Video Broadcasting – Cable). Relative to 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 generally continues to be transmitted together with the digital signal. Access to more than a hundred channels is provided, including dozens in high definition. Interactive services like Video on Demand (VOD) and 'missed broadcast' are possible. The number of households with digital television through cable rose in the third quarter of 2011 to 3.3 million. At the end of 2010, the corresponding figure was 3.0 million. This form of digital television therefore again achieved the largest absolute increase in the number of subscribers in the first three quarters of 2011. This has been the case since 2005.

### Digital television over the internet (IPTV)

A fourth way of receiving digital television is over 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. This form of digital television only transmits the channel opted for by the user.

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. An optical fibre connection or a high-speed DSL connection is often recommended. 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 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.
IPTV sharply gained in popularity in 2010. The number of connections more than doubled from 350,000 at the end of 2009 to 715,000 at the end of 2010. The number of connections again rose in 2011: in the third quarter of 2011, there were 894,000 subscribers. The number of IPTV users in 2011 consequently exceeded the number of digital TV connections through satellite and terrestrial broadcast television.

### 3.3.1 Digital television connections by reception method, 2004–2011




Source: TNO.

1) 2011 third quarter.

### Digital television through cable most widely used

In the third quarter of 2011, there were a total of 5.9 million digital television connections, 6 percent more than there were at the end of 2010. Figure 3.3.1 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 TV connections, while RTV cable has accounted for the largest share since 2006. In the third quarter of 2011, cable television had a market share of over 56 percent. IPTV is on the upswing; in 2010 and 2011 its market share sharply increased to 15 percent. The number of terrestrially broadcast digital television connections rose sharply between 2005 and 2009. However, this market share declined in 2010 and 2011.

### Digital radio provides solution to scarcity of frequency

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 specific radio receiver is required to listen to digital radio.
Frequently used standards for digital radio are Digital Audio Broadcasting (DAB) and DAB+, an improved version of the DAB standard. Terrestrial Digital Audio Broadcasting (T-DAB) is the version used for terrestrially broadcasting digital radio, similar to the method used to broadcast traditional FM and AM channels. 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 2011, 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 1 September 2015.

### Digital radio not yet very well known

T-DAB is not yet very well known among the Dutch population. Only 12 percent of the Dutch population had ever heard of T-DAB in 2011 (Table 3.3.2). Just over 3 percent in fact has a device capable of receiving digital radio over T-DAB. This is virtually the same as in 2010.

Men are more likely to be familiar with T-DAB than women. In addition, T-DAB is also better known among people with secondary and higher education than those with a lower level of education. The relatively high familiarity among the 65+ population is striking. Men with higher education are most likely to have a T-DAB device.

### 3.3.2 Familiarity with digital radio through T-DAB and ownership of required equipment

| | Heard about T-DAB at one time | Has a T-DAB receiver |
|---|---|---|
| | *% of the population aged 12 up to and including 74 in the relevant category* | |
| Total | 11.8 | 3.2 |
| Men | 16.3 | 4.4 |
| Women | 7.2 | 2.0 |
| 12–25 years | 8.7 | 3.0 |
| 25–44 years | 12.2 | 3.9 |
| 45–65 years | 12.0 | 2.7 |
| 65–75 years | 15.2 | 2.6 |
| Less educated individuals | 9.2 | 2.1 |
| Individuals with secondary education | 13.1 | 3.7 |
| Highly educated individuals | 13.6 | 4.0 |

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

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.

Digital Radio Mondiale (DRM) is a separate standard.[2)] This can be considered as the digital equivalent of 'shortwave'. The advantage of shortwave is that a broadcaster's range is far greater than that of an FM broadcaster. Disadvantages of shortwave are that more 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. In 2011, only Radio Netherlands Worldwide (RNW) broadcasted from the Netherlands according to the DRM standard.

2) 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.

# 12 percent are familiar with digital radio

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

A range of ‘streams’ (data streams) can be listened to over 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 over 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.

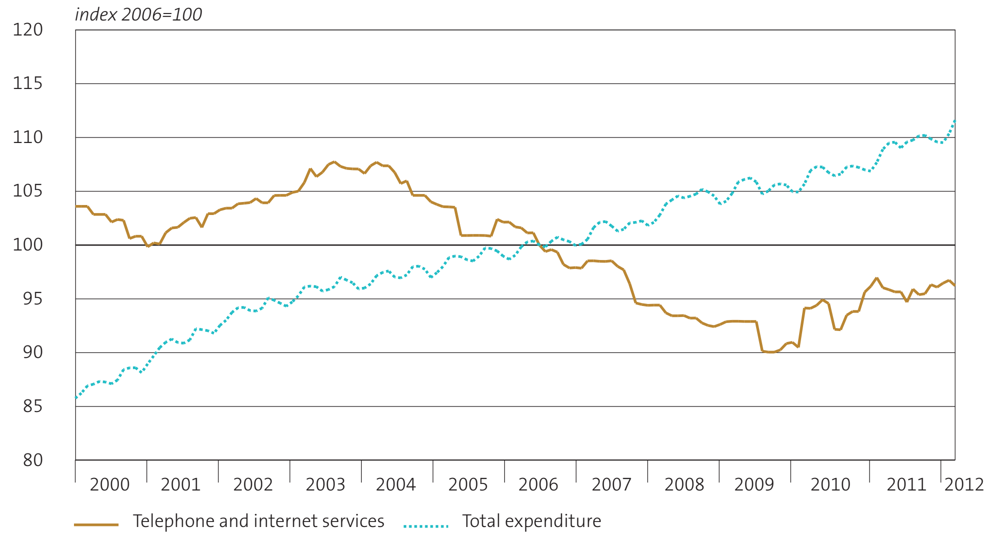
## 3.4 Telecommunications pricing trends

This section deals with telephony and internet pricing. Prices are compared between countries, as well as over time. Comparing telecommunications prices with earlier periods is not an easy task. Due to rapid technological developments, telecom products quickly lose their comparability with products from the past. For example, the speed of internet connections is regularly increased as a result of which its quality increases. Such improvements are often applied without (proportional) price increases. In such instances, the consumer receives greater quality for the same amount. Quality corrections are therefore applied to be able to nevertheless establish real price trends for such products. For example, if an average internet subscription now is twice as fast as ten years ago, the current price is divided by two in order to establish a real price trend. Sufficient information is not always available to determine the quality corrections, particularly for telecommunications equipment. However, if the price trend can be reliably corrected for quality, then this correction is also applied in actual practice.

### Telephony and internet prices are once again on the rise

Figure 3.4.1 displays the price index for telephone and internet services. Among other things, this includes internet connections, and fixed and mobile telephone connections (costs for having the connection plus the costs of 'calling minutes'). The acquisition costs of (mobile) telephones are not included in this. In addition, the graph displays the consumer price index related to all expenditures.

**3.4.1 Consumer price index – total expenditure and telephone and internet services, 2000–2012**



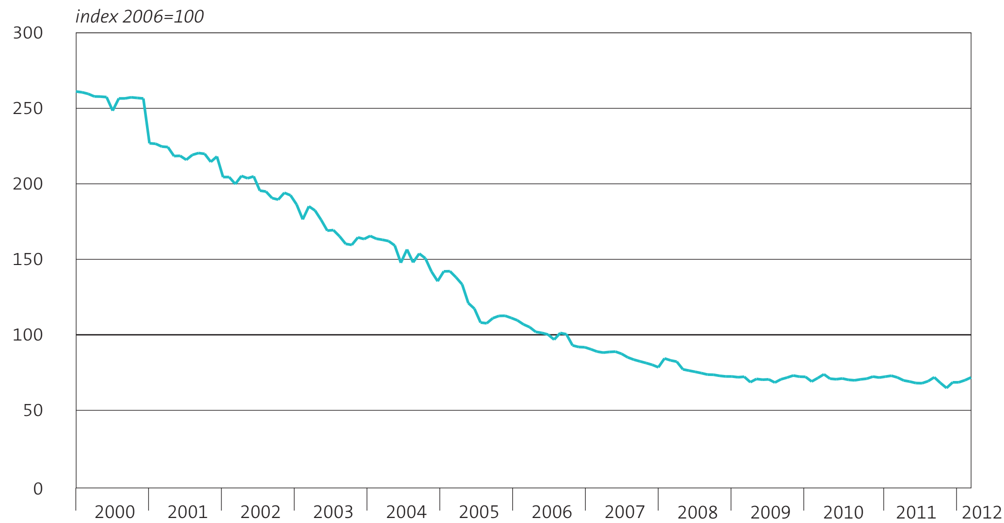

Source: Statistics Netherlands, Consumer Price Index.

The price index for telephone and internet services displayed a declining trend over the period 2004–2009. The rising quality of the products (the internet connection available in 2012 is many times faster than the connection in 2000) plays a role in this regard. However, prices once again rose starting in 2010. In March 2012, prices were over 6 index points higher than they were at their lowest point in September 2009. In this case this represents a price increase of almost 7 percent over this period. It should be noted that the prices of telephone and internet services in March 2012 were still lower than they were during the period 2000–2007.

### The cost of telephones has sharply declined

The price of telephone equipment has sharply decreased in recent years. The price of telephones at the beginning of 2000 was almost four times as high as at the beginning of 2012. This includes fixed as well as mobile telephones. Smartphones are included in this figure in recent years as well.

### 3.4.2 Consumer price index – telephone equipment, 2000–2012

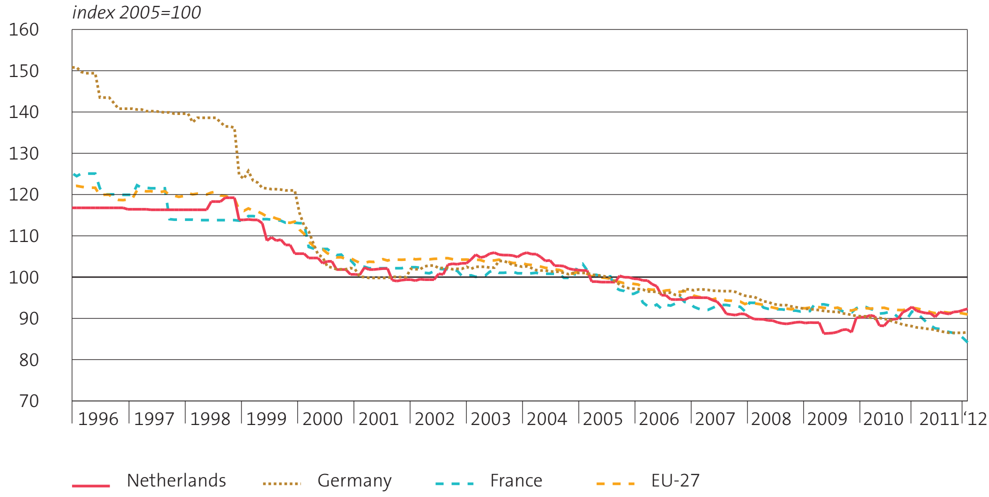



Source: Statistics Netherlands, Consumer Price Index.

### Prices are not increasing in all countries

Figure 3.4.3 displays the telecommunications price trends for the Netherlands, Germany, France and the EU. In contrast to Figure 3.4.1, this figure includes the prices of mobile and fixed telephones. The declining trend in the figures for the Netherlands between 2004 and 2009 also occurs in other countries. What is striking is that the price decrease in Germany was relatively strong during 1996–2001. The increase that has occurred in the Netherlands since 2010 did not occur in France and Germany.

**3.4.3 Consumer price index – telephone and internet equipment and services, international, 1996–2012**

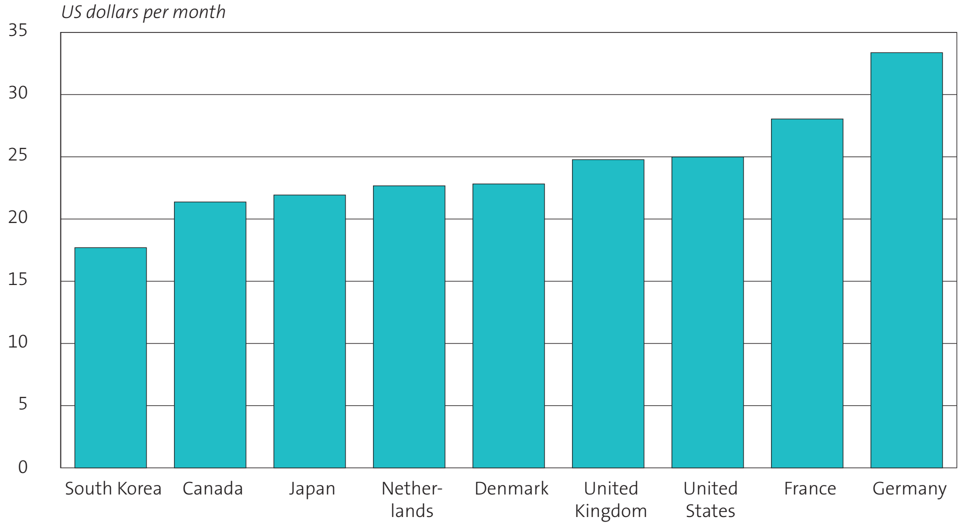



Source: Eurostat.

### The price of a broadband connection in the Netherlands is average in international terms

The price trends were discussed above with the aid of index figures. In addition, the various price levels in other countries provide an interesting perspective for judging the situation in the Netherlands. Figure 3.4.4 provides an overview of the monthly rates for a broadband internet starter package in the Netherlands and a number of benchmark countries. This can be a DSL or cable subscription. The graph includes the cheapest version for each country. 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. Broadband subscriptions have been upgraded several times in recent years in the Netherlands. These upgrades give consumers a higher speed for an equivalent price. It is also possible to downgrade a subscription and pay a lower rate for an old, lower speed. From the figure it is evident that rates for a broadband starter package are average in the Netherlands compared to these benchmark countries.

### 3.4.4 Broadband starter package rates, international, third quarter 2011[1)]




Source: Point-Topic.

1) The lowest rate for broadband can be for a DSL or a cable subscription.

# ICT use by households and individuals

# 4

# ICT use by households and individuals

## 4.1

**ICT facilities in households**

- Ownership of a PC is a matter of course
- The Netherlands a leader in terms of internet access
- Mobile telephone and laptop are replacing the desktop for internet access
- Internet access via mobile telephone rose sharply
- Lack of interest is the main reason for no internet use
- Over eight in ten individuals use the internet on a daily basis
- Internet used most at home

## 4.2

**Activities and services on the internet**

- Communicating the most important internet activity
- Internet also extensively used as a source of information
- Online banking an integral part of life
- Half of young people search online for information about education and training
- A quarter of internet users send or read political-social messages
- Social networks are the most popular form of social media
- Further increase in the number of e-shoppers
- The Netherlands is among the countries with the most e-shoppers
- Profile of the Dutch e-shopper: 25 to 45 years, well-educated
- Online purchasing of trips, holidays and accommodation common
- Especially new goods
- Most online purchases originate in own country
- Preference for traditional shopping the main reason for not shopping online

## 4.3 ICT skills

- Over four in five computer users use the ‘cut and paste’ function
- One third of computer users are highly skilled
- Use of search engines is widespread
- Quarter of internet users are highly skilled on the web
- Internet skills increased sharply between 2006 and 2011
- Dutch residents give their own skills a positive rating

**ICT has acquired an important place in the life of virtually every individual in the Netherlands in 2012. Modern means of information and communication are becoming increasingly common in households and are being used more intensively. A growing proportion of users is engaging in an expanding range of internet activities not only inside the home, but virtually everywhere.**

# 4.1 ICT facilities in households

Many people can no longer easily imagine a life without computers, the internet and mobile telephones. Due to the availability of high-speed, mobile internet connections, the internet is no longer only used at home or at work, but virtually everywhere. The method used by Dutch individuals to go online is changing. This is happening less frequently via the desktop and increasingly more frequently via the mobile telephone. As a result, ICT is occupying an increasingly more prominent place.

**'ICT use by households and individuals' survey**

The *ICT use by households and individuals* survey is a random one carried out among:
- Individuals aged 12 up to and including 74 years, resident in the Netherlands
- Dutch households with at least one member in this age group

The survey, which has been carried out each year since 2005, does not include populations of care institutions, correctional facilities and shelters, and involves the questioning of around 4,500 individuals.

The purpose of the survey is to gather information about the use of ICT equipment and the internet by households and individuals. It is carried out by all Member States of the European Union (EU). This makes it possible to place Dutch results in a European perspective.

### Ownership of a PC is a matter of course

It is no longer possible to imagine Dutch households without a PC. In 2011, 94 percent of households had a desktop or laptop (Table 4.1.1). This amounted to 6.2 million households comprising 12.5 million individuals. In the last decade the ownership of a PC by households continued to increase, with growth levelling off in recent years since the saturation point has virtually been reached. For example, no less than 92 percent of households owned a PC in 2010 and this figure therefore only increased by 2 percentage points in 2011.

### 4.1.1 ICT facilities used by households and individuals, 2002–2011

| | 2002 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *% of households* | | | | | | | | *absolute (millions)* | | | | |
| **Households[1)]** | | | | | | | | | 6.6 | 6.5 | 6.6 | 6.5 | 6.6 |
| PC (desktop/laptop) | 76 | 83 | 84 | 86 | 88 | 91 | 92 | 94 | 5.7 | 5.7 | 6.0 | 6.0 | 6.2 |
| Access to the internet | 63 | 78 | 80 | 83 | 86 | 90 | 91 | 94 | 5.4 | 5.6 | 5.9 | 6.0 | 6.2 |
| Broadband internet connection | 15 | 54 | 66 | 74 | 74 | 77 | 84 | 83 | 4.8 | 4.8 | 5.1 | 5.5 | 5.5 |
| | *% of individuals* | | | | | | | | *absolute (millions)* | | | | |
| **Individuals[2)]** | | | | | | | | | 12.8 | 12.9 | 12.9 | 13.0 | 13.0 |
| PC (desktop/laptop) | 81 | 87 | 88 | 90 | 92 | 93 | 94 | 96 | 11.6 | 11.8 | 12.1 | 12.3 | 12.5 |
| Access to the internet | 69 | 83 | 85 | 88 | 91 | 93 | 94 | 95 | 11.3 | 11.7 | 12.0 | 12.2 | 12.5 |
| Broadband internet connection | 17 | 59 | 71 | 79 | 78 | 79 | 87 | 84 | 10.1 | 10.0 | 10.3 | 11.3 | 11.3 |

Source: Statistics Netherlands, POLS: 2002, ICT use by households and individuals: 2005–2011.

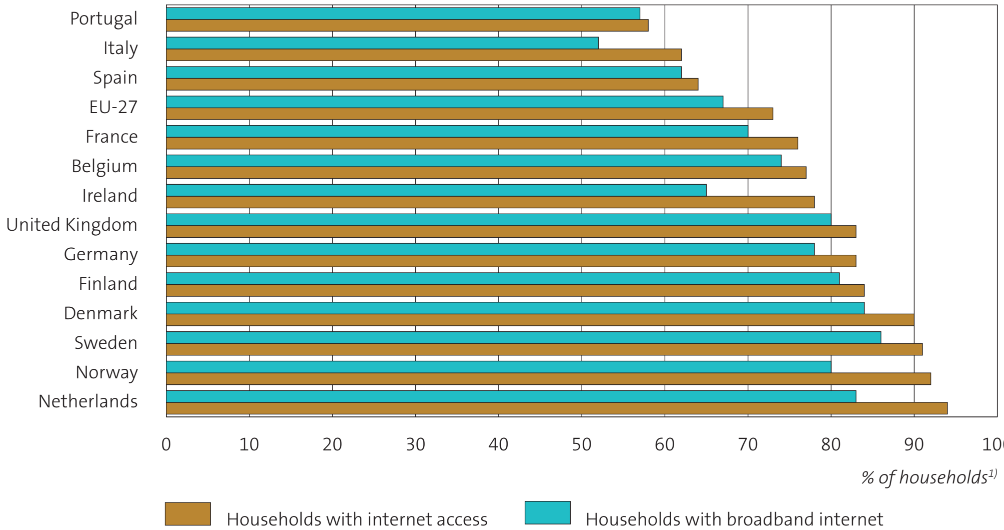
1) Private households with at least one person aged 12 up to and including 74 years.
2) Individuals aged 12 up to and including 74 years in private households.

In 2011, 94 percent of households had access to the internet. This is the same as the percentage of households with a PC. In other words there were virtually no households with a PC without an internet connection. As was the case with the percentage of PC owners, the proportion of households with internet access also increased sharply in the period 2002–2011, but is growing at a reduced rate in recent years. The proportion of households with internet access in 2011 was almost 30 percentage points higher than in 2002, whereas it increased by only three percentage points relative to 2010.
Broadband internet has also become commonplace in Dutch households. In 2011, 83 percent of households had a broadband internet connection. The corresponding figure for 2002 was a mere 15 percent.

### The Netherlands a leader in terms of internet access

Of the countries in Figure 4.1.2, the Netherlands had the highest percentage of households with internet access in 2011. Over nine in ten Dutch households were connected. This proportion was also high among Norwegian, Swedish and Danish households. It was lowest in Spain, Italy and Portugal. Of all households in the EU, over seven in ten had internet access.

### 4.1.2 Households with internet access and broadband internet, international, 2011




Source: Eurostat.

1) Private households with at least one person aged 16 up to and including 74 years.

The Netherlands also ranked among the top in Europe in 2011 in terms of the proportion of households with a broadband internet connection. Eighty-three percent of Dutch households had access to the internet through a broadband connection. Only in Sweden and Denmark was this percentage higher. Of all households in the EU, 67 percent had a broadband connection. Spain, Portugal and Italy had the lowest percentages of households with broadband internet.

### Mobile telephone and laptop are replacing the desktop for internet access

Progressively fewer Dutch households are using a desktop computer to access the internet. In 2005, 93 percent of households with internet access still used a desktop. By 2011, this figure had declined to 76 percent (Table 4.1.3). Other devices are increasingly being used to access the internet. In 2011, almost three quarters of households with internet access used a laptop to access the internet. The corresponding figure for 2005 was a mere 27 percent. Especially the use of the mobile telephone to access the internet rose sharply in 2011. In 2011, half of households with internet access used a mobile telephone for this purpose. This is over four times as many as in 2005. Other devices were also used more often for internet access than in previous years. Internet use through video game consoles or television sets with set-top boxes was virtually non-existent in 2005, whereas in 2011, 19 percent of households with internet used a video game console and 15 percent a TV with a set-top box for internet access. The proportion of households that used a palmtop computer to access the internet doubled in the period 2005–2011. In 2005 it was 3 percent and in 2011 it was 6 percent. In spite of the increasing use of laptops, mobile telephones and other devices, the desktop remained the most common means of accessing the internet in 2011. In Chapter 3 mention was made of the fact that the major share of internet data traffic also took place via the desktop. Mobile devices are apparently primarily used for exchanging information and less for exchanging files.

### 4.1.3 Devices in households that can be used for internet access[1)]

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| | *% of households with internet* | | | | | | |
| Desktop computer | 93 | 91 | 89 | 84 | 83 | 78 | 76 |
| Laptop computer | 27 | 32 | 42 | 54 | 62 | 68 | 74 |
| Mobile telephone | 12 | 13 | 19 | 22 | 28 | 35 | 50 |
| Palmtop computer | 3 | 4 | 5 | 5 | 7 | 6 | 6 |
| Video game console | 1 | 1 | 4 | 7 | 12 | 16 | 19 |
| TV with set-top box | 0 | 1 | 3 | 4 | 8 | 10 | 15 |

Source: Statistics Netherlands, ICT use by households and individuals, 2005-2011.

1) Private households with at least one person aged 12 up to and including 74 years; multiple answers possible.

# Half of internet users use mobile internet

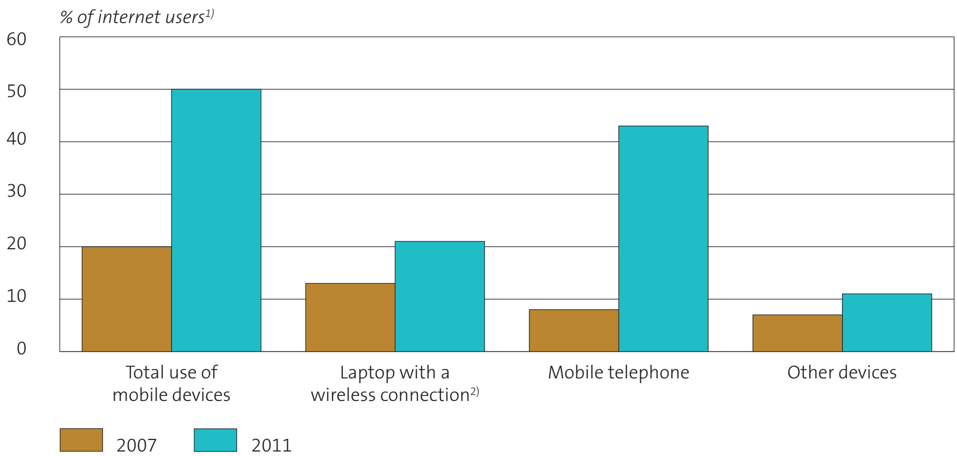
**Internet access via mobile telephone rose sharply**

The use of devices for mobile internet access further increased. In 2011, half of internet users had access to the web through mobile devices. This is considerably more than in 2007, when the corresponding proportion of users was one fifth (Figure 4.1.4). Especially the mobile telephone was used more often than before by internet users. In 2011, 43 percent of internet users made use of mobile telephones, while the corresponding figure in 2007 was a mere 8 percent. The percentage increase in internet use via mobile telephones also sharply increased in comparison to 2010: from 21 percent to 43 percent.

Laptops were far more frequently used for mobile internet access in 2011 compared to 2007; however, this percentage barely increased in recent years. The proportion of internet users that use laptops for mobile internet access has remained steady at approximately 20 percent since 2008. The emergence of tablets is in part evident from the category 'Other devices' in Figure 4.1.4. While this category did not yet contain any tablets in 2007, it did so in 2011.

Devices for mobile internet were most commonly used by internet users aged 12 to 25. Over two thirds of these young people used such a device in 2011 (69 percent). The proportion of individuals who used mobile internet was also high among those aged 25 to 45 (61 percent). Older internet users, aged 65 to 75, were far less inclined to use devices for mobile internet access than younger people (13 percent).

### 4.1.4 Use of mobile internet access devices, 2007 and 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2007 and 2011.

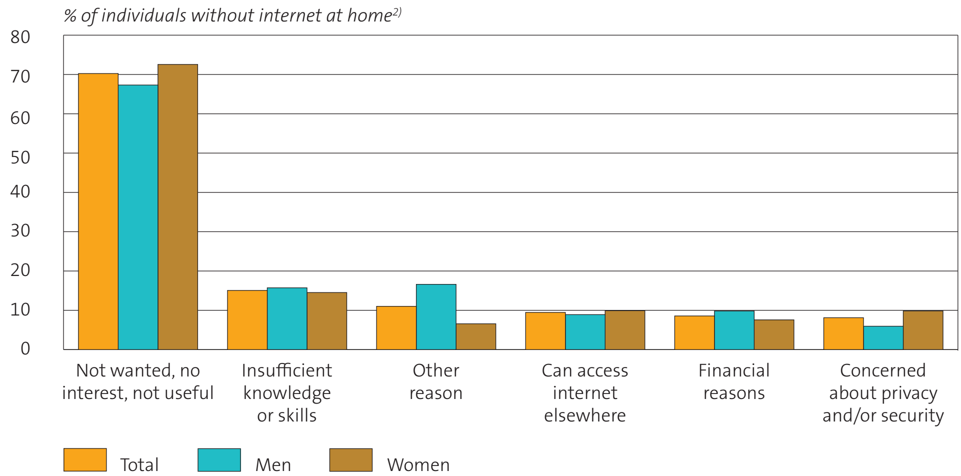
[1] Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey; multiple answers possible.
[2] Excluding use at home or at work.

Those aged 65+ almost as often used laptops with a wireless connection for mobile internet access (8 percent) as mobile telephones (7 percent). Among young people, the mobile telephone is by far the most often used device. Among those aged 12 to 25, 64 percent used a mobile telephone to go online and 24 percent used a laptop with a wireless connection.

### Lack of interest is the main reason for no internet use

The key reason for individuals not to have access to the internet at home is a lack of interest. In 2011, 70 percent of individuals without internet simply saw no use or need for having an internet connection. Although significantly less in number, relatively many individuals were of the opinion that they did not have sufficient knowledge or skills (15 percent). Financial limitations were cited as the reason for not having access to the internet in the home for 9 percent of people. Other reasons included the possibility of going online elsewhere (9 percent) and concerns about privacy and security (8 percent).
Women were somewhat more likely to show a lack of interest in an internet connection at home than men, although the difference is slight. Also in terms of the other reasons provided for not having access to the internet at home, there are no major differences between men and women (Figure 4.1.5). The principal reason for individuals aged 25 to 75 years not to have access to the internet at home was a lack of interest. This applied to a greater degree to those in the 65+ category than to people between 25 to 65 years of age. Of those between 65 to 75 years of age without an internet connection in their own home, 78 percent cited a lack of interest. The corresponding figure for those between 25 to 65 years of age was 62 percent.

**4.1.5 Reasons for not using internet at home, by gender, 2011[1)]**




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

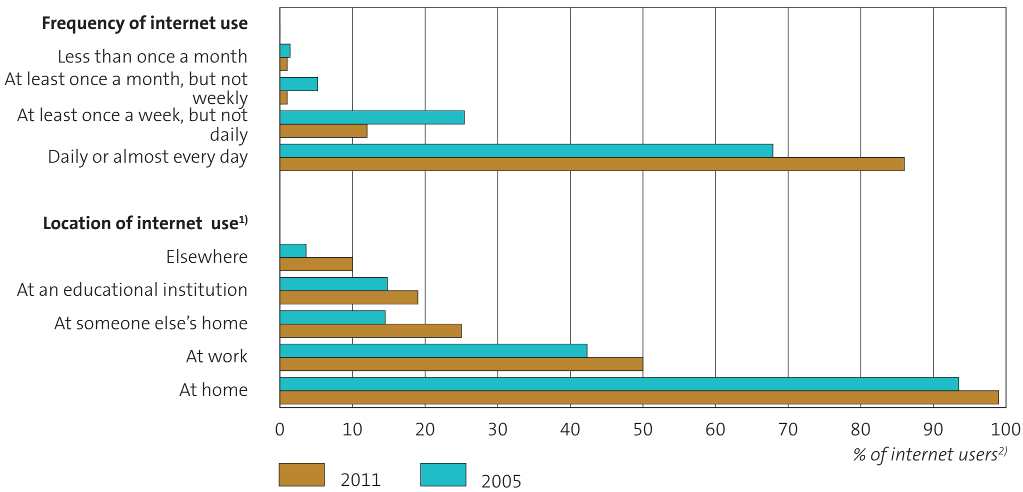
[1)] Multiple answers possible.
[2)] Individuals aged 12 up to and including 74 years in private households.

Seventy-four percent of less educated individuals without internet specified a lack of interest as the reason. Those with upper secondary and higher education without internet access at home also gave this as the most important reason (61 and 46 percent, respectively). A quarter of the highly educated had access to internet elsewhere and therefore had no need for having internet at home. This was also true for those with an upper secondary education. Less educated individuals without internet far less frequently had access to this option (5 percent).

### Over eight in ten individuals use the internet on a daily basis

Of all internet users 86 percent used the internet every day or almost every day in 2011 (Figure 4.1.6). Almost one in eight made use of the internet once a week but not daily. Other internet users went online at least once a month but not weekly (1 percent) or less than once a month (1 percent). The proportion of individuals who use the internet on a daily basis has increased considerably relative to 2005, when only 68 percent of individuals did so. The internet is therefore increasingly frequently used in the Netherlands.

### 4.1.6 Frequency and location of internet use, 2005 and 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2005 and 2011.

[1] Multiple answers possible.
[2] Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey.

### Internet used most at home

Virtually all internet users had an internet connection at home in 2011 (99 percent). The workplace was also frequently used to access the internet; almost half of all internet users did so at work (50 percent). Almost one fifth of internet users went online at an educational institution (19 percent). The percentage of internet users that used a connection in someone else's home was significantly higher in 2011 than in 2005: 25 and 15 percent, respectively. This could possibly be related to the broader availability of the wireless internet via WiFi in homes, combined with the increased ownership of portable devices, such as smartphones and tablets.

## 4.2 Activities and services on the internet

For many Dutch people, the internet is now (2012) a very valuable means of communication and source of information. Online shopping has also become an important activity for many internet users. The intensity of internet use is continuously increasing.

### Communicating the most important internet activity

Communicating has been the most important internet activity of individuals for many years. This was also the case in 2011. Virtually every user communicated in one form or another over the internet, most using e-mail to do so (95 percent). A significant proportion of internet users, namely 29 percent, also chatted online (Table 4.2.1). Nevertheless, the proportion of users that chat online has decreased markedly relative to 2005, when four in ten internet users did so. 'Chatting' in this case is understood to mean, in addition to typing text messages to other individual users, participating in newsgroups or online discussion forums. People are increasingly using the internet for making telephone calls. Six percent of internet users made telephone calls over the internet in 2005. The corresponding figure for 2011 was 25 percent.
Men communicated almost as much as women over the internet in 2011. Ninety-four percent of men used e-mail, while ninety-seven percent of women did so. In terms of IP telephony the difference between men and women is also small. Over one quarter of men used IP telephony in 2011 (26 percent), while the proportion of women to do so was

23 percent. The difference is greater in terms of chatting. Almost one third of men chatted in 2011 (32 percent) compared to 25 percent of women.

### 4.2.1 Activities of internet users; communication, 2005–2011

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| | *% of internet users*[1] | | | | | | |
| **Communication** | | | | | | | |
| E-mail | 92 | 93 | 94 | 94 | 95 | 96 | 95 |
| IP telephony[2] | 6 | 12 | . | 13 | 15 | 19 | 25 |
| Other, for example, chatting | 40 | 40 | 35 | 27 | 29 | 28 | 29 |

Source: Statistics Netherlands, ICT use by households and individuals, 2005–2011.

[1] Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey; multiple answers possible.
[2] The questions were changed after 2007. As such the results for the individual years in the period 2008 to 2011 are comparable, but less so in the period before this.

Almost all internet users make use of e-mail, regardless of their age. Age is a differentiating factor in other forms of internet communications, however. For example, over half of young people chatted in 2011, whereas the proportion of older people who did so was much lower. Only 10 percent of internet users aged 65 to 75 chatted. Furthermore, relatively more young people aged 12 to 25 use IP telephony than individuals aged 65 to 75 (33 and 16 percent respectively).

### Almost all internet users use e-mail

## Internet also extensively used as a source of information

In addition to communicating, the internet is also extensively used as a source of information. Almost nine in ten individuals used the internet in 2011 to search for information on goods and services (Table 4.2.2). The internet was also frequently used to listen to radio or watch television (60 percent). This percentage has increased sharply in recent years and was only 26 percent in 2005, for example. Internet users in the Netherlands also frequently used the internet in 2011 for playing games, reading newspapers and using travel-related services. Downloading software and searching for a job were less common.

### 4.2.2 Activities of internet users; information and entertainment, 2005–2011

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| | *% of internet users[1)]* | | | | | | |
| **Information and entertainment** | | | | | | | |
| Searching for information about goods and services | 87 | 88 | 89 | 86 | 87 | 90 | 87 |
| Listening to radio or watching television | 26 | 35 | 42 | 52 | 57 | 58 | 60 |
| Playing and/or downloading games, images or music | 50 | 55 | 56 | 65 | 57 | 56 | 59 |
| Downloading or reading newspapers and/or news magazines | 35 | 43 | 45 | 47 | 49 | 53 | 56 |
| Using services in the travel sector | 49 | 50 | 54 | 55 | 51 | 55 | 52 |
| Downloading software | 27 | 31 | 34 | 37 | 34 | 32 | 30 |
| Applying or looking for a job | 19 | 22 | 21 | 18 | 19 | 21 | 20 |

Source: Statistics Netherlands, ICT use by households and individuals, 2005–2011.

1) Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey; multiple answers possible.

## Online banking an integral part of life

Advances in internet applications are making it increasingly possible for individuals to conduct a broad range of (financial) transactions, from the home. Online banking is one of the internet services that very rapidly became an integral part of life. In 2011 over eight in ten internet users engaged in online banking (Table 4.2.3). This proportion is roughly the same as it was in 2010. Over nine in ten internet users aged 25 to 45 engaged in online banking. Those aged 12 to 25 made the least use of online banking services (62 percent). Over two thirds of internet users aged 65+ used online banking services (68 percent).
In addition to online banking, individuals can also conduct other kinds of financial transactions over the internet, such as purchasing shares or purchasing and selling goods and services. Nine percent of internet users performed such activities in 2011. Ten percent of internet users aged 45 and over performed such financial transactions from time to time over the internet, while this figure was 7 percent for those aged 12 to 25.

### 4.2.3 Use of the internet for online banking and other financial services, by age, 2005–2011

| | Online banking | | | | | | | Other financial services | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| | *% of internet users[1)]* | | | | | | | | | | | | | |
| Total | 58 | 67 | 72 | 74 | 78 | 81 | 82 | 5 | 8 | 7 | 8 | 6 | 9 | 9 |
| 12 to 25 years | 40 | 49 | 54 | 56 | 59 | 63 | 62 | 2 | 3 | 4 | 5 | 3 | 6 | 7 |
| 25 to 45 years | 69 | 78 | 83 | 85 | 89 | 91 | 93 | 5 | 9 | 8 | 8 | 7 | 9 | 9 |
| 45 to 65 years | 59 | 70 | 75 | 76 | 79 | 83 | 85 | 7 | 11 | 10 | 11 | 7 | 9 | 10 |
| 65 to 75 years | 47 | 55 | 53 | 63 | 64 | 73 | 68 | 4 | 7 | 7 | 9 | 10 | 10 | 10 |

Source: Statistics Netherlands, ICT use by households and individuals, 2005–2011.

1) Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey.

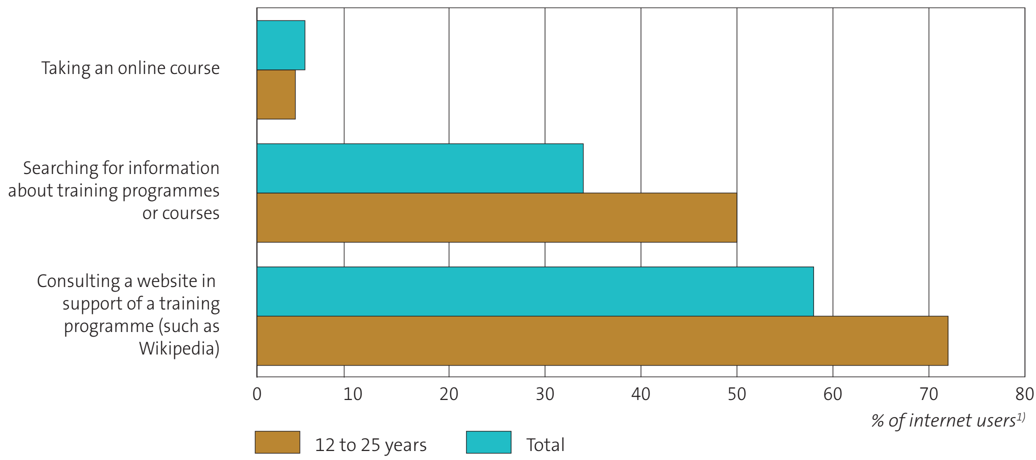
**Half of young people search online for information about education and training**

Training institutes provide information about training programmes and courses over the internet. Some training programmes and courses can also be completed online. In addition, websites can serve as a source of information while taking a course. The internet therefore plays an important role in completing educational programmes and in providing information about education.
In 2011, 34 percent of internet users searched for information about training programmes or courses over the internet. In addition, 5 percent took an online course (Figure 4.2.4). Young people aged 12 to 25 were particularly active in searching online for information about education and training (50 percent). The proportion of internet users that took courses over the internet was somewhat less than average among young people. Over seven in ten young people consulted websites for the purpose of searching for information in 2011 (72 percent). This ratio was 58 percent among all internet users.

**A quarter of internet users send or read political-social messages**

The internet provides opportunities for being politically and socially involved. For example, internet users can post or read online messages about political or social issues. In addition, they can participate in online discussions or surveys on such subjects.
Over one quarter of internet users (27 percent) posted messages or read online about political or social issues in 2011 (Figure 4.2.5). This proportion was highest among those aged between 25 and 45 (29 percent of internet users). Those aged 65+ were least active in this area (20 percent).

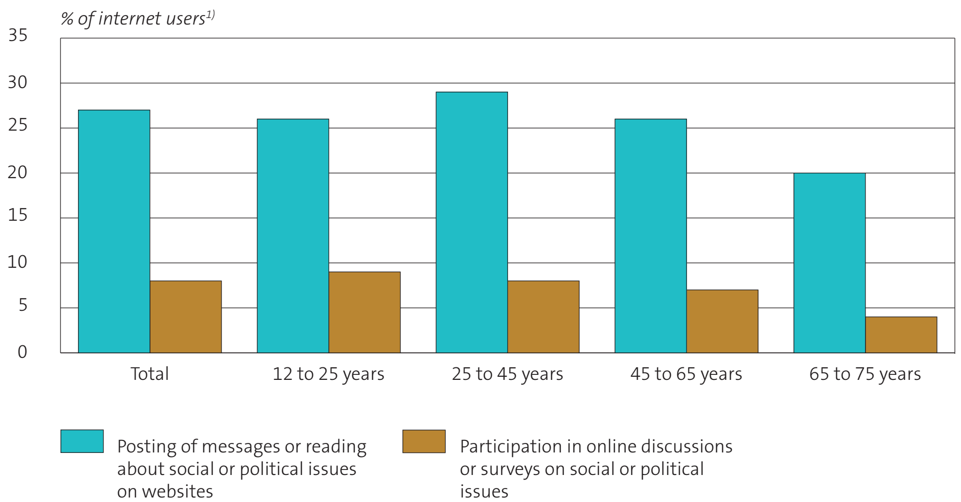
## 4.2.4 Internet activities in relation to training programmes, courses or learning, 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

1) Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey; multiple answers possible.

## 4.2.5 Political-social internet activities, 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

1) Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey.

Participation in online discussions on social or political issues is less common. Eight percent of all internet users took part in such panels in 2011. Among highly educated internet users, the proportion was three times as high (12 percent) as it was for less educated internet users (4 percent).

**Social networks are the most popular form of social media**

Social media can be used to share information by, for example, posting messages to an online discussion forum, weblog or social network. There are several types of social media. Table 4.2.6 displays the breakdown used in Statistics Netherlands' survey of ICT use by households and individuals in 2011. Social networks were the most often used form of social media among Dutch internet users in 2011. Almost two thirds of internet users were active in a social network (64 percent). In order to use a social network, an individual must create a profile that includes a few identifying personal details. Users can then establish contact with other participants and share messages and files, such as photos and videos.
Young people aged 12 to 25 are the principal users of social media. Social networks are especially popular among this age group: 95 percent of young internet users were active in social networks in 2011. The rate of participation was considerably lower among older people. Just over one fifth of internet users aged 65 to 75 participated in a social network in 2011.
Social networks such as Hyves, Facebook and Twitter are the most popular. Almost nine in ten young internet users made use of such applications in 2011. Furthermore, many internet users aged 12 to 25 use instant messaging: almost eight in ten. Instant messaging is an application that enables a user to immediately communicate with others that are online at that point in time.

## 95 percent of young people use social networks

In particular, many highly educated internet users use professional social networks such as LinkedIn: over four in ten in 2011. Among the less educated this figure was 5 percent. Those less educated, however, scored much higher than their highly educated counterparts in terms of the use of instant messaging (49 to 30 percent respectively).

## 4.2.6 Use of social media, 2011

| | Posting messages to chat sites or online discussion forums | Reading or maintaining weblogs | Social networks | | | | Other social media |
|---|---|---|---|---|---|---|---|
| | | | Total social networks | Exchanging text messages (instant messaging such as MSN) | Professional network (such as LinkedIn) | Other social network (such as Hyves, Facebook or Twitter) | |
| | *% of internet users[1)]* | | | | | | |
| Total | 29 | 21 | 64 | 37 | 20 | 53 | 32 |
| **Gender** | | | | | | | |
| Men | 32 | 23 | 63 | 38 | 23 | 50 | 31 |
| Women | 25 | 19 | 64 | 35 | 16 | 55 | 32 |
| **Age** | | | | | | | |
| 12 to 25 years | 50 | 27 | 95 | 78 | 11 | 88 | 4 |
| 25 to 45 years | 31 | 25 | 72 | 35 | 29 | 61 | 23 |
| 45 to 65 years | 16 | 17 | 44 | 17 | 18 | 29 | 49 |
| 65 to 75 years | 10 | 8 | 22 | 11 | 5 | 15 | 71 |
| **Level of education** | | | | | | | |
| Primary education | 32 | 17 | 67 | 49 | 5 | 58 | 30 |
| Secondary education | 27 | 21 | 60 | 33 | 15 | 53 | 34 |
| Higher education | 26 | 28 | 65 | 30 | 41 | 46 | 29 |

Source: Statistics Netherlands, ICT use by households and individuals, 2011.

1) Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey; multiple answers possible.

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

*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 many other applications. In addition to being a personal 'friends' site, Facebook is also used for business networking.

*Twitter*
An international service for sending short messages (micro blogs). 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.

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

*LinkedIn*
An international network for maintaining business contacts. LinkedIn is designed for individuals who are looking for work or employees, seeking to promote their company, or who wish to maintain contacts with current and former colleagues and/or fellow students. The emphasis of a LinkedIn profile is on profession and qualifications.

**Further increase in the number of e-shoppers**

The number of individuals shopping online increased to 9.5 million in 2011 (Table 4.2.7). Growth was not as strong as in previous years, although the popularity of online shopping continues to increase. The convenience of the internet, the possibility of comparing products in terms of price and quality, the growing quantity of information and, in certain instances, the lower costs, probably play an important role in this regard. In 2011, 6.7 million individuals frequently ordered goods and/or services over the internet. Frequent e-shoppers are internet users who made online purchases in the three months prior to the survey. The proportion of frequent e-shoppers was 55 percent in 2011, just as it was in 2010. The number of internet users who do not engage in online shopping further decreased to 2.5 million (21 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.

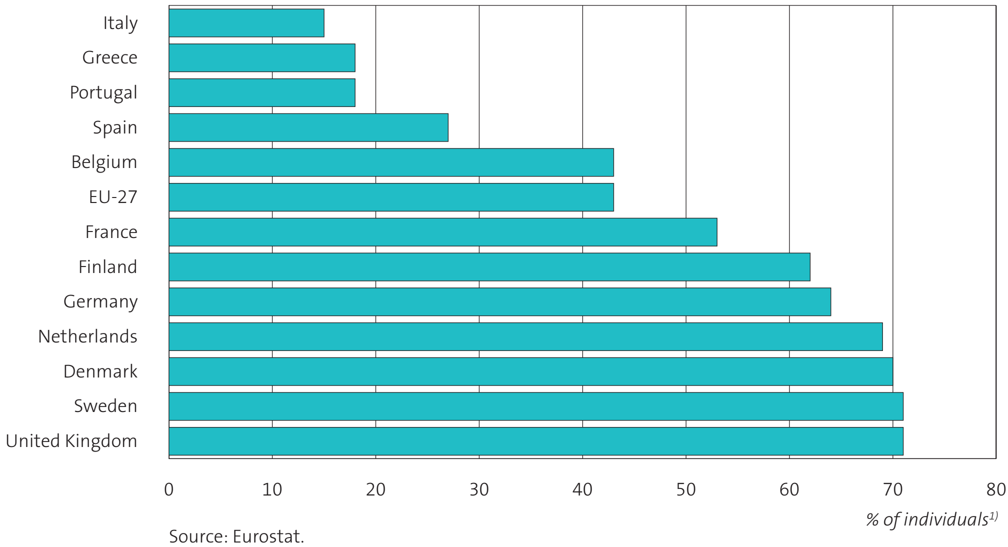
### 4.2.7 Online shopping by internet users, 2002–2011[1)]

| | 2002 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|
| | *absolute (millions)* | | | | | | | |
| E-shopper | 3.6 | 5.9 | 6.6 | 7.5 | 7.7 | 8.8 | 9.3 | 9.5 |
| Frequent e-shopper | 1.9 | 3.9 | 4.5 | 5.3 | 5.4 | 6.0 | 6.6 | 6.7 |
| Less frequent e-shopper | 1.7 | 2.0 | 2.1 | 2.2 | 2.4 | 2.7 | 2.7 | 2.8 |
| Not an e-shopper | 5.3 | 4.8 | 4.2 | 3.8 | 3.7 | 3.0 | 2.7 | 2.5 |
| Total internet users | 8.9 | 10.7 | 10.9 | 11.3 | 11.5 | 11.8 | 12.0 | 12.1 |
| | *% of internet users* | | | | | | | |
| E-shopper | 40 | 55 | 61 | 66 | 67 | 74 | 77 | 79 |
| Frequent e-shopper | 21 | 36 | 41 | 47 | 47 | 51 | 55 | 55 |
| Less frequent e-shopper | 19 | 19 | 20 | 19 | 21 | 23 | 22 | 23 |
| Not an e-shopper | 60 | 45 | 39 | 34 | 33 | 25 | 23 | 21 |
| Total internet users | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Source: Statistics Netherlands, POLS, 2002 and ICT use by households and individuals, 2005–2011.

1) Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey. Frequent e-shoppers made an online purchase in the three months prior to the survey. Less frequent e-shoppers did so more than three months ago.

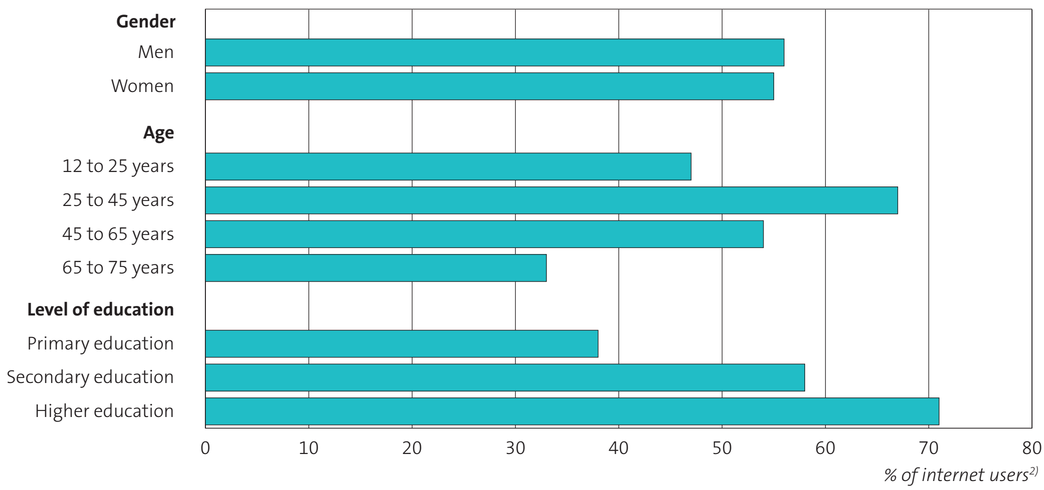
### 4.2.8 Individuals with online purchases in the twelve months prior to the survey, international, 2011




Source: Eurostat.

[1)] Individuals aged 16 up to and including 74 years.

### 4.2.9 Frequent e-shoppers by personal characteristics, 2011[1)]




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who made online purchases in the three months prior to the survey.
[2)] Individuals who used the internet in the three months prior to the survey.

### The Netherlands is among the countries with the most e-shoppers

Sixty-nine percent of individuals aged 16 to 75 in the Netherlands engaged in e-shopping in 2011.[1] Of the countries specified in Figure 4.2.8, the Netherlands, together with Sweden, Denmark and the United Kingdom had the highest number of e-shoppers in relative terms. The United Kingdom and Sweden had the highest percentage (71 percent). Online shopping occurred least in Italy, where only 15 percent of individuals aged 16 to 75 engaged in the activity.

### Profile of the Dutch e-shopper: 25 to 45 years, well-educated

The profile of the frequent Dutch e-shopper did not change much in 2011 relative to 2010. It involves highly educated individuals aged 25 to 45. In previous years, men were more likely to shop online than women; however, this distinction virtually disappeared in 2011 (Figure 4.2.9). Of all internet users aged 25 to 45, 67 percent frequently shopped online. Online shopping occurred less frequently among internet users aged 65 to 75. Nevertheless, 33 percent of such older people were frequent e-shoppers. Seventy-one percent of highly educated internet users were frequent e-shoppers. The corresponding figure for less educated internet users was 38 percent.[2]

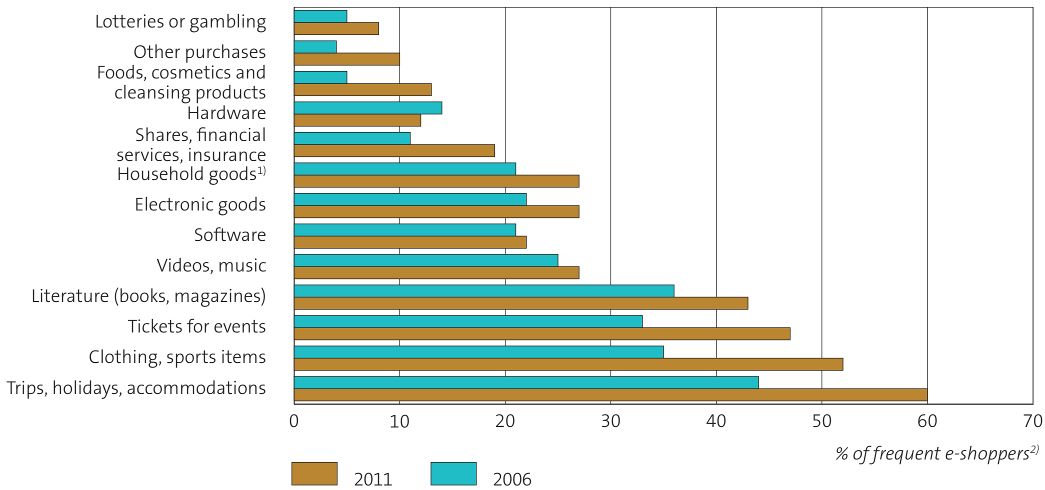
### Online purchasing of trips, holidays and accommodation common

As was the case in previous years, the purchasing of ‘trips, holidays and accommodation’ was the most common type of online purchase made (Figure 4.2.10). Six in ten frequent e-shoppers booked trips and holidays online. Other products frequently purchased online were clothing items (52 percent), tickets for events (47 percent) and literature (43 percent). In 2011, more internet users made online purchases in almost all of the different purchase categories than in 2006. The online purchase of ‘clothing and sports items’ experienced the strongest growth: from 35 percent in 2006 to 52 percent in 2011. The online purchase of ‘trips, holidays and accommodation’ and ‘tickets for events’ also showed strong growth.

1) 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 4.2.7.

2) 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 (CBS, 2003).

## 4.2.10 Online purchases by type, 2006 and 2011



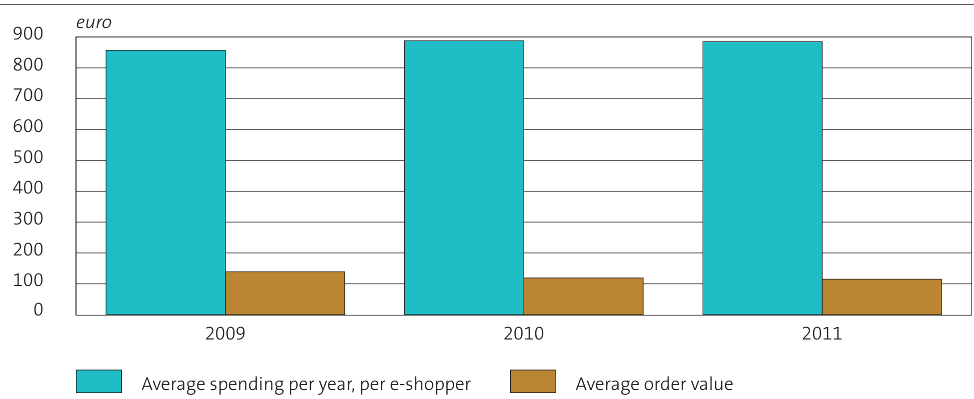

Source: Statistics Netherlands, ICT use by households and individuals, 2006 and 2011.

[1] For example furniture, washing machines and toys.
[2] Individuals aged 12 up to and including 74 years who made online purchases in the three months prior to the survey.

### Small purchases continue to increase

According to Thuiswinkel.org the average value of online orders continues to decline. In 2011, consumers spent an average of 115 euro per online purchase, while the corresponding figure was 119 euro in 2010. This figure was also higher in 2009 when the average amount spent on an online order was 139 euro. In other words, consumers are increasingly more often making smaller purchases over the internet.
The average spent on internet purchases by an e-shopper was 885 euro in 2011, roughly equal to the average amount spent in 2010 (888 euro).

## Internet spending, 2009–2011



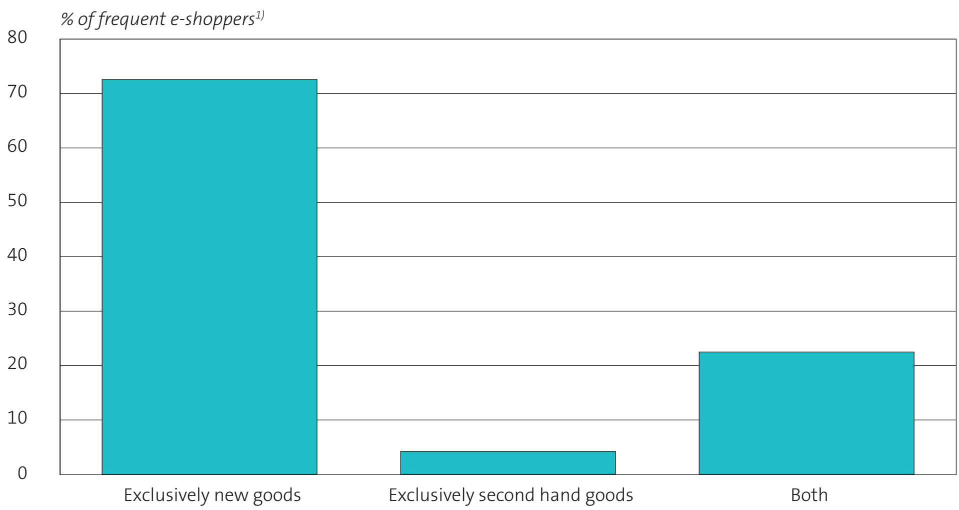

Source: Thuiswinkel Market Monitor, 2011-2.

There are clear differences between men and women in terms of online purchasing behaviour. For example, in 2011 more women than men purchased clothing online. Over six in ten frequent female e-shoppers purchased clothing online (62 percent) compared to 41 percent of male e-shoppers. By contrast, men more frequently purchased software over the internet than women (31 and 12 percent of frequent e-shoppers, respectively).

### Especially new goods

Over 72 percent of frequent e-shoppers exclusively purchased new goods for personal use over the internet in 2011 (Figure 4.2.11). Only 4 percent exclusively purchased second hand goods. Almost one quarter purchased new as well as second hand goods (22 percent).

#### 4.2.11 Online purchases of new and/or second hand goods, 2011

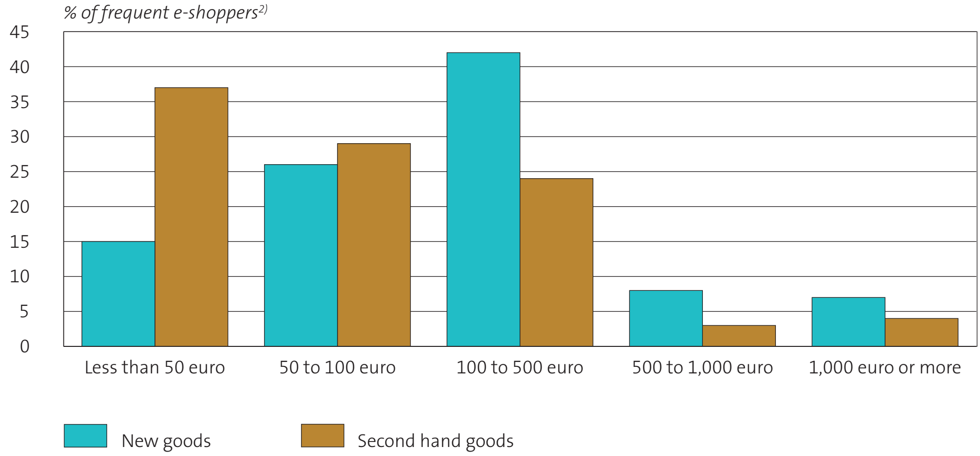



Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who made online purchases in the three months prior to the survey.

Four in ten frequent e-shoppers in total spent 100 to 500 euro in the three months prior to the survey on new goods purchased over the internet (Figure 4.2.12). During that period over a quarter spent a total of 50 to 100 euro on new goods. Only 7 percent spent 1,000 euro or more. Less money was spent on second hand goods. Of the frequent e-shoppers, 37 percent spent not more than 50 euro on second hand goods in the three months prior to the survey.

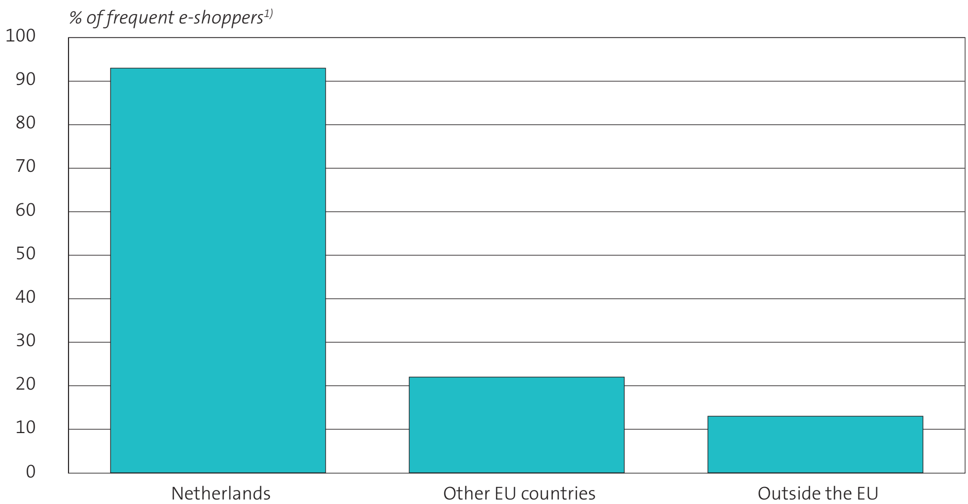
### 4.2.12 Total expenditures on the online purchase of new and second hand goods, 2011[1)]




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Total expenditure on goods purchased over the internet in the three months prior to the survey.
[2)] Individuals aged 12 up to and including 74 years who made online purchases in the three months prior to the survey.

### 4.2.13 Online purchase of goods or services, by supplier origin, 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who made online purchases in the three months prior to the survey; multiple answers possible.

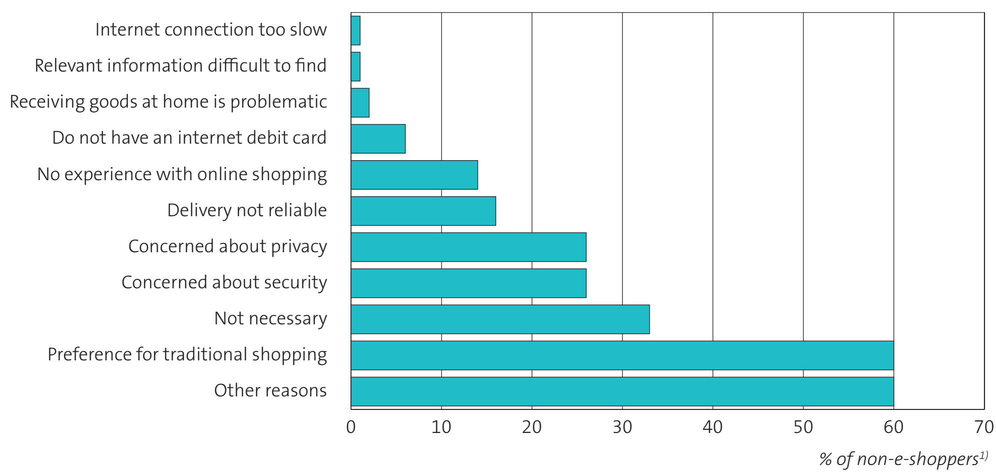
### Most online purchases originate in own country

The larger proportion of frequent e-shoppers made online purchases from individuals or companies residing in the Netherlands (93 percent) in 2011. Almost a quarter purchased goods from suppliers in other EU countries and 13 percent made purchases over the internet from other parts of the world (Figure 4.2.13).

### Preference for traditional shopping the main reason for not shopping online

Internet users who did not shop online in 2011 refrained from doing so mainly because of a preference for traditional shopping. They considered it important to be able to try on clothing in a store, for example. Six in ten internet users who did not shop online cited this as a reason (Figure 4.2.14). Another reason for not shopping online frequently cited by respondents was that they did not consider online shopping necessary (33 percent). In addition to these reasons, security concerns also played an inhibitive role. Over a quarter of internet users who did not shop online cited security concerns or expressed concerns about privacy. The inability to receive goods at home (2 percent) and the speed of the internet connection were far less frequently mentioned as reasons for not shopping online.

**4.2.14 Reasons for not shopping online, 2011**




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1] Individuals aged 12 up to and including 74 years who used the internet in the three months prior to the survey and who did not make any purchases in the three months prior to the survey; multiple answers possible.

# 4.3 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, the Digivaardig & Digibewust programme launched in 2009, which aims to increase these skills in the Dutch population.[3] One of the aims of this programme is to enable the Dutch population to better exploit the opportunities provided by ICT. 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.

### 1 in 3 computer users is highly skilled

#### Measuring computer skills

Respondents were asked about the activities that they had performed at some point when using a computer. Their computer skills can be determined based on the answers given.

The following ten activities were asked about in the survey:

- Copying or moving a file or folder;
- Copying or pasting information in a document;
- Using simple formulas in a spreadsheet;
- Preparing presentations using software such as Powerpoint that include illustrations, for example;
- Transferring files between the computer and other devices, such as a mobile telephone;
- Compressing folders or files, using WinZip for example;
- Installing new devices, such as a printer or modem;
- Changing software settings (excepting internet browsers);
- Installing a new or replacing an old operating system such as Windows or Linux;
- Writing a computer program using a programming language.

The respondents were subsequently subdivided into four categories:

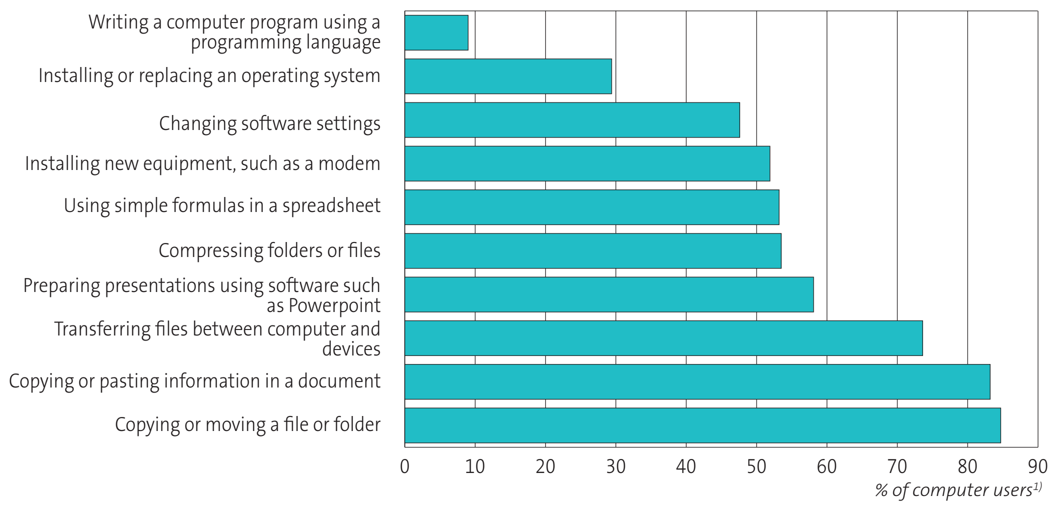
- No skills: had not performed any of the referenced activities;
- Few skills: had performed one, two or three of the referenced activities;
- Average skills: had performed four, five, six or seven of the referenced activities;
- Many skills: had performed eight or more of the referenced activities.

[3] Visit www.digivaardigdigibewust.nl for more information about the Digivaardig & Digibewust programme.

### Over four in five computer users use the ‘cut and paste’ function

In 2011, 85 percent of computer users had copied or moved files or folders from time to time. In addition, 83 percent had copied and pasted information into a document (Figure 4.3.1). Transferring files between the computer and other devices, such as a mobile telephone, digital camera, MP3 or MP4 player was also commonplace. Seventy-four percent of computer users had experience with such actions. Installing a new or replacing an old operating system such as Windows or Linux is less commonplace (29 percent). In 2011, only 9 percent of computer users had ever written a computer programme using a programming language.

### 4.3.1 Computer activities, 2011



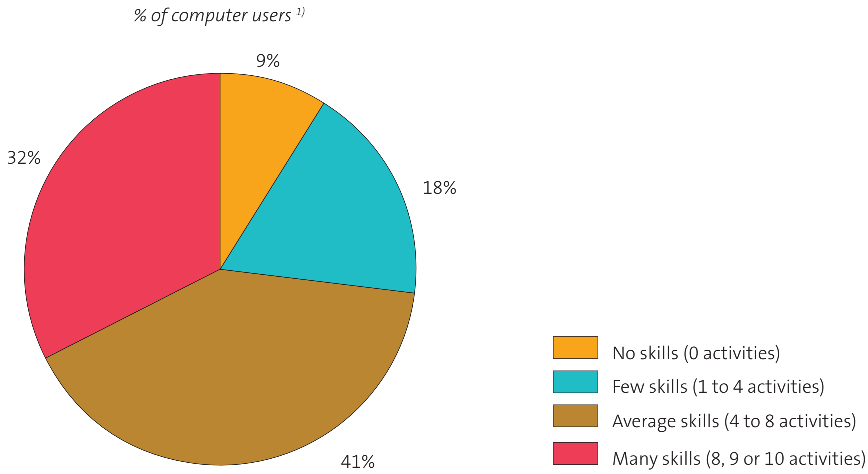

Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who have used a computer at some time.

### One third of computer users are highly skilled

Almost a third of Dutch computer users had many computer skills in 2011 (Figure 4.3.2). Over four in ten had average computer skills. Approximately one fifth had few skills and 9 percent had no skills. Although this group did use a computer, their activities were different than the ones distinguished by the survey. The relevant skills are identified in the text box on the previous page.

## 4.3.2 Computer skills, 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1] Individuals aged 12 up to and including 74 years who have used a computer at some time.

## 4.3.3 Computer skills by personal characteristics, 2011

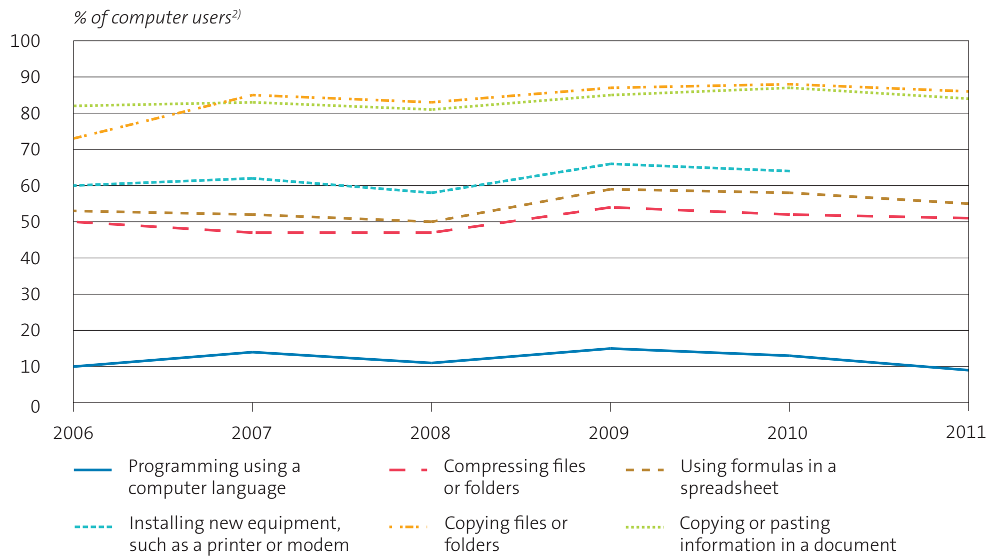
| | None (0 activities) | Few (1 to 4 activities) | Average (4 to 8 activities) | Many (8, 9 or 10 activities) |
|---|---|---|---|---|
| | *% of computer users[1]* | | | |
| **Gender** | | | | |
| Men | 7 | 13 | 33 | 47 |
| Women | 11 | 23 | 49 | 17 |
| **Age** | | | | |
| 12 to 25 years | 2 | 10 | 55 | 33 |
| 25 to 45 years | 5 | 12 | 41 | 42 |
| 45 to 65 years | 13 | 24 | 36 | 26 |
| 65 to 75 years | 30 | 35 | 21 | 13 |
| **Level of education** | | | | |
| Primary education | 17 | 25 | 40 | 19 |
| Secondary education | 7 | 19 | 41 | 32 |
| Higher education | 2 | 9 | 42 | 47 |
| Total | 9 | 18 | 41 | 32 |

Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1] Individuals aged 12 up to and including 74 years who have used a computer at some time.

Almost half of men (47 percent) had many computer skills in 2011 (Figure 4.3.3). In fact, highly skilled computer users constituted the largest group among men. This proportion is almost three times as high as that of women (17 percent). Computer users in the 25 to 45 age group are the most skilful. Forty-two percent of them had many computer skills in 2011. Individuals aged 65 or over were the least skilful. Of those aged 65 to 75, 35 percent had few skills and 30 percent had no skills. Almost half of highly educated individuals had many computer skills in 2011. The corresponding figure for less educated individuals was 19 percent. Less educated individuals more often than others have no computer skills (17 percent). Only 2 percent of highly educated individuals had no computer skills.
For six of the ten activities distinctly identified in the survey it is possible to display the trend from 2006.[4] The skills of computer users in these areas remained fairly stable over the period 2006–2011. Copying or pasting information in documents, and copying folders or files occur most frequently in all years. The proportion of computer users that perform these activities is fairly constant between 80 and 90 percent. Writing a computer program using a computer language is clearly the least often performed activity in all years.

**4.3.4 Computer activities, 2006–2011[1)]**




Source: Statistics Netherlands, ICT use by households and individuals, 2006-2011.

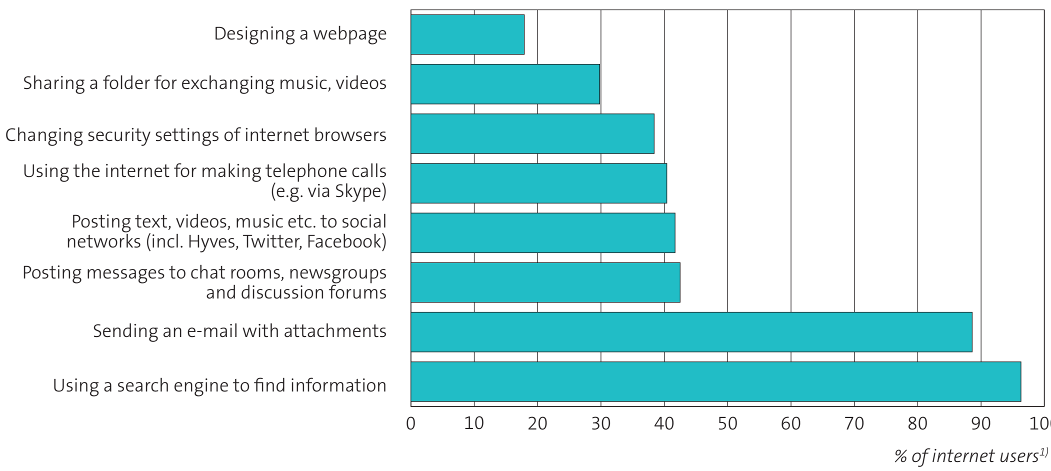
[1)] The figure for 'Installing new equipment, such as a printer or modem' is lacking in 2011. Due to a change in the questions asked in that year, the figure is no longer comparable with previous years.
[2)] Individuals aged 12 up to and including 74 years who have used a computer at some time.

[4)] The computer activities 'Preparing presentations using software such as Powerpoint', 'Transferring files between the computer and other devices', 'Changing software settings' and 'Installing or replacing an operating system' were measured for the first time in the 2011 survey.

### Use of search engines is widespread

Almost all internet users in the Netherlands (96 percent) used a search engine for finding information in 2011 (Figure 4.3.5). In addition, most internet users have sent e-mails with attachments at some point (89 percent). Approximately four in ten internet users had posted messages to chat rooms. This also applies to being active on social networks, using IP telephony and changing the security settings of browsers. The design of a webpage was the least performed internet activity. In 2011, less than one in five internet users had done so at some point (18 percent).

### 4.3.5 Internet activities, 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who have used a computer at some time.

### Quarter of internet users are highly skilled on the web

Almost a quarter of internet users (24 percent) had many internet skills in 2011 (Figure 4.3.6). Thirty percent had average skills. The remaining internet users had few internet skills (46 percent). The proportion of internet users without any skills is virtually nil. This is in contrast to the proportion of computer users without any skills. Almost one in three men had many internet skills in 2011 (Figure 4.3.7). This proportion is significantly higher than that of women (19 percent). More than half of women had few internet skills. The corresponding figure among men was 41 percent. The difference between men and women is smaller in terms of internet skills than it is with respect to computer skills.

### Measuring internet skills

Respondents were asked about the activities that they had performed at some point when using the internet. Their internet skills can be determined based on the answers given.

*Internet skills 2011 (Figures 4.3.6 and 4.3.7)*
This involves the following eight activities in 2011:

- Using a search engine to find information;
- Sending an e-mail with attachments;
- Posting messages to chat rooms, newsgroups or a discussion forum;
- Using the internet to make telephone calls;
- Designing a webpage;
- Sharing a folder for exchanging music or videos;
- Posting text, games, pictures, videos or music to websites, for example on social network pages such as – Hyves, Facebook or Twitter;
- Changing the security settings of internet browsers.

To determine internet skills in 2011, respondents were divided into four categories:

- No skills: had not performed any of the referenced activities;
- Few skills: had performed one, two or three of the referenced activities;
- Average skills: had performed four or five of the referenced activities;
- Many skills: had performed six, seven or eight of the referenced activities.

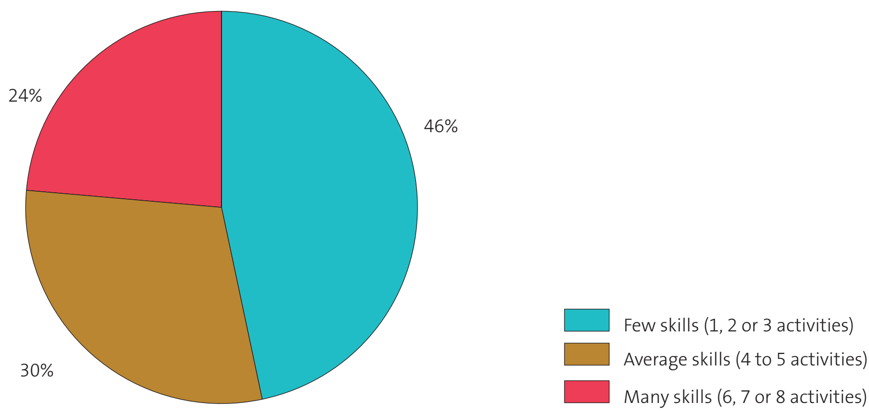
*Internet skills 2006 and 2011 (Figures 4.3.8 and 4.3.9)*
No figures are available for 2006 for the internet activities 'Posting text, games and the like on social network pages' and 'Changing security settings of internet browsers'. This is why the comparison of internet activities between 2006 and 2011 is based on six rather than eight activities. The respondents were subsequently subdivided into four categories:

- No skills: had not performed any of the referenced activities;
- Few skills: had performed one or two of the referenced activities;
- Average skills: had performed three or four of the referenced activities;
- Many skills: had performed five or six of the referenced activities.

Due to the differences in composition and classification, the figures for internet skills in Figures 4.3.6 and 4.3.7 deviate from those in figures 4.3.8 and 4.3.9.

## 4.3.6 Internet skills, 2011

*% of internet users[1)]*




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who have used the internet at some time.

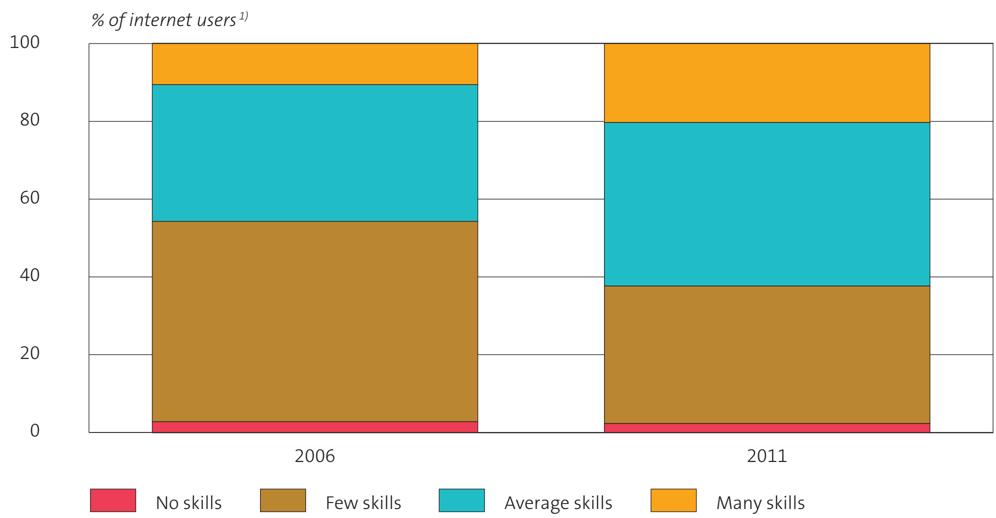
## 4.3.7 Internet skills by personal characteristics, 2011

| | Few (1, 2 or 3 activities) | Average (4 or 5 activities) | Many (6, 7 or 8 activities) |
|---|---|---|---|
| | *% of internet users[1]* | | |
| **Gender** | | | |
| Men | 41 | 30 | 28 |
| Women | 52 | 29 | 19 |
| **Age** | | | |
| 12 to 25 years | 21 | 39 | 41 |
| 25 to 45 years | 36 | 34 | 30 |
| 45 to 65 years | 65 | 24 | 11 |
| 65 to 75 years | 82 | 13 | 4 |
| **Level of education** | | | |
| Primary education | 52 | 28 | 21 |
| Secondary education | 48 | 29 | 23 |
| Higher education | 39 | 33 | 28 |
| Total | 47 | 30 | 24 |

Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1] Individuals aged 12 up to and including 74 years who have used the internet at some time.

## 4.3.8 Skills of internet users, 2006 and 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2006 and 2011.

[1] Individuals aged 12 up to and including 74 years who have used the internet at some time.

Young internet users are the most skilled on the web. Of those aged 12 to 25, 41 percent had many internet skills. Individuals aged 65 or over were the least skilful. Of those aged 65 to 75, over four in five internet users had few skills.
Almost one in three highly educated individuals had many internet skills in 2011. The corresponding figure for less educated individuals was one in five. The difference in relation to the level of education is also smaller in terms of internet skills than it is with respect to computer skills.

### Internet skills increased sharply between 2006 and 2011

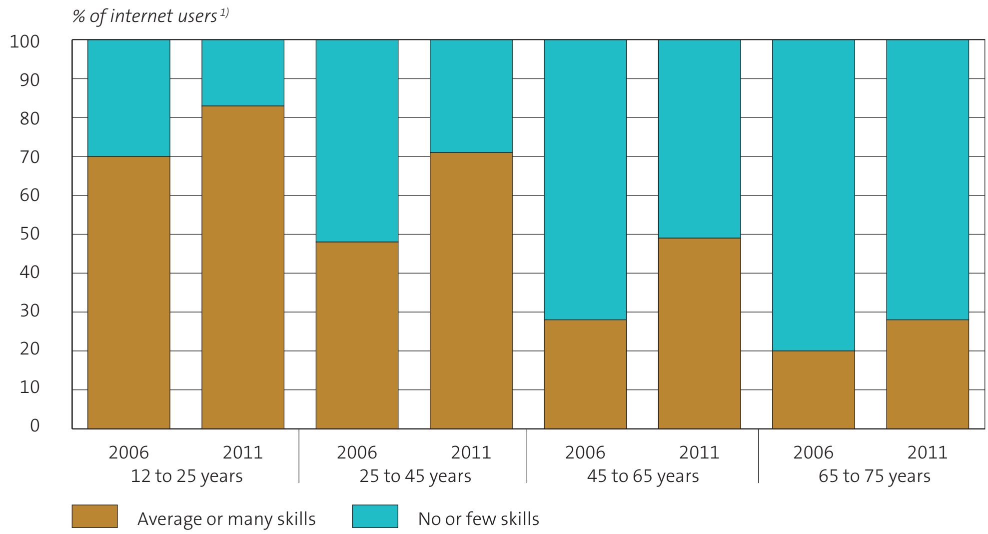
The internet skills of the Dutch population have increased considerably in 2011, relative to 2006 (Figure 4.3.8).[5] Calculated on the basis of the six activities surveyed in both years, 62 percent of internet users had average skills or many skills in 2011. The corresponding figure for 2006 was only 46 percent. Internet skills especially increased between 2006 and 2009, with little change occurring after this. Internet skills increased among all age groups (Figure 4.3.9).[6] In addition, the proportion of individuals aged 12 to 25 with average or many internet skills grew from 70 percent in 2006 to 83 percent in 2011. The corresponding increase for individuals aged 25 to 45 was even higher: from 48 percent to 71 percent. In addition, the proportion of individuals aged 45 to 65 with average or many internet skills grew from 28 percent in 2006 to 49 percent in 2011. Finally, among the 65+ age group, this proportion increased from 20 percent to 28 percent.

### Dutch residents give their own skills a positive rating

In 2011, many computer users rated their computer and internet skills in positive terms. Approximately three quarters considered their own computer and internet skills sufficient for protecting their own computer against viruses or spam (Figure 4.3.10). This also applied to the protection of personal information. More than nine in ten computer users judged their skills as sufficient for communicating with family, friends or acquaintances over the internet. Young computer users are more positive about their skills than older people.

[5] The figures over 2011 in Figure 4.3.8 deviate from those in Figure 4.3.6 (see text box 'Measuring internet skills').
[6] The figures over 2011 in Figure 4.3.9 deviate from those in Figure 4.3.7 (see text box 'Measuring internet skills').

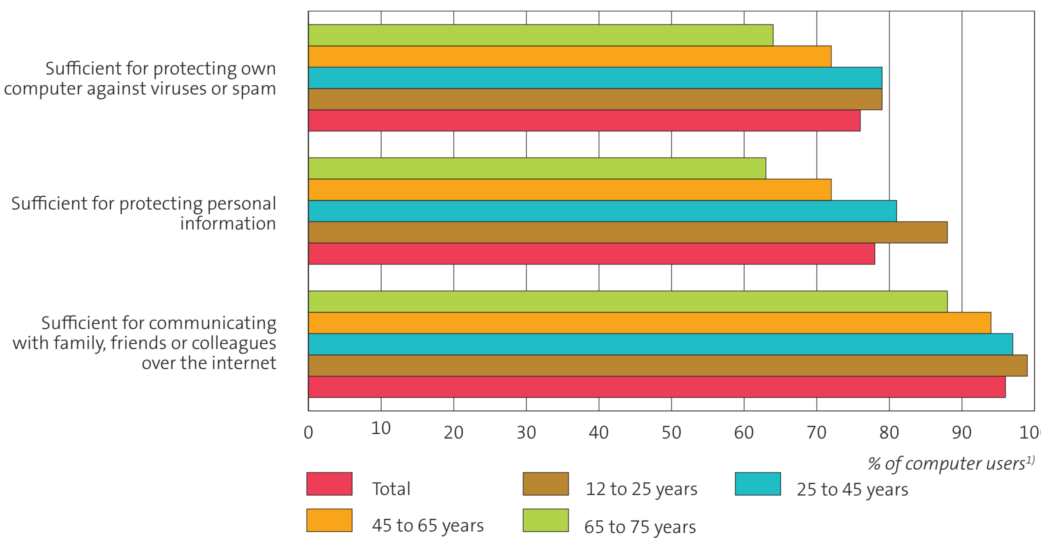
## 4.3.9 Internet skills by age category, 2006 and 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2006 and 2011.

[1)] Individuals aged 12 up to and including 74 years who have used the internet at some time.

## 4.3.10 Evaluation of computer and internet skills, 2011




Source: Statistics Netherlands, ICT use by households and individuals, 2011.

[1)] Individuals aged 12 up to and including 74 years who have used a computer at some time.

### Internet skills of the Dutch population

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. For the *Trendrapport Computer- en Internetgebruik 2011* internet skills were surveyed by telephone. Previously, such as for the 2010 Trendrapport, performance was measured by asking respondents to actually perform tasks on the internet.
The University of Twente's survey distinguishes between operational skills ('clicking knowledge'), formal skills (working with files, browsing and navigating), information skills (searching for information in computer files and on the internet), communication skills (establishing and maintaining contacts and presenting oneself 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 analysis shows that of the five skills surveyed, communication skills are least developed among Dutch internet users.

The average score on a scale of 1 to 5 inclusive is 2.29. At 3.91, the ability to formally navigate the internet scores highest. Although the internet is increasingly being used as a communication medium, it is evident that internet users on average have only moderately developed communication skills.
In terms of operational and strategic skills, as well as information skills, Dutch internet users scored somewhat better in 2011 than in 2010.[1)] The researchers in part explain this trend on the basis of the increased number of hours spent online by the Dutch population, as a result of which they become more experienced on the internet. Although increased internet experience does not necessarily lead to improved skills, it can nevertheless contribute to this. This especially applies to operational and formal skills.

Source: Deursen, A.J.A.M. van & Dijk, J.A.C.M. van (2011), *'Trendrapport Computer- en Internetgebruik* 2011. *Een Nederlands en Europees perspectief'*. University of Twente, Enschede.

1) The 2011 results are not fully comparable with the 2010 results due to the changed survey method.

companies

# ICT use by companies

# 5

# ICT use by companies

## 5.1

**ICT infrastructure and use**

- Computer and internet use has stabilised
- Use of mobile broadband is rapidly increasing
- Dutch companies use relatively fast internet connections
- Over eight in ten companies have their own website
- Many Dutch companies have a website
- Teleworking is increasing

## 5.2

**Internal data communication**

- Over half of companies use open source software
- Open source internet browsers used most often

## 5.3

**External data communication**

- ADE common in Dutch business sector
- Invoices sent out electronically often not suitable for automated processing
- Internet often used for communicating with government
- Few companies limit electronic contact with governments
- Limitation of electronic contact with government low in the Netherlands
- Construction industry frequently uses the internet for tenders

## 5.4

**E-commerce**

- E-selling more frequently conducted via website than via EDI
- E-selling in the Netherlands far above EU average
- Most companies limit e-selling to own country
- One third of Dutch companies make e-purchases
- Dutch companies do not make a great deal of online purchases
- E-commerce sales are increasing

## 5.5 ICT and environmental impacts

- Half of companies have paper reduction procedures
- Companies make moderate use of ICT to reduce environmental burden

## 5.6 ICT and innovative activities

- ICT of major importance to innovation
- ICT most important to major product and process innovators
- ICT most important to innovators in the financial and ICT sectors
- ICT especially important in terms of searching for information

**The ICT infrastructure in companies, together with digital aids such as computers, laptops and to an increasing extent smartphones and tablets, forms an essential pillar of business operations. Computer and internet use by companies has been at a high and stable level for years in the Netherlands. Increasingly this is facilitated through means of mobile broadband connections.**

# 5.1 ICT infrastructure and use

Information and communication technologies (ICT) have penetrated the Dutch business sector, as well as beyond, at a high pace over the last few decades. The Netherlands, together with Switzerland and Sweden, is among the countries with the best ICT infrastructure in the world (Economist Intelligence Unit, 2011). The way in which ICT is applied by companies in many sectors is of fundamental importance in determining their competitive strength. For example, new products and processes can be developed and existing ones optimised through means of the use of ICT (European Commission, 2009b). ICT can also operate as a differentiating factor among competitors in many other ways; for example because companies with advanced ICT use are considered attractive employers. The current trend towards flexible working arrangements, independent of place and time is being embraced by more and more companies. The ICT infrastructure, together with digital aids such as laptops, tablets and smartphones, forms an essential pillar in this regard. However, the degree to which ICT is ultimately used does not have to be the same for all companies and remains a decision based on economic grounds. For example, it would not be very useful for a company in the hospitality sector to invest in technologies that facilitate time and location-independent working. By contrast, in companies with many knowledge workers, a system of this nature can have a major impact on the efficiency of business operations and the company's appeal as an employer.

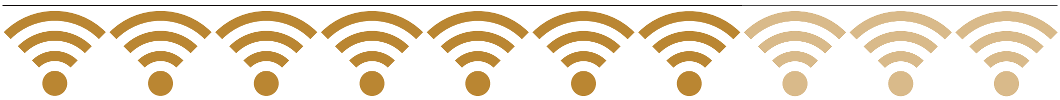
**'ICT use by companies' survey**

The 'ICT use by companies' survey is a random survey of companies with 10 or more employed persons. Companies with 250 or more employed persons all receive a questionnaire. Statistics Netherlands has carried out the survey each year since 1983. Up until 2001, the survey was known as the 'Automation Survey'. ICT is by nature a technology that is highly subject to change. The content of the ICT questionnaire is therefore continuously subject to modification as well. In the early years, questions focused mainly on the number of computers owned, automation personnel and automation costs. The emphasis in recent years has been more on issues like internet use, e-commerce and the application of software. This makes the compilation of longer time series difficult. To place the Dutch situation in proper perspective, it is frequently compared with the prevailing situations in other countries. International comparisons are possible because the Dutch ICT survey has been in harmony with those of other EU countries since 2001.

### Computer and internet use has stabilised

Over two thirds of working persons used a computer with internet access at work in 2010 (67 percent). This percentage has been at a stable level since 2008. The use of the internet at work presents a similar picture. The number of working persons using the internet for their work was 60 percent in 2010 compared to 57 percent in 2008.
Virtually all employed persons (99 percent) in the ‘IT and information services sector’, ‘Banks’ and ‘Insurance companies’ use computers for performing their work. This also applies to Research institutes and Travel agencies (both 98 percent). The use of internet for work was also high in these sectors. Almost all employees of Banks used the internet in 2010 (99 percent). This also applies to employed persons working at Insurance companies and in ‘IT and information services’ (98 and 97 percent respectively). Ninety-eight percent of employed persons in Research institutes also made frequent use of the internet. The nature of work in sectors such as ‘Other business services’ and ‘Hospitality’ is less suited to the use of computers and the internet. Approximately one third of employed persons in both these sectors used a computer in 2010. Employed persons in the Other business services sector ranked lowest in terms of internet use (27 percent). This sector includes interior cleaning companies, for example.
The differences between small and large companies in terms of computer as well as internet use are only slight in this regard. At small companies (10 to 20 employed persons), 61 percent of employed persons regularly used a computer in 2010, whereas the corresponding figure for large companies (500 or more employed persons) was 70 percent. The difference in terms of internet use at the workplace was somewhat smaller: 56 percent at small companies compared to 62 at large companies.

**Large companies: 7 in 10 employees use a computer**

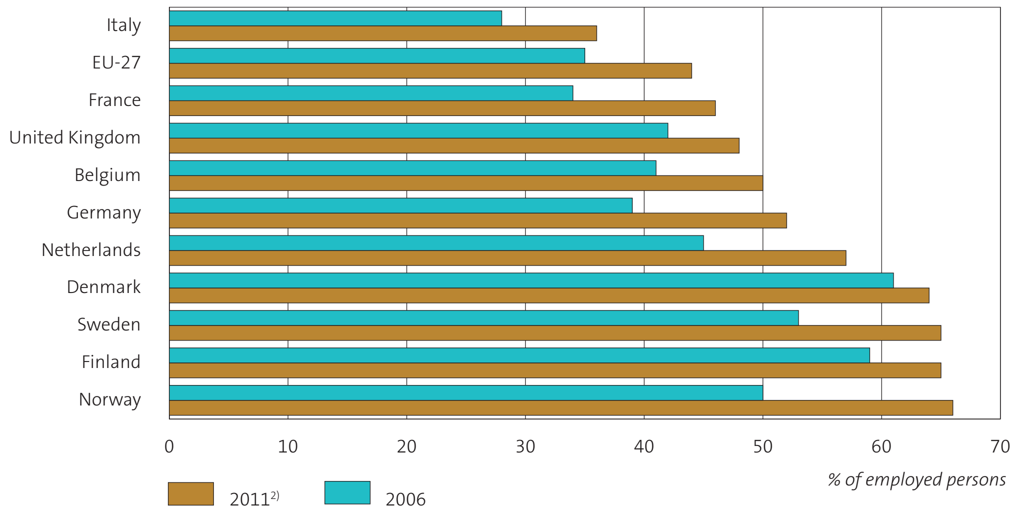


The Netherlands is substantially above the EU average as regards the share of employed persons who use a computer with internet access at work. The EU average in 2011 was 44 percent, whereas in the Netherlands the corresponding figure was 57 percent (see text box about the differences between national and European figures). Of the countries included in Figure 5.1.1, Norway (not an EU country) had the highest percentage of employed persons with internet access at work (66 percent). Other Scandinavian countries likewise had a high score, as had been the case as far back as 2006. At 36 percent in 2011, Italy scored lowest among the benchmark countries.

**European figures differ from Dutch results**

In this section, any discussion of the performance of the Netherlands in an international context excludes the financial sector from consideration. Due to the specific character of this sector, not all countries include this sector in their ICT survey. The harmonised international figures consequently exclude this sector as well. This can result in differences in comparison to the national publications of Statistics Netherlands concerning the ICT use by companies that do include this sector. Furthermore, the harmonised European results use January 2011 as the reference period for some variables. Statistics Netherlands deviates somewhat from this by referring to December 2010 in these instances. The results produced in accordance with the national method are therefore presented as part of the 2010 reporting period. For international comparisons, the reporting year is 2011.

### 5.1.1 Employed persons who use a computer with internet access at work, international, 2006–2011[1)]




Source: Eurostat.

1) Employed persons in companies with 10 or more employed persons, excluding financial institutions.
2) Denmark and the United Kingdom: 2010 instead of 2011.

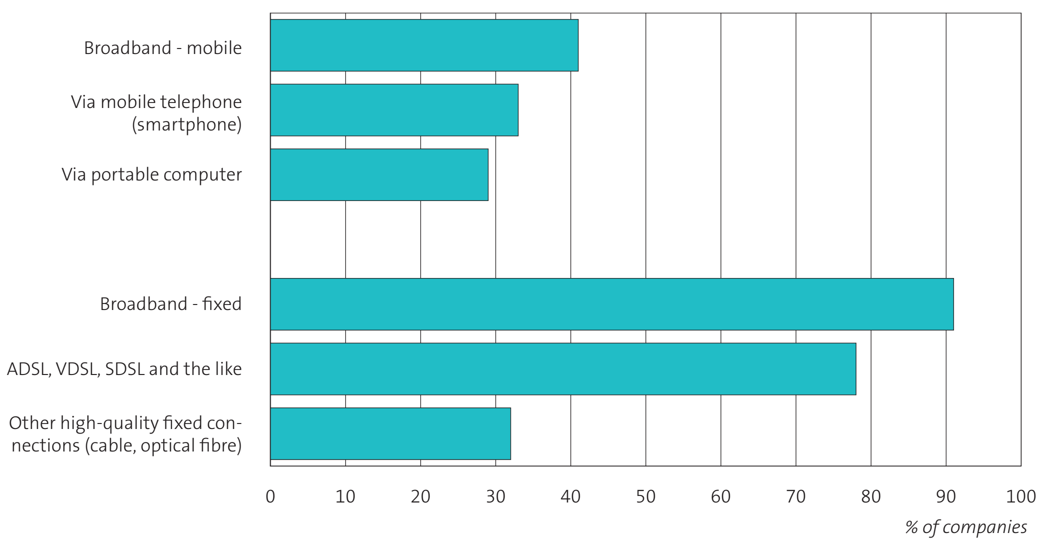
The differences in Figure 5.1.1 are strongly related to the national economic structures. Indeed, in certain sectors the use of the internet by employees is more important than in other sectors. Countries with a relatively high share of manufacturing companies consequently score lower in Figure 5.1.1 than countries with a large services sector.

### Use of mobile broadband is rapidly increasing

In 2010, 93 percent of Dutch companies had internet access via a broadband connection. Broadband internet consists of high-quality connections such as optical fibre, cable and ADSL, as well as high-quality mobile connections. The number of companies that have mobile broadband is increasing. In 2010, 91 percent of companies had a fixed broadband connection and 41 percent had a mobile broadband connection (Figure 5.1.2). In 2009, only 28 percent of companies had a mobile broadband connection. The use of mobile broadband has therefore experienced rapid growth. Thirty-three percent of companies used mobile broadband connections via smartphones. In addition, 29 percent of companies in 2010 used notebooks, laptops or tablets for mobile broadband internet access.

# Mobile broadband used extensively in IT sector

**5.1.2 Broadband connections in companies, by type of connection, 2010[1)]**




Source: Statistics Netherlands, ICT use by companies, 2010.

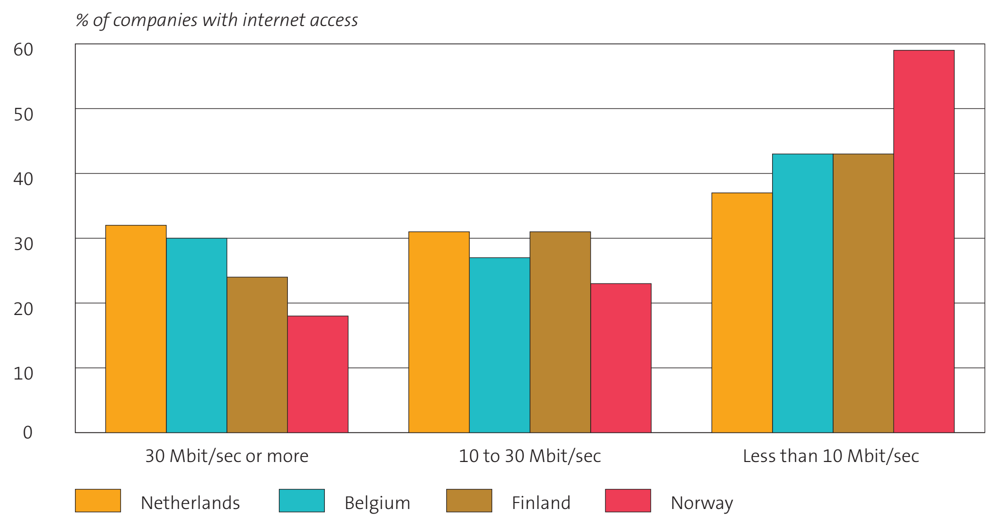
1) Companies with 10 or more employed persons.

In 2010, companies in the ‘IT and information services’ sector had the most mobile broadband connections: over seven in ten. The share of companies with a mobile broadband connection was also relatively high in the ‘Insurance companies’ and ‘Telecommunication’ sectors (65 and 64 percent, respectively). Sixty-three percent of Research institutes had mobile broadband. This percentage was lowest for companies in the Food, drink and tobacco industry (27 percent).
Large companies are in the lead in terms of the use of mobile broadband connections. Seventy-one percent of companies with at least 500 employed persons had mobile broadband compared to one third of companies with 10 to 20 employed persons. The principle that applied regardless of size is that mobile broadband connections were more frequently used via smartphones than portable computers.

### Dutch companies use relatively fast internet connections

In comparison to other European countries, Dutch companies use fast internet connections. Of Dutch companies that used the internet in 2011, almost one third had an internet connection rated at 30 Mbit/sec or more (32 percent). The Netherlands had the highest share of companies with this type of high-speed internet connection of the

**5.1.3 Maximum download speed of fastest internet connection in companies, international, 2011[1)]**




Source: Eurostat.

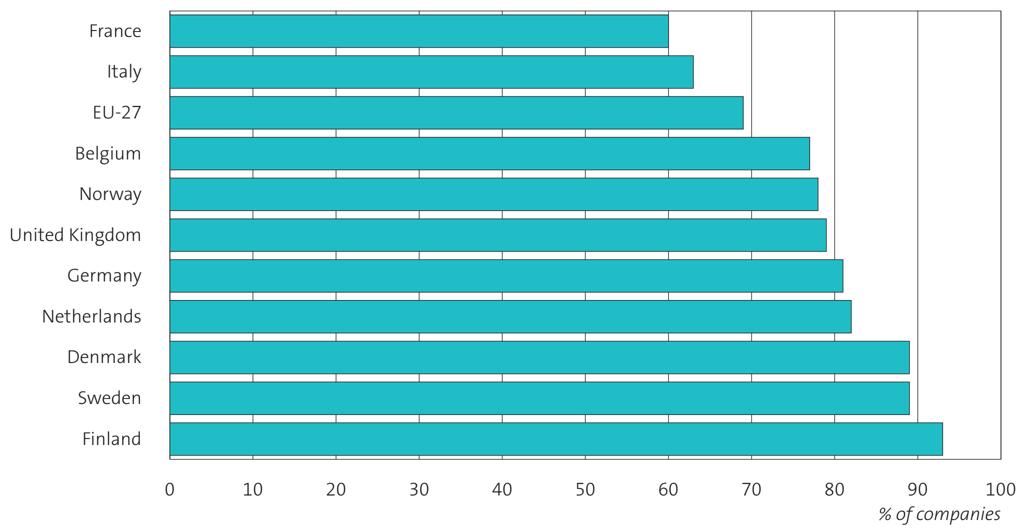
[1)] Companies with 10 or more employed persons, excluding financial institutions.

countries in Figure 5.1.3. Belgium also scored high (30 percent). While the group of companies with an internet connection slower than 10 Mbit/sec represents the largest group in the Netherlands (37 percent), it is small in international terms. Especially Norway had a large group of companies with a slow internet connection (59 percent).

### Over eight in ten companies have their own website

At the end of 2010, 83 percent of Dutch companies had their own website. However, the rate of increase in the percentage of companies that have their own website on which they profile themselves has slowed. For example, 79 percent of companies already had their own website in 2005. Over a quarter of companies provided features, such as online ordering, booking or reserving, on their website (27 percent). There are major differences between sectors in this respect that are primarily due to the nature of business operations. Travel agencies and companies active in the Accommodation sector most often provided the option of making online bookings (77 and 73 percent, respectively). The Machine industry scored lowest among all sectors (8 percent). Indeed, over nine in ten companies in the Machine industry had a website, but primarily used it to profile themselves.
Websites are more common among larger companies than among smaller ones. Of the

**5.1.4 Companies with own website, international, 2011[1)]**




Source: Eurostat.

[1)] Companies with 10 or more employed persons, excluding financial institutions.

companies with 10 to 20 employed persons, 78 percent had a website, whereas virtually all companies with 500 or more employed persons had one (98 percent). Over one third of these large companies (34 percent) also provided the option of making reservations, bookings or placing orders via their website. Smaller companies provided these options to a lesser degree (26 percent).

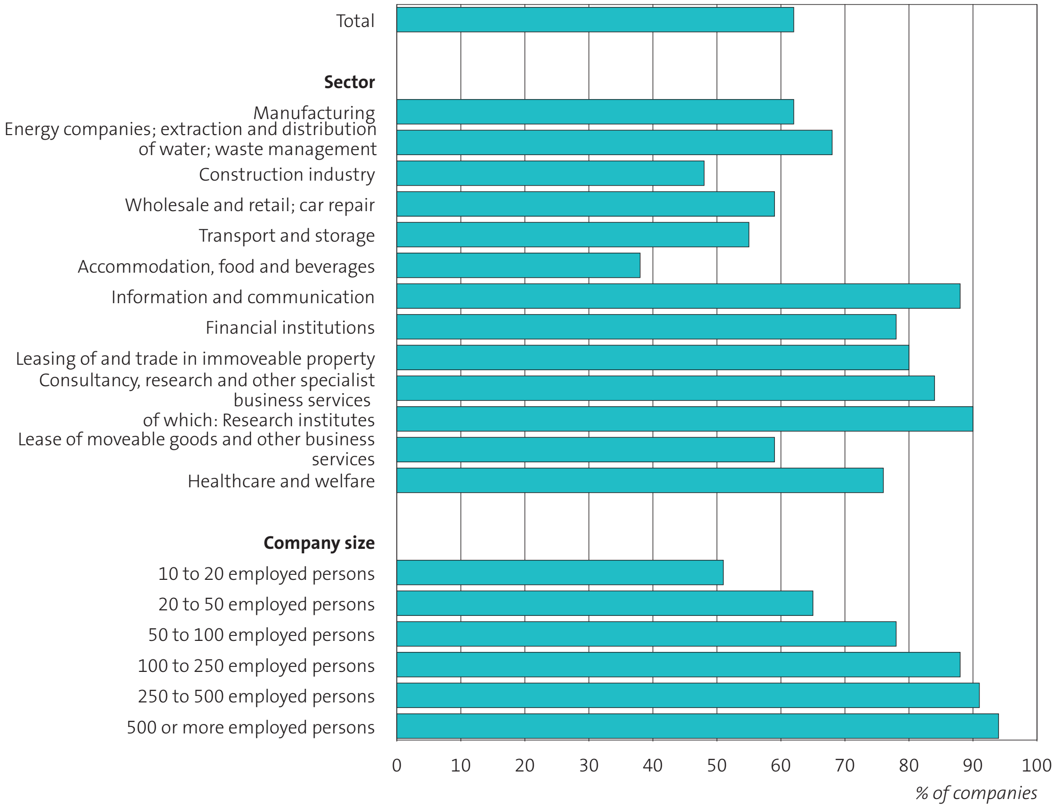
### Many Dutch companies have a website

Compared to other EU countries, many Dutch companies had a website in 2011. This share was 82 percent in the Netherlands, compared to 69 percent in the EU-27 (Figure 5.1.4). Finland is the country with the highest share of companies with a website (93 percent). Other Scandinavian countries also scored high. In 2011, 89 percent of Danish as well as Swedish companies had a website. Norwegian companies were lagging somewhat in this respect (78 percent).

### Teleworking is increasing

More and more companies are offering their employees the option of teleworking and this share once again increased in 2010. Sixty-two percent of companies provided telework facilities to their employees that year (Figure 5.1.5) compared to 56 percent in 2009. Teleworking is in this case understood to mean that an employee retains access to the company's ICT systems while not on company premises.
Especially companies in the Information and communication sector support teleworking on a major scale (88 percent in 2010). Teleworking is also common in the 'Consulting, research and other specialist business services': 84 percent of companies. This sector also includes Research institutes, of which as many as 90 percent facilitate teleworking. Relatively few companies use teleworking in the Hospitality industry (38 percent). Indeed, activities in the Hospitality sector are largely unsuitable for teleworking.
Teleworking occurs most frequently in large companies. In 2010, 94 percent of companies with at least 500 employed persons provided telework facilities, whereas the corresponding figure for companies with 10 to 20 employed persons was 51 percent.
Of all employed persons, 21 percent regularly worked off company premises while retaining access to the company's ICT systems. Individuals working in the Information and communication sector did so most often: 50 percent. Fifty percent of employed persons at Research institutes also regularly made use of telework facilities. At 42 percent, Consulting, research and other specialist services also scored high. The Hospitality sector had the lowest share of teleworkers: 10 percent.

### 5.1.5 Companies with teleworkers, 2010[1)]




Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

# 5.2 Internal data communication

The ICT infrastructure in companies continues to evolve. In addition to basic ICT facilities, such as computers and the internet, additional applications, such as the interfaces between automated systems, are now increasingly feasible as well. Half of all companies in 2010 used software for recording sales orders. Of these companies, almost three quarters had linked this software to their invoicing and accounting system (Table 5.2.1). The accounting system furthermore was also the system to which the purchase order processing system was most often linked. Over 45 percent of all companies used purchase order processing software. Of these companies, 64 percent had linked their purchase order system to the accounting system. Companies in the Manufacturing sector headed the list in terms of having sales order processing software in place (72 percent). In addition, companies in the manufacturing sector also most often used purchase order processing software (61 percent). Seventy-two percent of companies in the manufacturing sector with a sales order processing system had established an automated link between this application and the invoicing and accounting system. This involves a fully automated interface without any human intervention. Linked sales order processing systems are also prevalent in the Trade sector, in which the timely delivery or availability of goods is of great importance. In 2010, 81 percent of trading

### 5.2.1 Companies with order processing systems linked to other automated systems, 2010[1)]

| | Sales order processing system linked to invoicing and accounting system | Sales order processing system linked to stock management system | Sales order processing system linked to production system | Sales order processing system linked to logistics system | Purchase order processing system linked to payment and accounting system | Purchase order processing system linked to stock management system |
|---|---|---|---|---|---|---|
| | *% of companies with sales order processing system* | | | | *% of companies with purchase order processing system* | |
| Total | 74 | 46 | 28 | 38 | 64 | 49 |
| **Sector** | | | | | | |
| Manufacturing | 72 | 53 | 51 | 49 | 64 | 57 |
| Energy companies; extraction and distribution of water; waste management | 75 | 28 | 23 | 33 | 72 | 36 |
| Construction industry | 70 | 23 | 15 | 20 | 74 | 26 |
| Wholesale and retail; car repair | 81 | 68 | 25 | 49 | 63 | 71 |
| Transport and storage | 73 | 29 | 15 | 52 | 63 | 21 |
| Accommodation, food and beverages | 51 | 34 | 9 | 17 | 45 | 18 |
| Information and communication | 65 | 29 | 23 | 25 | 63 | 29 |
| Financial institutions | 66 | 26 | 34 | 20 | 77 | 23 |
| Lease of and trade in immoveable property | 68 | 14 | 21 | 18 | 68 | 18 |
| Consultancy, research and other specialist business services | 72 | 26 | 23 | 26 | 65 | 26 |
| of which: | | | | | | |
| Research institutes | 79 | 26 | 19 | 33 | 67 | 33 |
| Lease of moveable goods and other business services | 76 | 22 | 15 | 20 | 67 | 23 |
| Healthcare and welfare | 75 | 17 | 29 | 21 | 63 | 25 |
| **Company size** | | | | | | |
| 10 to 20 employed persons | 73 | 39 | 20 | 30 | 58 | 39 |
| 20 to 50 employed persons | 71 | 46 | 25 | 37 | 61 | 52 |
| 50 to 100 employed persons | 77 | 54 | 39 | 51 | 70 | 54 |
| 100 to 250 employed persons | 81 | 59 | 46 | 60 | 75 | 59 |
| 250 to 500 employed persons | 80 | 61 | 46 | 57 | 75 | 59 |
| 500 or more employed persons | 92 | 63 | 53 | 67 | 83 | 62 |

Source: Statistics Netherlands, ICT use by companies, 2010.

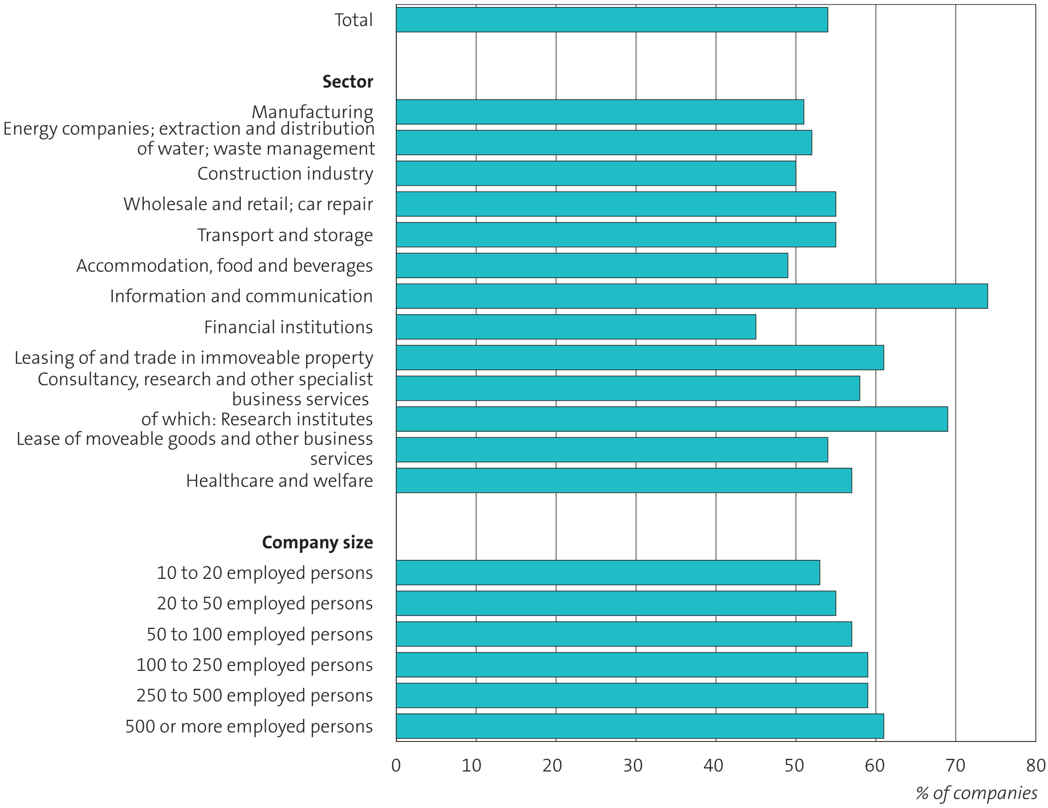
1) Companies with 10 or more employed persons.

companies with a sales order processing system had linked it to the invoicing system and 68 percent had linked it to their stock management system.
Purchase order processing systems linked to a payment and accounting system were most prevalent among Financial institutions (Table 5.2.1). Purchase order processing systems linked to stock management systems were most prevalent in the Trade sector.
Small companies are less apt to use software for the purpose of recording sales orders than large companies. The same applies to purchase order processing software. In addition, large companies more frequently link their sales order and purchase order processing software to other systems than small companies.

**Over half of companies use open source software**

In 2010, 54 percent of companies used some form of open source software (Figure 5.2.2). Before software can be classified as open source it must comply with a number of criteria (Open Source Initiative, 2012). It concerns software in respect of which the source code may be read, supplemented or improved and further distribution is permitted. Open source software is generally (but not by definition) available free of charge. As is the case for closed software, costs are associated with its installation, familiarisation and maintenance. Open source software comes in many variations. Well-known open source operating systems include Linux and OpenBSD; however, open source versions are also available for office and business applications, internet browser software and ERP or CRM applications. If a company uses open source software, this does not mean that all software within the company has an open character. For example, the use of open source may be limited to the use of an internet browser.
Fifty-three percent of small companies with 10 to 20 employed persons used open source software in 2010. The corresponding figure for companies with 500 or more employed persons was 61 percent. Small companies primarily made high use of open source web browsers (42 percent), while large companies often made use of an open source operating system such as Linux, OpenBSD or Apache (44 percent).
Of all sectors, the use of open source software was most prevalent in the Information and communication sector in 2010. The share of companies with open source software in this sector was 74 percent. Open source web browsers were the most often used in this regard: by 70 percent of companies. The number of companies classified as Research institutes that used open source software was also high (69 percent). Financial institutions were the least likely to use open source software, although 45 percent nevertheless had some form of open source software in use. All sectors therefore had a significant adoption of open source software.

### 5.2.2 Companies using open source software, 2010[1)]



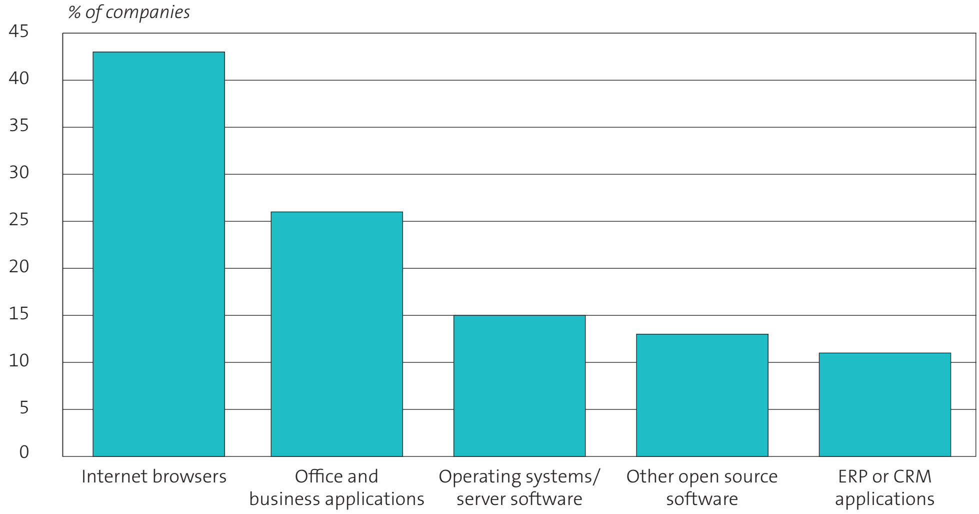

Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

#### Open source internet browsers used most often

Open source internet browsers were the form of open source software most often used by Dutch companies in 2010 (43 percent of companies). Open source versions of office and business applications were also used relatively frequently. Over a quarter of companies were using this type of software (Figure 5.2.3). Open source ERP or CRM applications, such as OpenERP, Joomla or MySQL were used much less often by Dutch companies (11 percent).

**5.2.3 Companies using open source software, by type, 2010[1)]**




Source: Statistics Netherlands, ICT use by companies, 2010.

[1)] Companies with 10 or more employed persons.

# 5.3 External data communication

External data communication is defined as the communication between a company's computers and third party computers. This type of communication has been in use for several decades. Internet technology has facilitated the fast and efficient exchange of information stored on computers or servers within an electronic network. Since more and more companies have high capacity internet connections, these types of applications can be increasingly used. The fully automated handling of processes is an example of this. This is also referred to as Automated Data Exchange (ADE). Whether or not through a website, ADE can be applied in different ways. International and other standards that describe the required format of these messages are often used. Examples of well-known formats are XML and EDI. ADE, among other things, can be used for e-invoicing and electronically sending and receiving transport documents, and exchanging data with governments. The Dutch government also provides digital services to companies, in particular for the purpose of simplifying communication.

**ADE common in Dutch business sector**

Seventy percent of all companies used some form of ADE in 2010. Companies in the Manufacturing and Transport and storage sectors were most likely to use ADE. Seventy-four percent of companies in these two sectors applied at least one form of ADE (Table 5.3.1). The differences with companies in the other sectors are relatively small, however. Financial institutions make the least use of ADE, even though the share in this sector nevertheless was 62 percent.
Large companies with at least 500 employed persons made the highest use of ADE (85 percent). The use of ADE in small companies with up to 20 employed persons at 65 percent was not that uncommon either, however.

### 5.3.1 Companies with automated data exchange; e-invoicing, 2010[1)]

| | At least one type of ADE | Sent out e-invoice suited for automated processing | Sent out e-invoice not suited for automated processing | Received e-invoice suited for automated processing | Received e-invoice not suited for automated processing |
|---|---|---|---|---|---|
| | *% of companies* | | | | |
| Total | 70 | 11 | 28 | 22 | 61 |
| **Sector** | | | | | |
| Manufacturing | 74 | 11 | 30 | 19 | 67 |
| Energy companies; extraction and distribution of water; waste management | 66 | 10 | 25 | 17 | 59 |
| Construction industry | 68 | 4 | 17 | 20 | 48 |
| Wholesale and retail; car repair | 71 | 17 | 28 | 28 | 64 |
| Transport and storage | 74 | 12 | 33 | 23 | 63 |
| Accommodation, food and beverages | 63 | 4 | 29 | 16 | 52 |
| Information and communication | 73 | 10 | 46 | 19 | 76 |
| Financial institutions | 62 | 10 | 23 | 23 | 57 |
| Lease of and trade in immoveable property | 63 | 13 | 23 | 23 | 64 |
| Consultancy, research and other specialist business services | 71 | 6 | 31 | 20 | 69 |
| of which: | | | | | |
| Research institutes | 67 | 7 | 40 | 22 | 71 |
| Lease of moveable goods and other business services | 66 | 9 | 27 | 19 | 54 |
| Healthcare and welfare | 63 | 23 | 27 | 21 | 59 |
| **Company size** | | | | | |
| 10 to 20 employed persons | 65 | 8 | 25 | 22 | 56 |
| 20 to 50 employed persons | 71 | 10 | 28 | 20 | 64 |
| 50 to 100 employed persons | 76 | 16 | 33 | 22 | 71 |
| 100 to 250 employed persons | 78 | 21 | 37 | 25 | 70 |
| 250 to 500 employed persons | 82 | 26 | 40 | 31 | 72 |
| 500 or more employed persons | 85 | 38 | 43 | 41 | 70 |

Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

### Invoices sent out electronically often not suitable for automated processing

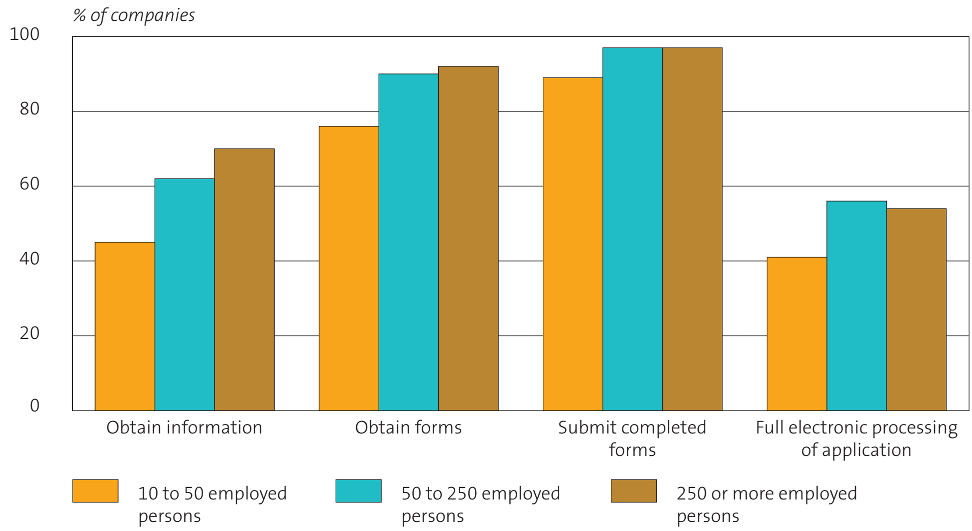
Twenty-eight percent of companies used e-mail to electronically send out invoices. A smaller share of companies used a fully automated system such as EDI to send out e-invoices (11 percent).
The use of fully automated electronic invoicing is more common among large companies than small companies. Thirty-eight percent of large companies with 500 or more employed persons used a fully automated process to send out invoices compared to 8 percent of companies with 10 to 20 employed persons. For large companies with a high volume of invoices it pays off to invest in an e-invoicing system.
Almost half of companies in the Information and communication sector sent out e-invoices in a non-standardised format in 2010 (46 percent). This share was also relatively high among Research institutes (40 percent). The Construction industry was less apt to use this method of invoicing (17 percent).
It is more common for companies to receive invoices electronically than it is for them to send them out electronically. One fifth of all companies in 2010 received invoices that could be processed automatically (22 percent). In addition, 61 percent received e-invoices that were not suitable for this. Here too large companies scored higher than small ones. However, the differences are not as pronounced as they are for electronically sending out invoices.
Seventy-six percent of companies in the Information and communication sector received e-invoices in a format not suitable for automated processing. Companies in the Construction industry received the lowest number of invoices by e-mail, for example, although almost half of these companies nevertheless received invoices this way (48 percent). Trading companies most often received e-invoices that lend themselves to automated processing (28 percent).

### Internet often used for communicating with government

Many companies use the internet to communicate with governments. Ninety-two percent of all companies had contact with government over the internet in 2010. Especially the electronic submission of forms, such as tax declarations and grant applications, was an often used application: by nine in ten Dutch companies. Of these companies, 83 percent submitted the VAT declaration electronically. Over six in ten companies electronically submitted forms for the declaration of social premiums paid by employees. Half of companies that completed forms over the internet in 2010 electronically submitted their corporation tax declaration themselves.
The differences between small and large companies in relation to the electronic submission of forms are only slight. Eighty-nine percent of companies with 10 to 50 employed persons used the internet to submit forms electronically compared to 97 percent of companies with 50 employed persons or more (Figure 5.3.2).

Companies also commonly downloaded forms. Seventy-eight percent of all companies in 2010 obtained one or more forms electronically. The principle that once again applies is that large companies more often download forms than small companies, but that the differences are slight. Ninety-two percent of companies with at least 250 employed persons downloaded a form in 2010, whereas the corresponding figure for companies with 10 to 50 employed persons was 76 percent.
Almost half of companies in 2010 used the internet to obtain information from government. A somewhat smaller share of companies completed an administrative procedure electronically entirely via the internet; in other words without any additional paper work (43 percent).

### 5.3.2 Companies that communicate with government over the internet, by company size and purpose, 2010[1)]




Source: Statistics Netherlands, ICT use by companies, 2010.

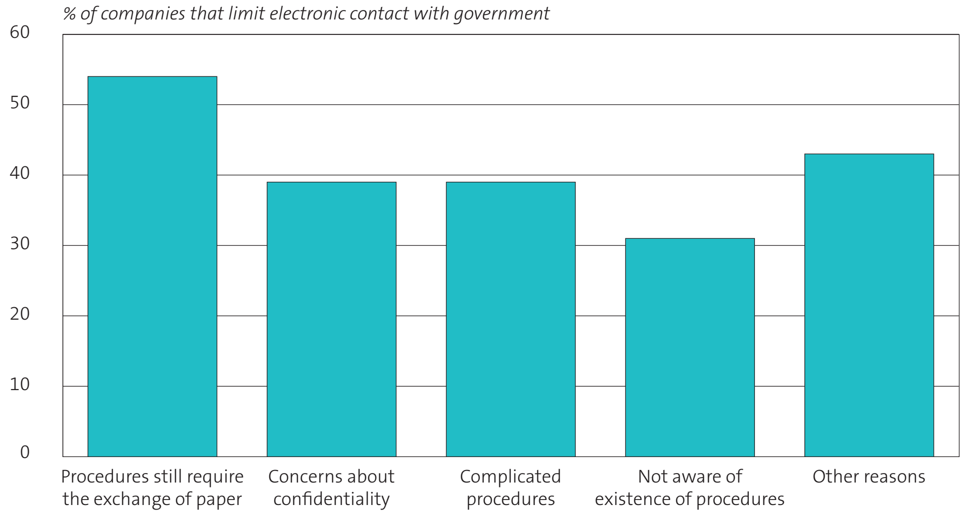
1) Companies with 10 or more employed persons.

Companies in the 'Energy supply and waste management industry' were exceptionally active in terms of communicating with the government over the internet. Companies in this sector primarily often received information and forms from government over the internet. The submission of completed forms over the internet and the fully electronic processing of applications most often occurred in companies active in 'Specialist and business services'. Research institutes scored above average in terms of each of the differentiated forms of electronic communication with government. By contrast, companies in the Hospitality sector scored low.

**Few companies limit electronic contact with governments**

In 2010, few companies had reason to limit their electronic contact with government. Only 4 percent of companies reduced their contact with governments over the internet. Limiting contact with government over the internet occurred least among Financial institutions (2 percent). Large companies relatively often had reason to limit communication with government over the internet (7 percent). The fact that procedures still require the exchange of paper or a visit in person was the most important reason for limiting electronic contact with government. Lack of awareness of the existence of electronic government procedures is rare (Figure 5.3.3).

**5.3.3 Reasons for limiting electronic contact with government, 2010[1)]**




Source: Statistics Netherlands, ICT use by companies, 2010.

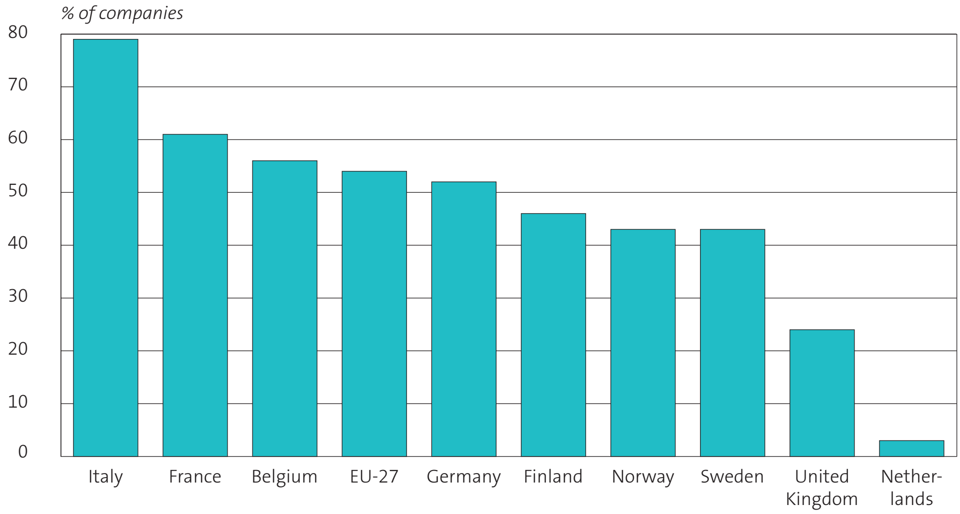
1) Companies with 10 or more employed persons.

Detailed information about companies that communicate with government over the internet is contained in the statistical annex to this publication. The statistical annex can be consulted online at www.cbs.nl/ICT-knowledge-economy.

### Limitation of electronic contact with government low in the Netherlands

In 2011, of the countries in Figure 5.3.4, the Netherlands had the lowest percentage of companies that had reason to limit electronic contact with government (3 percent). This share was much higher in Italy. Almost 8 in 10 Italian companies saw reason for limiting communication with government over the internet. This percentage was also significantly higher in France and Belgium than in the Netherlands (61 and 56 percent respectively). The EU average was 54 percent.

**5.3.4 Companies with reason to limit electronic contact with government, international, 2011[1)]**




Source: Eurostat.

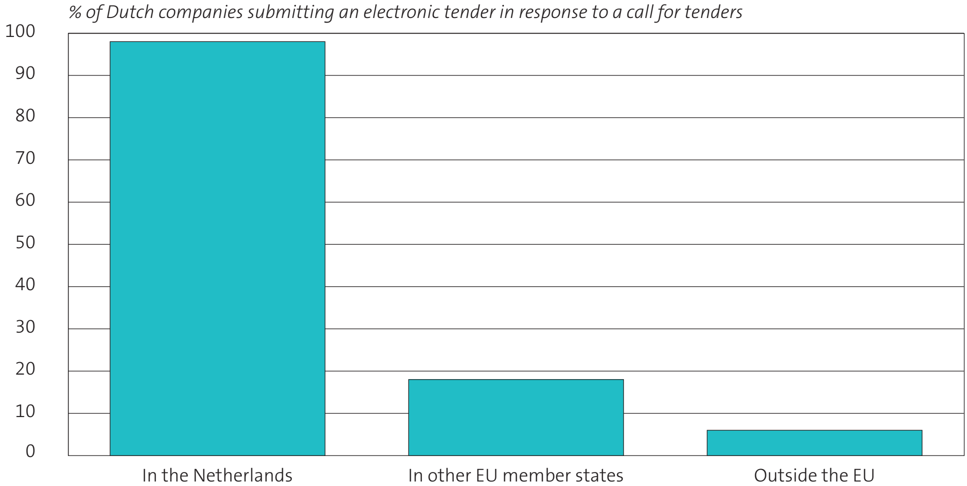
1) Companies with 10 or more employed persons, excluding financial institutions.

### Construction industry frequently uses the internet for tenders

Large companies in the Construction industry often obtain information from government about tenders over the internet. Fifty-nine percent of construction companies with 250 or more employed persons used the internet for this purpose in 2010. This is far above the average of 16 percent. Over one in eight companies actually submitted a tender over the internet in response to a call for tenders (13 percent). Here too, large construction companies, at 68 percent, were highly overrepresented. The Information and communication sector was also exceptionally active in this area. A quarter of all companies in this sector electronically

submitted a tender in response to a call for tenders. For large ICT companies with at least 250 employed persons, the share was as high as 50 percent. It is well-known that many companies in the ICT sector and the Construction industry often work with tendering procedures. Use of the internet is a broadly used method in this regard.
Dutch companies most often respond over the internet to a call for tenders issued by Dutch government authorities. They respond far less often to calls for tenders issued by foreign governments. Dutch companies more often responded to calls for tenders issued by EU countries than countries outside the EU (Figure 5.3.5).

**5.3.5 Use of the internet by companies for responding to government tenders, by region, 2010[1)]**



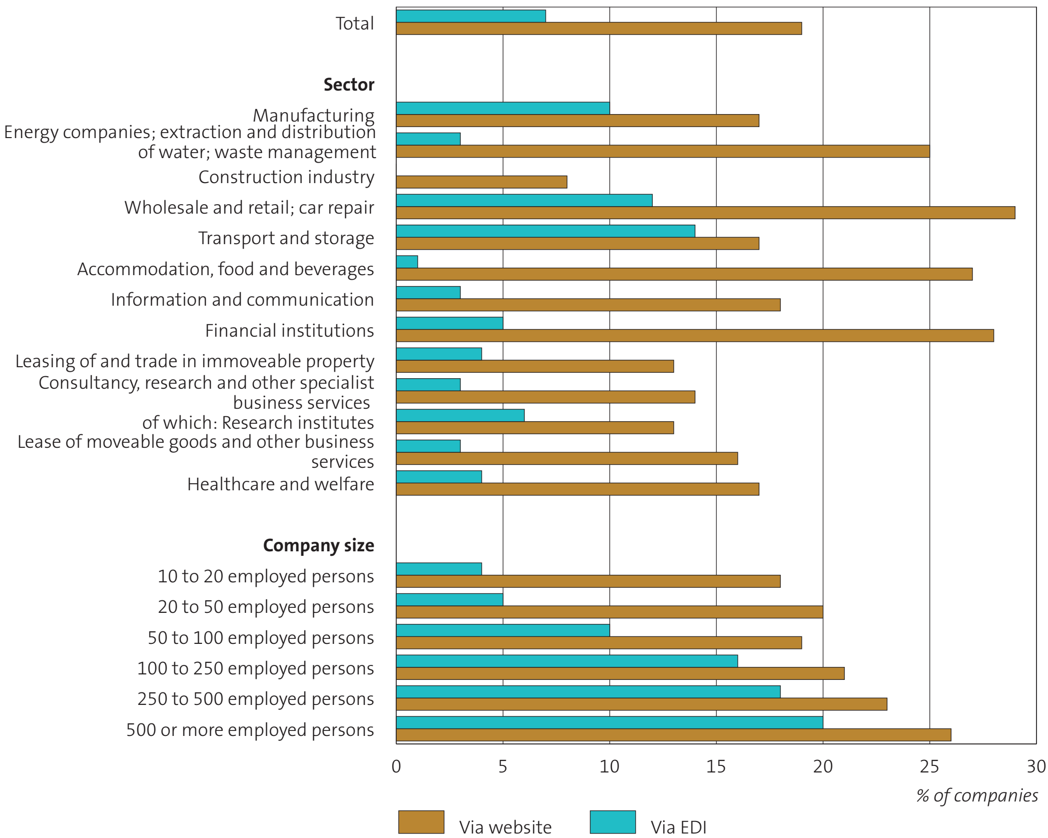

Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

# 5.4 E-commerce

A specific use of electronic networks is the online ordering of goods or services. E-commerce concerns the receipt or submission of orders by means of electronic networks, irrespective of the method of payment and delivery. This includes sales and purchases over the internet, as well as purchases and sales via other more specialised networks, such as Electronic Data Interchange (EDI). EDI relates to the submission or receipt of business information in an agreed upon format that enables automated processing. This is

**5.4.1 Sale by companies via website or EDI, 2010[1)]**




Source: Statistics Netherlands, ICT use by companies, 2010.

[1)] Companies with 10 or more employed persons.

therefore often used for repetitive transactions. There are a number of EDI standards, such as XML, and EDIFACT, which was developed by the United Nations. Due to the emergence of the internet and open standards, EDI has now also become accessible to smaller companies.

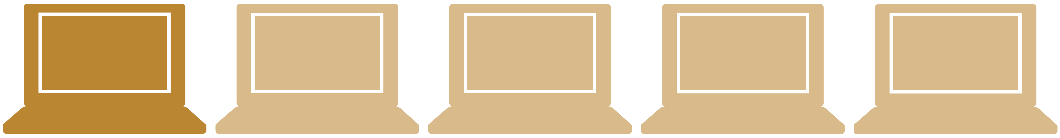
### E-selling more frequently conducted via website than via EDI

Companies more often receive orders via a website than via EDI. In 2010, 19 percent of companies sold goods or services via a website versus 7 percent via EDI (Figure 5.4.1). EDI is exclusively used for transactions between companies (Business-to-Business). The use of EDI requires specific investments in the installation and maintenance of these systems. This makes EDI an attractive option for a limited group of companies. The use of websites for e-selling has a significantly lower entry threshold.
Twenty-nine percent of companies in the 'Wholesale and retail sector' received orders via a website in 2010. This means that the share of trading companies receiving such orders is higher than in any other sector. The share of companies receiving orders via a website was also high among Financial institutions (28 percent) and the Hospitality sector (27 percent). Providers of accommodation in particular have adopted e-selling on a large scale, while bars and restaurants are far less active in this respect.
Companies with 500 or more employed persons often use e-selling, via a website as well as EDI. Of these large companies, 26 percent received orders via a website and 20 percent via EDI in 2010. As regards small companies with 10 to 20 employed persons, the EDI share in particular is much smaller: 4 percent. The share of small companies that received orders via a website was significantly higher: 18 percent. The low entry threshold of this approach is a contributing factor in the adoption of selling via a website on a considerable scale by small companies.

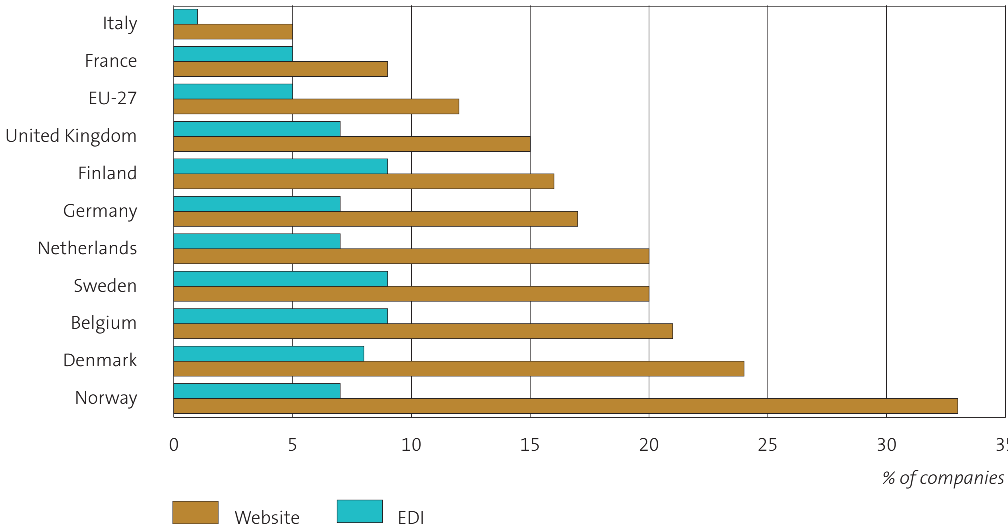
### E-selling in the Netherlands far above EU average

The share of Dutch companies that receive orders via a website is well above the average of the EU-27. This is also true of selling via EDI. In 2011, 20 percent of Dutch companies received orders via a website compared to an EU average of 12 percent. In terms of the receipt of orders via EDI, the difference between the Netherlands (7 percent) and the EU (5 percent) was considerably smaller. Of the countries in Figure 5.4.2, the share of companies that received orders via a website was highest in Norway (33 percent). Selling via EDI was predominant in Belgium, Sweden and Finland. In these three countries 9 percent of companies received orders in a previously agreed upon format that enables automated processing.

## One fifth of companies engage in selling over the internet



### 5.4.2 Selling by companies via website or EDI, international, 2011[1)]




Source: Eurostat.

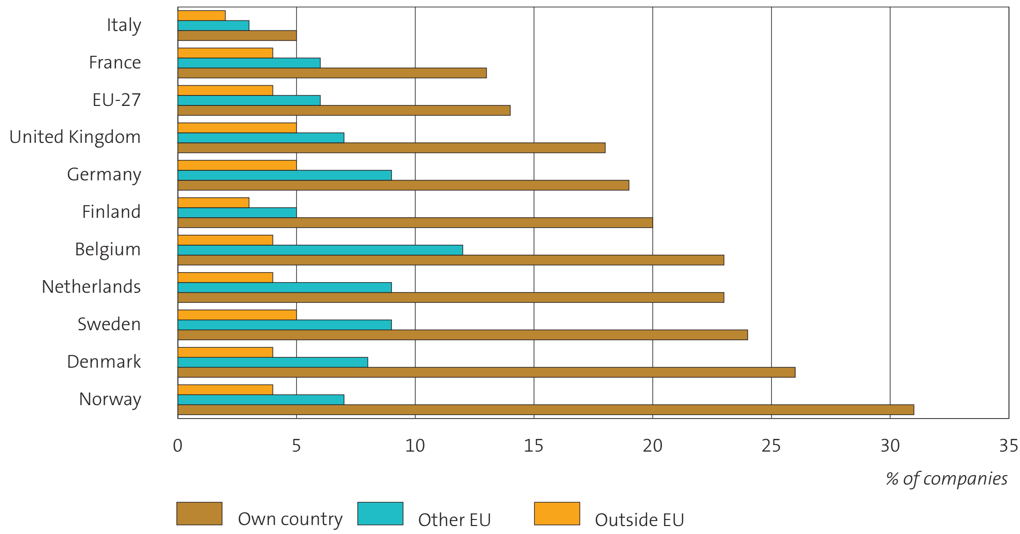
[1)] Companies with 10 or more employed persons, excluding financial institutions.

### Most companies limit e-selling to own country

Companies most often receive electronic orders from buyers located in their home market. This not only applies to the Netherlands, but to other European countries as well (Figure 5.4.3). Almost a quarter of Dutch companies (23 percent) sold goods or services to buyers in the Netherlands over the internet or via EDI in 2011. The EU average for domestic e-selling was 14 percent. At 31 percent, this share was highest in Norway (not an EU country).

Nine percent of Dutch companies sold goods or services electronically to buyers in other EU countries. This is slightly lower than the share in Belgium (12 percent). E-selling outside the EU is somewhat less common. The share of Dutch companies engaged in this form of international trade is the same as the EU-27 average: 4 percent. The fact that the Netherlands has an especially open economy strongly focused on foreign trade is therefore not sharply reflected in the electronic sale of goods and services.

**5.4.3 Companies and e-selling, by region of buyer, 2011[1)]**




Source: Eurostat.

1) Companies with 10 or more employed persons, excluding financial institutions.

### One third of Dutch companies make e-purchases

In 2010, one third of Dutch companies made purchases via e-commerce. This is defined as the sending out of orders over external networks, such as the internet or EDI. Orders via e-mail are not considered part of e-commerce. E-purchasing is particularly in vogue in the Information and communication sector. Over half of ICT companies made e-purchases in 2010. Use was also relatively prevalent among companies in the ‘Trade’ and ‘Specialist and business services’ sectors (37 percent and 34 percent, respectively). Forty percent of Research institutes made purchases via e-commerce.
Primarily large companies make purchases via external networks. Sixty-one percent of companies with at least 500 employed persons had placed orders via e-commerce. This

share was significantly lower among small companies with 10 to 20 employed persons (29 percent). This difference can probably be explained by the fact that large companies more often make purchases on a large scale, have more highly developed ICT systems and have larger investment budgets relative to small companies.
For 17 percent of companies, the value of online purchases amounted to 10 percent or more of total purchases (Table 5.4.4). For a significant group of companies, e-commerce therefore constitutes a substantial purchasing channel. Indeed, for 7 percent of companies, the value of online purchases amounted to more than half of the total purchase value. This share was especially high in the 'Information and communication' and in the 'Wholesale and retail trade' sectors (15 and 13 percent, respectively).

### 5.4.4 Company purchases via e-commerce, 2010[1)]

| | >= 1% of the total purchase value | >= 2% of the total purchase value | >= 5% of the total purchase value | >= 10% of the total purchase value | >= 25% of the total purchase value | >= 50% of the total purchase value |
|---|---|---|---|---|---|---|
| | *% of companies* | | | | | |
| Total | 28 | 24 | 22 | 17 | 11 | 7 |
| **Sector** | | | | | | |
| Manufacturing | 28 | 23 | 20 | 13 | 7 | 4 |
| Energy companies; extraction and distribution of water; waste management | 27 | 19 | 16 | 11 | 6 | 4 |
| Construction industry | 25 | 22 | 18 | 14 | 8 | 5 |
| Wholesale and retail; car repair | 32 | 27 | 26 | 22 | 17 | 13 |
| Transport and storage | 26 | 21 | 18 | 10 | 5 | 2 |
| Accommodation, food and beverages | 24 | 24 | 22 | 20 | 12 | 8 |
| Information and communication | 45 | 41 | 39 | 31 | 21 | 15 |
| Financial institutions | 26 | 19 | 18 | 12 | 6 | 5 |
| Lease of and trade in immoveable property | 21 | 12 | 7 | 5 | 2 | 2 |
| Consultancy, research and other specialist business services | 30 | 26 | 22 | 16 | 9 | 5 |
| of which: | | | | | | |
| Research institutes | 31 | 27 | 21 | 15 | 10 | 7 |
| Lease of moveable goods and other business services | 21 | 17 | 13 | 9 | 5 | 3 |
| Healthcare and welfare | 28 | 24 | 23 | 18 | 10 | 6 |
| **Company size** | | | | | | |
| 10 to 20 employed persons | 26 | 23 | 20 | 16 | 11 | 8 |
| 20 to 50 employed persons | 28 | 23 | 21 | 16 | 9 | 6 |
| 50 to 100 employed persons | 32 | 27 | 24 | 17 | 9 | 6 |
| 100 to 250 employed persons | 33 | 29 | 26 | 19 | 13 | 9 |
| 250 to 500 employed persons | 42 | 37 | 34 | 25 | 17 | 12 |
| 500 or more employed persons | 48 | 43 | 39 | 30 | 17 | 12 |

Source: Statistics Netherlands, ICT use by companies, 2010.

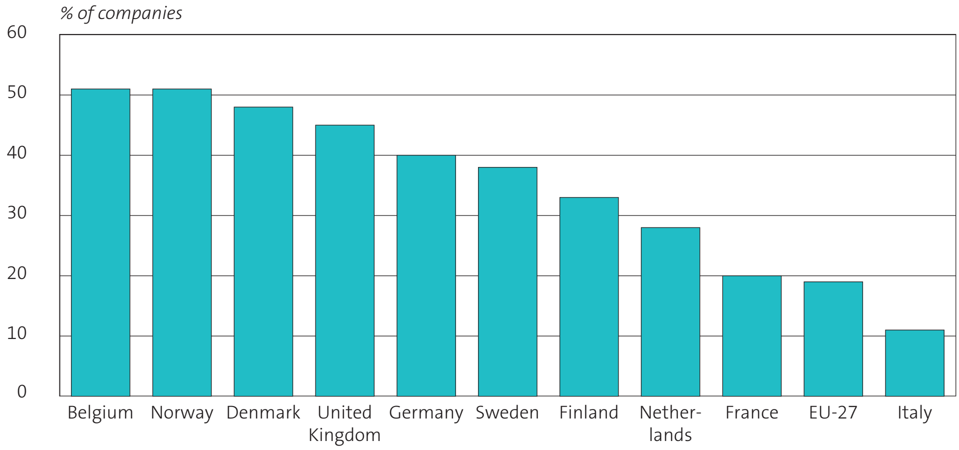
1) Companies with 10 or more employed persons.

E-purchasing is more important to large companies than it is to small companies. In three in ten companies with 500 or more employed persons e-purchasing accounted for at least 10 percent of the total purchase value. Only one sixth of companies with less than 100 employed persons managed to attain this limit of 10 percent of the purchase value. It is striking that the differences between small and large companies are less pronounced among companies that extensively use e-commerce for making their purchases. For example, 8 percent of small companies did more than 50 percent of their total purchases electronically compared to 12 percent of large companies. Company size therefore plays a smaller role in the decision to make extensive use of e-commerce for purchasing.

### Dutch companies do not make a great deal of online purchases

In comparison to other European countries, the share of Dutch companies that make their purchases via e-commerce is not high. In 2011, e-purchasing accounted for more than 1 percent of the total purchase value in 28 percent of Dutch companies. This share is nevertheless significantly higher than the EU average (19 percent). However, it significantly lagged Belgium and Norway, where in 2011 more than half of companies made electronic purchases amounting to more than 1 percent of the total purchase value. This share was also significantly higher in Denmark (48 percent) and the United Kingdom (45 percent) than in the Netherlands.

**5.4.5 Company purchases via e-commerce, international, 2011[1)2)3)]**



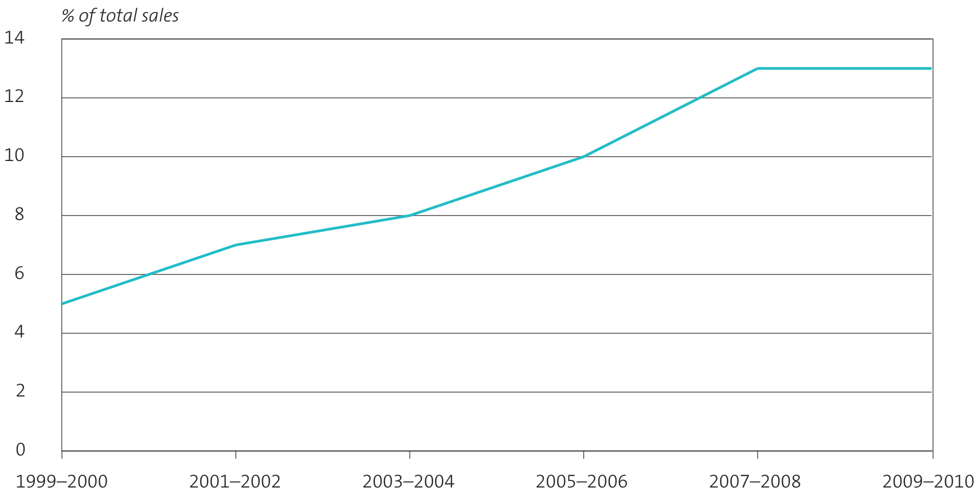

Source: Eurostat.

1) Companies with 10 or more employed persons, excluding financial institutions.
2) Belgium, Denmark, Germany and the United Kingdom: 2010 instead of 2011.
3) Companies that purchase at least 1 percent of their total purchase value via e-commerce.

### E-commerce sales are increasing

The share of e-commerce as a percentage of total company sales increased from 5 percent over the period 1999–2000 to 13 percent over the period 2009–2010 (Figure 5.4.6). The share of e-commerce rose sharply between 1999 and 2008, after which growth was only slight.[1)]

**5.4.6 E-commerce trend**




Source: Statistics Netherlands, ICT use by companies.

[1)] Companies with 10 or more employed persons.

# 5.5 ICT and environmental impacts

EU member states have announced that they intend to achieve a 30 percent reduction in greenhouse emissions by 2020 in comparison to 1990 (EU, 2009). The Dutch government is focusing on continuing and strengthening the national energy conservation approach

[1)] Companies often find it very difficult to accurately identify the percentage of their total sales achieved through e-selling. To provide proper insight into the trend the data for two years were combined each time in Figure 5.4.6.

(Rutte Cabinet, 2010). Long-term agreements have been formulated between the central government, companies, institutions and municipalities concerning the reduction of energy consumption in the Netherlands. ICT can play an important role in this respect. Teleworking was already addressed earlier in this chapter (Section 5.1). Reductions in commuting traffic and in the required office capacity as a result of teleworking are examples of favourable environmental impacts resulting from the use of ICT. This section focuses on the procedures and rules of conduct applied by companies to generate favourable environmental impacts in other areas as well. On the one hand, savings can be realised by installing efficient ICT equipment, such as devices that shut themselves down in case of inactivity. On the other hand, the use of ICT can function as an enabling technology in greening (business) processes. By strategically deploying ICT, companies can achieve energy savings in various areas.

### 5.5.1 Deployment of ICT to reduce company burden on environment, 2010[1)]

| | Use of ICT to reduce paper consumption | Use of ICT to reduce energy consumed by devices | Use of ICT to reduce physical travel | Use of ICT to reduce energy consumed by processes |
|---|---|---|---|---|
| | *% of companies* | | | |
| Total | 48 | 31 | 41 | 19 |
| **Sector** | | | | |
| Manufacturing | 42 | 29 | 43 | 22 |
| Energy companies; extraction and distribution of water; waste management | 57 | 43 | 44 | 32 |
| Construction industry | 40 | 24 | 29 | 16 |
| Wholesale and retail; car repair | 49 | 31 | 39 | 21 |
| Transport and storage | 47 | 35 | 40 | 26 |
| Accommodation, food and beverages | 38 | 19 | 23 | 12 |
| Information and communication | 50 | 40 | 73 | 25 |
| Financial institutions | 46 | 37 | 53 | 19 |
| Lease of and trade in immoveable property | 44 | 31 | 30 | 16 |
| Consultancy, research and other specialist business services | 58 | 39 | 55 | 20 |
| of which: | | | | |
| Research institutes | 57 | 40 | 76 | 32 |
| Lease of moveable goods and other business services | 51 | 29 | 40 | 14 |
| Healthcare and welfare | 58 | 38 | 33 | 16 |
| **Company size** | | | | |
| 10 to 20 employed persons | 43 | 26 | 36 | 14 |
| 20 to 50 employed persons | 47 | 30 | 38 | 20 |
| 50 to 100 employed persons | 55 | 37 | 50 | 27 |
| 100 to 250 employed persons | 60 | 46 | 54 | 31 |
| 250 to 500 employed persons | 64 | 49 | 60 | 37 |
| 500 or more employed persons | 70 | 64 | 67 | 43 |

Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

### Half of companies have paper reduction procedures

Table 5.5.1 distinguishes four procedures that contribute to reducing waste and energy consumption in companies through the use of ICT. The most commonly used procedure in 2010 was to reduce the number of paper prints and copies. Almost half of companies used a procedure of this kind. The use of the telephone, web or video conferencing instead of physical travel was another frequent occurrence in companies (41 percent). Thirty-one percent of all companies used procedures designed to reduce the energy consumption of ICT equipment. Examples of such procedures include the (automatic) shutdown of computers and screens, and the use of multifunctional equipment capable of copying, scanning and printing. Almost one fifth of companies used ICT to reduce the energy consumed by business processes, such as the optimisation of work procedures and logistics processes.

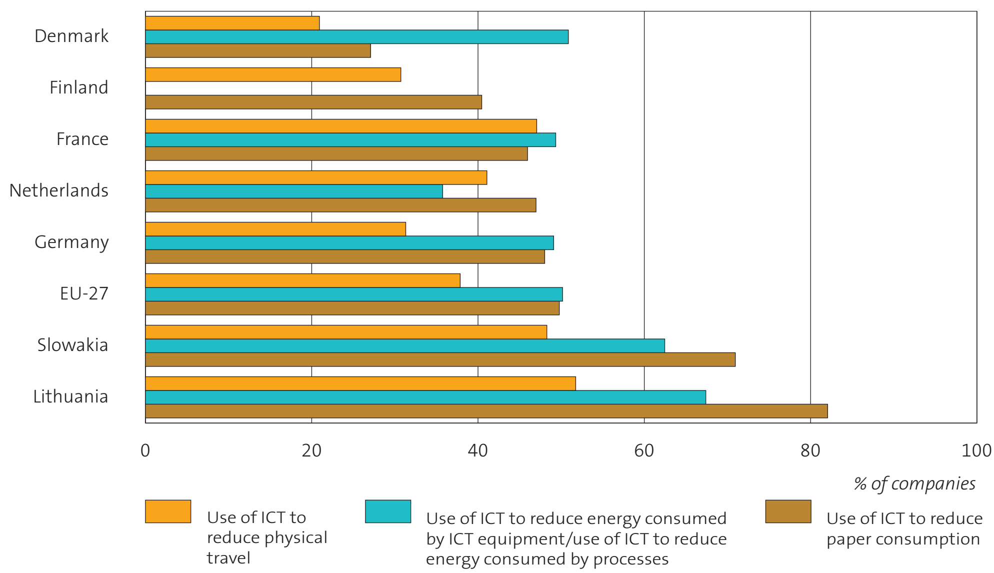
# One fifth of companies are using ICT to green their business processes

Reducing the energy consumption of business processes through means of the use of ICT is most common among companies in the 'Energy supply and waste management' sector and among Research institutes. Thirty-two percent of companies in these sectors used such ICT applications in 2010. Procedures designed to reduce the energy consumption of ICT equipment are also most common among energy and waste management companies (43 percent). The sectors with many companies that have procedures designed to limit physical travel are the same sectors that also score high in terms of teleworking (Section 5.1). Indeed, both areas are closely interrelated and fit into the same strategy designed to reduce the relevance of physical distances through means of the use of ICT. Almost three quarters of companies in the 'Information and communication' sector made use of the telephone, web or video conferencing for the purpose of reducing physical travel (73 percent). This share was even higher among Research institutes (76 percent).
Large companies, more than small companies, make use of ICT to achieve favourable environmental effects. For example, 43 percent of companies with 500 or more employed persons used ICT to reduce the energy consumed by business processes. As regards small companies with 10 to 20 employed persons, this share was only 14 percent. Such applications for optimising work procedures are less accessible to small companies than to large companies, as they require a fairly highly developed ICT infrastructure and specific additional investments. In the case of low entry threshold 'green' ICT procedures, small companies therefore score significantly higher. For example, 43 percent of companies with 10 to 20 employed persons had procedures designed to reduce paper consumption.

### Companies make moderate use of ICT to reduce environmental burden

In comparison to other European countries, few Dutch companies use procedures designed to reduce the environmental burden of their business processes (Figure 5.5.2). Only in the case of procedures designed to limit physical travel did Dutch companies score somewhat higher than the EU average in 2011 (41 versus 38 percent). The Netherlands significantly lags the EU average when it comes to reducing the energy consumed by ICT equipment and using ICT to green processes. This is in particular common in Eastern European member states that therefore push up the average of the EU-27 to far above the results achieved in the Netherlands. In addition, Dutch companies (47 percent) scored lower than the EU average of 50 percent in terms of the use of procedures designed to reduce paper consumption.

**5.5.2 Deployment of ICT to reduce company burden on environment, international, 2011[1)]**



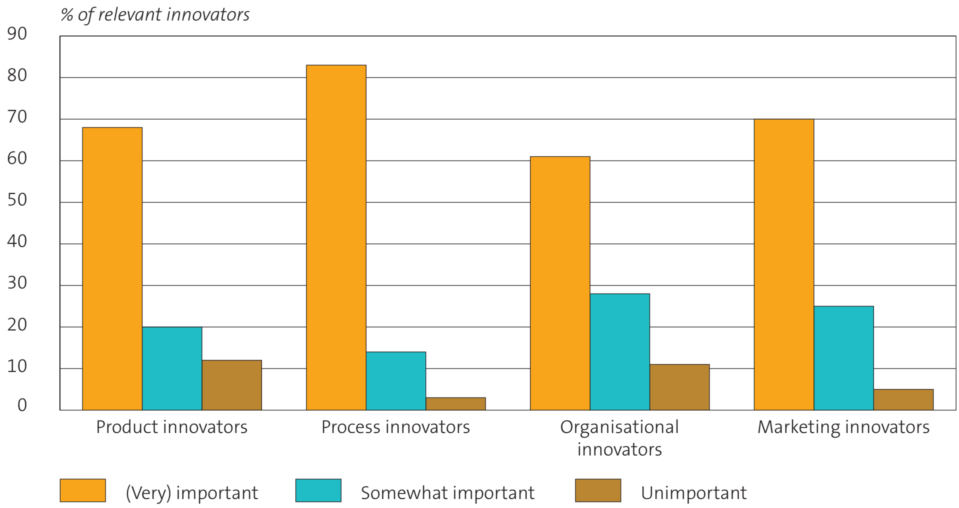

Source: Eurostat.

[1)] Companies with 10 or more employed persons, excluding financial institutions.

# 5.6 ICT and innovative activities

ICT is often considered as a driver of innovation (for example, see Van Leeuwen and Farooqui, 2008; Polder et al., 2009) and can be viewed as a general purpose technology that provides the infrastructure for the innovation process (Polder and Van Leeuwen, 2010). ICT has the potential of promoting innovation because ICT can accelerate the distribution of information, establish networks between companies and facilitate the creation of closer relationships between companies and customers. In addition, ICT may cause geographical restrictions to become less relevant and that communications become more efficient (Spieza, 2011).

**5.6.1 Importance of ICT by innovative activities in companies, 2010[1)]**




Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

### ICT of major importance to innovation

Many companies consider the use of ICT for innovations to be of major importance (important or very important). This applies to product and process innovations (technological innovations) as well as to organisational and marketing innovations (non-technological innovations). Process innovators assign the highest importance to ICT: in 2010, 83 percent of companies that had developed new or significantly improved processes (or had contracted for them to be developed) considered the use of ICT (very) important in this regard (Figure 5.6.1). For companies involved in marketing innovations, this share was 70 percent. Two thirds of product innovators also considered ICT (very) important for innovations (68 percent).

### ICT most important to major product and process innovators

Companies with at least 500 employed persons attach greater importance to the use of ICT in realising technological innovations (product innovation and process innovation) than smaller companies. ICT was (very) important to 80 percent of the major product innovators and 92 percent of the major process innovators. These percentages were lower in companies with fewer than 500 employed persons. Nevertheless, an ample majority of the smaller innovators considered ICT important.
In the case of non-technological innovations (organisational and marketing innovations) there are no or almost no differences between large and small companies. Indeed, among the group of marketing innovators, more of the smaller companies than larger companies consider ICT important. Among organisational innovators, the percentage that considers ICT important is somewhat lower for small companies than large companies, but the differences are not large (Table 5.6.2).

**5.6.2 Companies that consider ICT (very) important for innovation, by company size, 2010[1)]**

| | Product innovators | Process innovators | Organisational innovators | Marketing innovators |
|---|---|---|---|---|
| | *% of relevant innovators* | | | |
| 10 to 20 employed persons | 66 | 80 | 60 | 74 |
| 20 to 50 employed persons | 68 | 82 | 60 | 67 |
| 50 to 100 employed persons | 67 | 83 | 66 | 74 |
| 100 to 250 employed persons | 69 | 88 | 62 | 68 |
| 250 to 500 employed persons | 71 | 85 | 63 | 70 |
| 500 or more employed persons | 80 | 92 | 65 | 69 |
| Total | 68 | 83 | 61 | 70 |

Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

**ICT most important to innovators in the financial and ICT sectors**

ICT is exceptionally important for achieving product and process innovations by Financial institutions. This equally applies to innovators in the ICT sector. In 2010, over nine in ten innovators in these sectors considered ICT (very) important for these technological innovations (Table 5.6.3). The percentages were lower in the Manufacturing sector and in the Construction industry, but here too ICT was important to very important for half of the product innovators.

### 5.6.3 Companies that consider ICT (very) important for innovation, by sector, 2010[1)]

| | Product innovators | Process innovators | Organisational innovators | Marketing innovators |
|---|---|---|---|---|
| | *% of relevant innovators* | | | |
| Manufacturing | 49 | 71 | 55 | 63 |
| Energy companies; extraction and distribution of water; waste management | 73 | 67 | 48 | 64 |
| Construction industry | 47 | 66 | 44 | 52 |
| Wholesale and retail; car repair | 65 | 85 | 64 | 72 |
| Transport and storage | 80 | 88 | 70 | 84 |
| Accommodation, food and beverages | 69 | 88 | 64 | 56 |
| Information and communication | 91 | 95 | 67 | 87 |
| Financial institutions | 92 | 91 | 63 | 69 |
| Lease of and trade in immoveable property | 74 | 99 | 60 | 76 |
| Consultancy, research and other specialist business services | 85 | 89 | 70 | 70 |
| of which: | | | | |
| Research institutes | 83 | 93 | 64 | 64 |
| Lease of moveable goods and other business services | 78 | 93 | 61 | 79 |
| Healthcare and welfare | 82 | 88 | 66 | 70 |
| Total | 68 | 83 | 61 | 70 |

Source: Statistics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.

In terms of organisational innovation, companies in the 'Transport and storage' and in the 'Business services' sectors attach the greatest importance to ICT. Seven in ten organisational innovators in these sectors considered ICT (very) important for the development of a new or significantly improved organisation or management method. Sixty-four percent of organisational innovators in Research institutes responded likewise. ICT was primarily important for marketing innovations in the Information and communication sector.
In spite of the differences that characterise the various sectors, a significant share of all innovators in all sectors attach a great deal of importance to ICT. This applies to all forms of innovation.

### ICT especially important in terms of searching for information

ICT is especially important to innovative companies in searching for information. Two thirds of the innovators that considered ICT as (very) important said that ICT in 2010 was important in terms of searching for information sources (Table 5.6.4). Over half considered ICT important in terms of implementing the innovation (54 percent). In addition, many innovators assigned a great deal of importance to ICT for exchanging knowledge with their partners in innovation (53 percent).
ICT is of lesser importance for design activities: 37 percent of innovative companies considered ICT important for designing innovations. Indeed, design activities are not essential to the same degree for all types of innovations. Design primarily plays a role in product and marketing innovations. It is perhaps for that reason that innovators assign greater importance to ICT in other, more generally applicable areas.

### 5.6.4 Areas in which ICT was important to innovations, 2010[1)2)]

| | % of innovative companies that considered ICT (very) important |
|---|---|
| Searching for information sources | 66 |
| Implementing innovations | 54 |
| Exchanging knowledge | 53 |
| Other | 47 |
| Carrying out design activities | 37 |

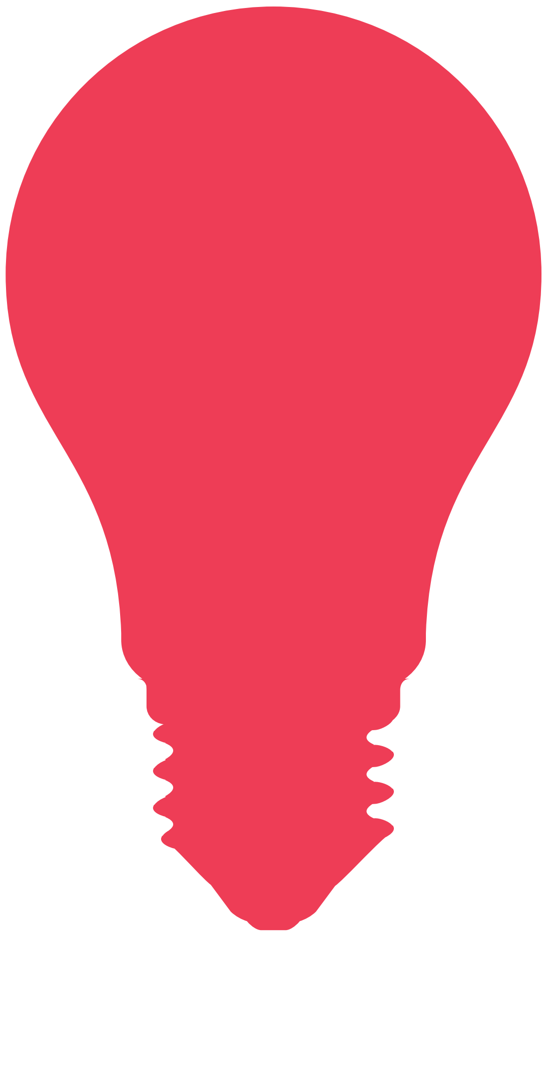
Source: Statisics Netherlands, ICT use by companies, 2010.

1) Companies with 10 or more employed persons.
2) Broad definition of innovative companies: product innovators, process innovators, organisational innovators and/or marketing innovators (also see Chapter 6).

Detailed information about the importance of ICT in the development of innovations is contained in the statistical annex to this publication. The statistical annex can be consulted online at www.cbs.nl/ICT-knowledge-economy.

# Innovation

# 6



# Innovation

## 6.1 Innovative companies

- Half of Dutch companies are innovative

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- Almost four in ten companies are technologically innovative
- Large companies and manufacturing sector are more often innovative
- ICT sector highly innovative
- Product and process innovations occur with equal frequency
- Innovative products account for a quarter of turnover
- Innovation expenditures primarily allocated to R&D and equipment acquisition
- Half of large companies work in partnership on innovation

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- Manufacturing also very strong in non-technological innovation
- Organisational innovations just outrank marketing innovations
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- One in eight companies encounter issues with innovation
- Innovation often delayed due to issues
- Lack of market demand important reason not to innovate

## 6.5 Stimulating creativity and innovation

- Brainstorming sessions most often used to stimulate creativity
- Innovators more actively stimulate creativity

**Knowledge is explicitly recognised as a production factor in a knowledge economy. A society or economy invests in the development of new knowledge by investing in Research & Development (R&D) and education. The existing knowledge is ultimately transformed into practical applications that can be converted into profits: innovations. The production of goods and services that others are unable to produce due to a lack of knowledge provides an important economic head start.**

# 6.1 Innovative companies

Innovations are a measure of the capacity of companies to transform knowledge into practical applications that can be converted into profits. The operationalisation of the innovation concept has traditionally been approached from a technological perspective focused on what a company produces (product innovation) and how a company manufactures this (process innovation). This approach more closely matches the product and process characteristics of the manufacturing sector and less that of the service sector. Not all types of innovations are included in this innovation concept. So-called non-technological innovation is the best known and most important example of this. Non-technological innovations are innovations in organisation and marketing. This type of innovation has become increasingly important over time. The relevance, for example, of organisational innovation when a new technology is introduced has been recognised for several years by international discussion forums. The reason for this is that non-technological innovations also indirectly influence the economic performance of a company or country. In an international context, it was agreed that a non-technological innovation nevertheless does not grant a company the status of innovator. The classical, narrow definition of the innovator concept therefore remains in force. This publication adheres to this definition. Companies that only implement (major) non-technological changes – for example in their organisation or marketing – therefore are not counted among the group of innovators.

**Technological determinism**

'Technological determinism' suggests that technology is the determining factor for economic and social developments. Technology is also presumed to determine the organisation's organisation structure. For example, the introduction of the conveyor belt had a major impact on the structure of organisations and consequently on the quality of work and society as well. For years ICT has been an example of a determining technology with strong social, societal and economic consequences. The technological determinism provides an explicit view of the innovation process. For example, based on this theory it can be presumed that process innovation and organisational innovation are interrelated; in other words that technological and non-technological innovations go hand in hand.

# Half of companies are innovative

Companies that apply some form of innovation can be divided into three groups on the basis of technological and non-technological innovations:

- Companies with technological innovations only;
- Companies with technological as well as non-technological innovations;
- Companies with non-technological innovations only.

Based on the classical innovation concept, the first two groups together form the group of innovators. The third group of companies is only considered part of the group of innovators according to the broad definition. The groups primarily contain companies that have

**Operationalising innovation**

The innovation concept is operationalised on the European questionnaire (Community Innovation Survey, (CIS)) via various questions. This operationalisation is in line with the widely recognised OECD's Oslo Manual that provides points of reference for measuring innovation in companies (OECD, 2005). The following variables are considered in this regard:

1. **Product innovation:** the company, in the relevant period, introduced one or more new or significantly improved products. These can be goods or services that are new to the market or that are only new to the company.

2. **Process innovation:** the company, in the relevant period, started using one or more new or significantly improved processes or methods. These new processes or methods can be related to:
   - The production of goods or services;
   - The logistics (delivery or distribution) of inputs (goods or services);
   - Supporting process activities, such as maintenance systems or procurement, accounting or estimating methods.

   These processes can be new to the market or only new to the company.

3. **Ongoing or abandoned product or process innovations:** the company, in the relevant period, worked on product and/or process innovations as described above, but terminated this work during the reporting period, and/or has not yet completed this activity.

4. **Organisational innovation:** the company, in the relevant period, introduced one or more of the following innovations:
   - New business practices for organising procedures;
   - New methods of organising work responsibilities and decision making;
   - New methods for organising external relationships with other companies or institutions.

5. **Marketing innovations:** the company, in the relevant reporting period, introduced innovations in one or more of the following areas:
   - The aesthetic design or packaging of products;
   - The use of new media for promoting products;
   - The positioning of products in the market or the use of new sales channels;
   - The pricing of products.

The literature and the various discussion forums make a distinction between *technological* innovation and *non-technological* innovation. A technologically innovative company has worked on product and/or process innovation in the reporting period and may or may not have finished it during that period. In terms of the overview presented above, at least one of the first three categories applies to technologically innovative companies.
A non-technologically innovative company has introduced one or more organisational and/or marketing innovations in the relevant period. Innovations that were terminated or that have not yet been completed in the relevant period are not included here. At least one of the last two categories presented in the overview above therefore applies to these companies. Companies can, of course, be simultaneously technologically and non-technologically innovative.

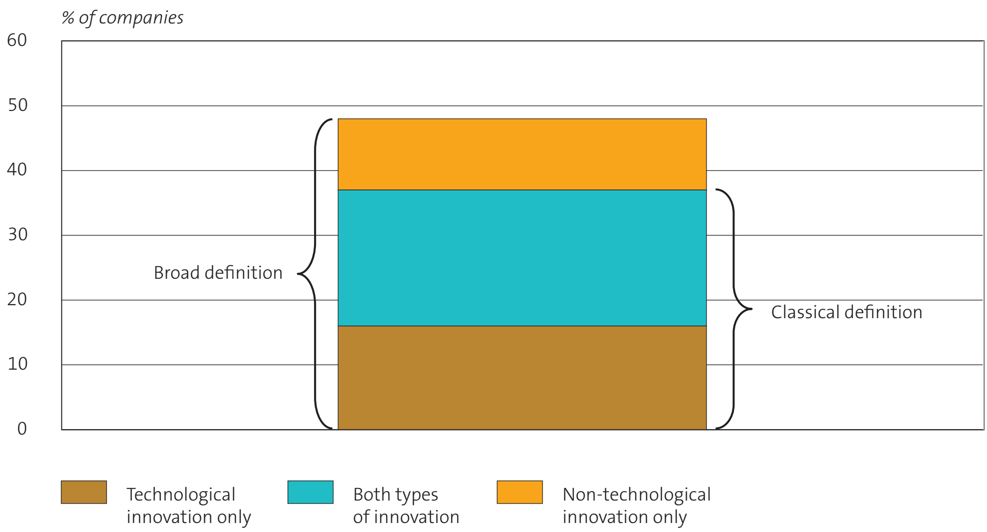
The term innovative originally only referred to technological innovation. According to the *classical or narrow definition* an innovator therefore is a company that is at least technologically innovative. The broad definition also includes non-technological innovation as part of the concept.

actually realised the above-referenced types of innovations during the relevant period. In terms of the technological innovations, the principle that applies is that ongoing or abandoned innovations also qualify a company as an innovator. A small portion of the (technological) innovators therefore are companies that in the survey period were still working on technological innovations or that abandoned these activities.

### Half of Dutch companies are innovative

According to the broader innovation concept, 48 percent of Dutch companies were innovative during the 2008–2010 period. According to the classical definition this is 38 percent (Figure 6.1.1). The number of companies that exclusively implements non-technological innovations (11 percent (rounded)) is therefore not negligible. Under the broad definition, the degree of innovation of companies in the Netherlands is significantly higher than under the narrow definition. Naturally this applies to many other countries as well. The position of the Netherlands in international comparisons would only improve under a broader concept if in the Netherlands relatively many companies were only engaged in non-technological innovation. Figures on innovation in the period 2008–2010 for all EU countries will only become available at a later date. This means that this publication cannot provide any international comparisons at this point.

**6.1.1 Innovation according to the classical and broad definitions, 2008–2010**




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

Companies that innovate technologically as well as non-technologically form the largest group (21 percent). At 16 percent, the share of companies that only realised technological innovations (or was in the process of working on them) is higher than the share of companies that was only involved with non-technological innovations (11 percent). Technological and non-technological innovation is discussed in further detail in the following two sections.
The percentage of innovative companies in the 2008–2010 reporting period is significantly higher than in the previous reporting period. However, Statistics Netherlands changed the observation method for the 2008–2010 survey, as a result of which the figures are not fully comparable with previous years. See text box below.

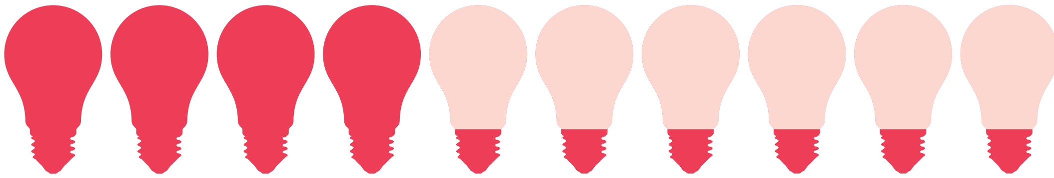
**Innovation survey – break in trend due to electronic questionnaires**

In the 2008–2010 version of the Innovation Survey, Statistics Netherlands for the first time used electronic questionnaires. Respondents were given the option of completing and returning the questionnaire via the internet. In addition, companies that preferred to participate in the survey using a paper-based questionnaire were given this option as well. Ultimately, more than ten thousand companies participated in the survey of which almost 90 percent used the electronic questionnaire. For several key indicators, the results of the 2008–2010 innovation survey are considerably higher than those of previous surveys. In particular, the figures concerning product and process innovators are higher than those in previous reporting periods. Statistics Netherlands carried out various analyses to explain this increase. The conclusion of these analyses is that in part a real increase took place in the number of innovators, but that the switch to internet questionnaires plays a greater role in explaining the increased results. Due to the way in which the questions were presented on the internet questionnaire, it would appear that companies are more inclined to qualify themselves as innovative. Based on the analyses carried out, there are sufficient indications to conclude that the old method underestimated the number of innovative companies in the Netherlands. The new method of observation consequently resulted in an improvement in the measurement of innovation in the Netherlands. For that reason it was decided to exclusively rely on the electronic questionnaires as the source for the official findings of the 2008–2010 innovation survey.

# 6.2 Technological innovation

As outlined in the previous section, only technologically innovative companies are classified as innovator according to the classical definition. On the one hand, product innovations, for example the introduction of new products designed to increase market share, form part of technological innovations. On the other hand, process innovations, such as innovations in production processes with the objective of saving costs, also form part of technological innovation. Trends in this area related to companies in the Netherlands are presented in this section. The information in this section deals with the number of innovators, as well as the share of revenues obtained by companies on the basis of these innovative products and services. In addition, the expenditures incurred by companies in support of their innovative activities are addressed, as is the degree to which companies partner with other companies or institutions.

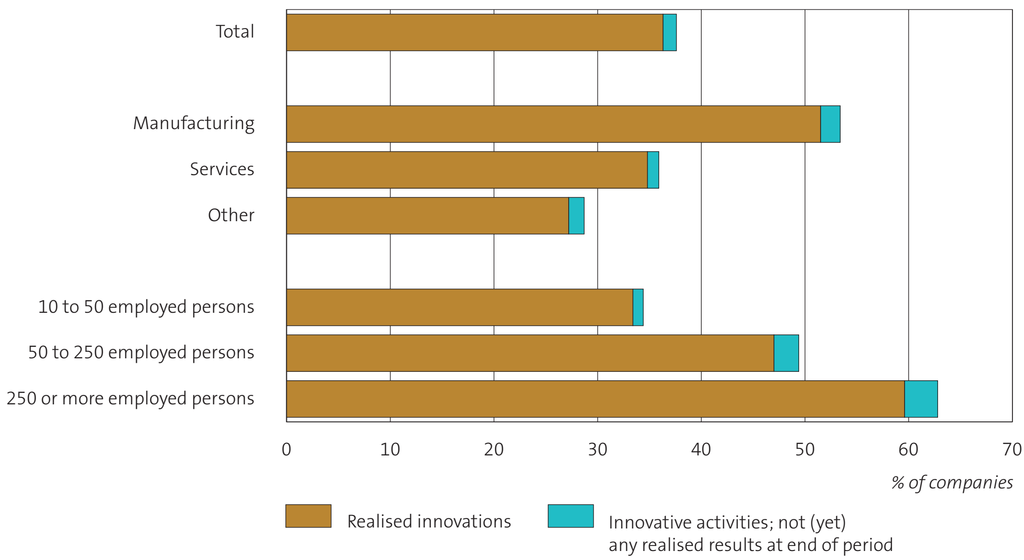
## 38 percent of companies are technologically innovative



### Almost four in ten companies are technologically innovative

During the period 2008–2010, 36 percent of Dutch companies with 10 or more employed persons realised a technological innovation (Figure 6.2.1). In addition, over 1 percent of companies developed technologically innovative activities that in the period 2008–2010 did not (yet) result in a realised innovation. This brought the total number of companies involved in technologically innovative activities to almost 38 percent. Almost four in ten Dutch companies were therefore technologically innovative in the period 2008–2010. This means that they significantly improved or renewed their products and services, and/or their processes, or at least were actively involved in doing so.

### 6.2.1 Companies with technologically innovative activities, 2008–2010




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

## 6.2.2 Innovators, by sector, 2008–2010

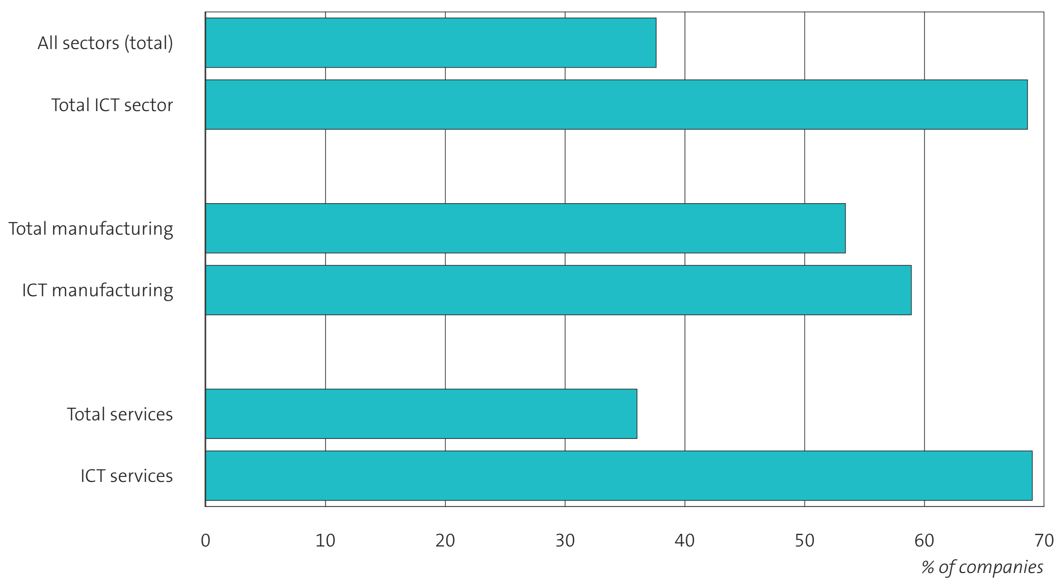
| | Companies | Innovators | |
|---|---|---|---|
| | *number* | | *%* |
| **Total** | 53,836 | 20,249 | 37.6 |
| **Manufacturing sector** | 8,899 | 4,752 | 53.4 |
| Food, drink and tobacco industry | 1,351 | 619 | 45.8 |
| Textile industry | 169 | 109 | 64.5 |
| Apparel industry | 52 | 21 | 40.6 |
| Leather industry | 32 | 20 | 62.3 |
| Primary woodworking industry | 318 | 151 | 47.6 |
| Paper industry | 186 | 108 | 58.3 |
| Printing and reproduction | 583 | 293 | 50.2 |
| Oil industry | 17 | 13 | 78.4 |
| Chemical industry | 328 | 214 | 65.3 |
| Pharmaceutical industry | 67 | 51 | 76.6 |
| Rubber and plastics industry | 433 | 285 | 65.8 |
| Other non-metallic mineral products industry | 310 | 191 | 61.6 |
| Basic metals | 124 | 60 | 48.4 |
| Metal products industry | 1,721 | 780 | 45.3 |
| Electrical engineering industry | 292 | 187 | 64.1 |
| Electrical appliances industry | 241 | 171 | 70.8 |
| Machinery and equipment industry | 1,007 | 653 | 64.9 |
| Motor vehicle industry | 200 | 131 | 65.4 |
| Other transport equipment industry | 185 | 119 | 64.5 |
| Furniture industry | 389 | 196 | 50.5 |
| Other manufacturing industries | 187 | 90 | 48.0 |
| Medical instruments industry | 204 | 70 | 34.5 |
| Repair and installation | 503 | 218 | 43.4 |
| **Services** | 35,866 | 12,895 | 36.0 |
| Wholesale and retail; car repair | 14,709 | 5,121 | 34.8 |
| Transport and storage | 3,646 | 903 | 24.8 |
| Accommodation, food and beverages | 3,608 | 861 | 23.9 |
| Information and communication | 482 | 317 | 65.9 |
| Telecommunication | 123 | 77 | 62.4 |
| Information technology services | 1,763 | 1,238 | 70.2 |
| Information services | 149 | 135 | 90.8 |
| Financial institutions | 1,203 | 533 | 44.3 |
| Leasing of and trade in immoveable property | 825 | 236 | 28.6 |
| Consultancy, research and other specialist business services | 4,380 | 1,902 | 43.4 |
| Leasing and other business services | 4,977 | 1,570 | 31.5 |
| **Other** | 9,070 | 2,602 | 28.7 |
| Agriculture, forestry and fisheries | 2,141 | 834 | 38.9 |
| Extraction of minerals | 71 | 37 | 52.4 |
| Extraction and distribution of energy and water | 82 | 56 | 67.8 |
| Waste collection and processing | 334 | 148 | 44.3 |
| Construction industry | 6,442 | 1,528 | 23.7 |

Source: Statistics Netherlands, Innovation Survey, 2008–2010.

### Large companies and manufacturing sector are more often innovative

Large companies are considerably more often innovative than small companies. Sixty-three percent of companies with at least 250 employed persons were innovative in the period 2008–2010. As regards small companies with 10 to 50 employed persons, this share was 34 percent.
Companies in the manufacturing sector are more often innovative than companies in the services sector. Fifty-three percent of companies in the manufacturing sector were innovative in the 2008–2010 period versus 36 percent in the services sector. The degree of innovation in the manufacturing sector is therefore significantly higher. In this regard, the degree of innovation is not significantly affected by innovative activities that did not lead to an innovation prior to the end of the reporting period.
For that matter, there are major differences in the degree of innovation between industries within the manufacturing sector and the services sector (Table 6.2.2). The pharmaceutical industry and the oil industry are the most innovative industries. Over three quarters of companies in these sectors were engaged in innovative activities in the period 2008–2010. In addition, the degree of innovation is also high in the electrical appliances industry. Within the services sector, the telecommunication and IT sectors are especially innovative.

### 6.2.3 Innovators in the ICT sector, 2008–2010




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

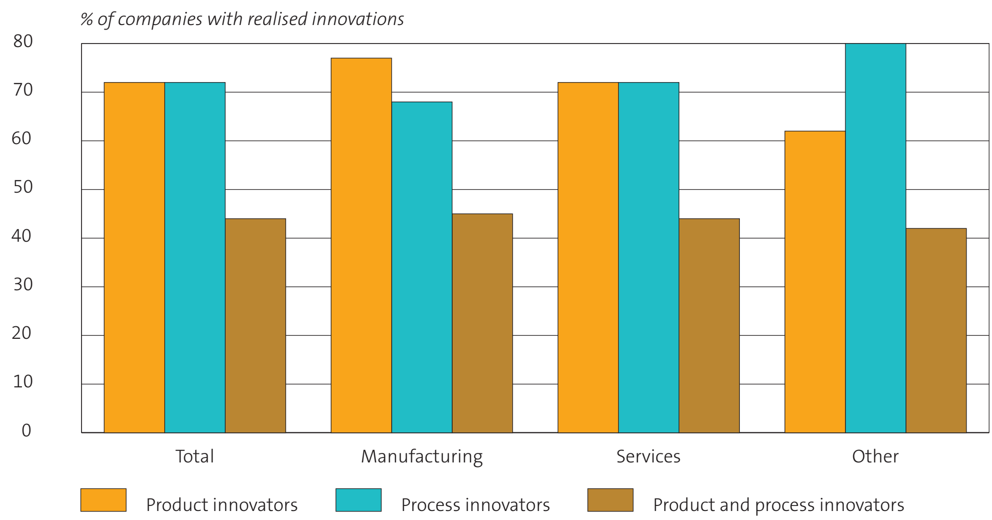
### ICT sector highly innovative

Section 5.6 already outlined the importance of ICT for innovations. The ICT sector itself is also especially innovative.[1)] More than two in three companies in the ICT sector were engaged in innovative activities in the period 2008–2010 (Figure 6.2.3).
Companies in the manufacturing sector are more often technologically innovative than companies in the services sector, as mentioned earlier. The share of innovators among companies in the ICT manufacturing sector is also high. However, the share of companies engaged in innovation is even higher in the ICT services sector. This is striking, because in the services sector overall there are relatively few innovators.

### Product and process innovations occur with equal frequency

Both forms of technological innovation occur with approximately the same frequency (Figure 6.2.4). Seventy-two percent of innovative companies that realised an innovation realised a product innovation in the period 2008–2010. Approximately the same number of companies realised a process innovation.

### 6.2.4 Product and process innovators by sector, 2008–2010




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

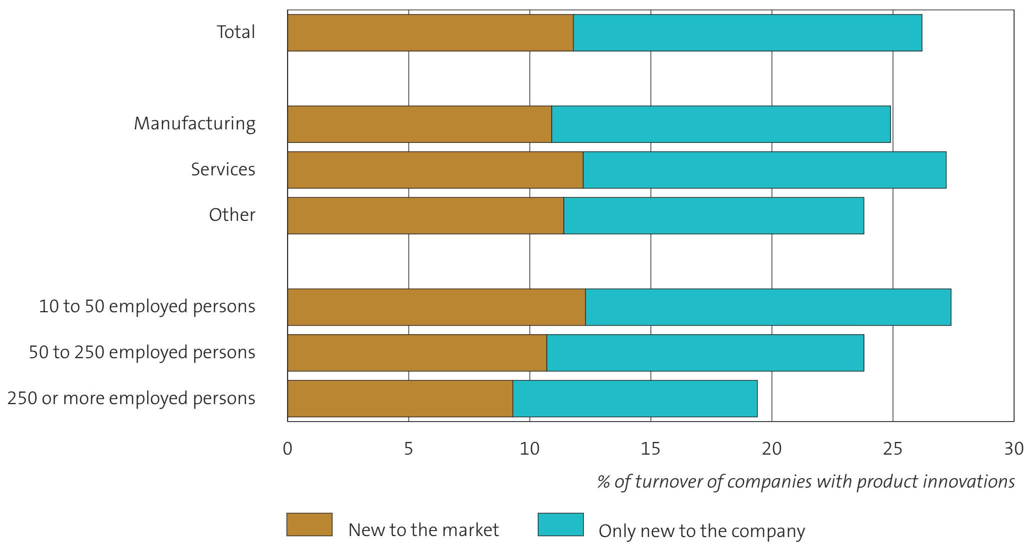
1) Section 2.2 includes a definition of the scope of the ICT sector.

The number of companies that realised both types of innovations is significantly lower (44 percent). In other words, the fact that a company realised a product innovation does not automatically mean that the company is also implementing a process innovation or vice versa. There are no major differences between sectors. There is a somewhat greater emphasis on product innovation in the manufacturing sector. By contrast, process innovations occur more frequently in the 'Other' sector.

### Innovative products account for a quarter of turnover

The degree of innovation is an indicator of the drive for innovation in companies, but does not provide an indication of the innovation's (economic) importance. A yardstick for measuring the economic importance of innovations is the average share of the new or significantly improved products in the total turnover of the innovative company. Another yardstick is the total turnover achieved with innovative products by all companies in the Netherlands in relation to their total turnover achieved.
The share in the company turnover achieved with innovative products on average was 26 percent in 2010 (Figure 6.2.5) among the group of product innovators. In other words,

**6.2.5 Average share in turnover of new or significantly improved products among product innovators, 2010**




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

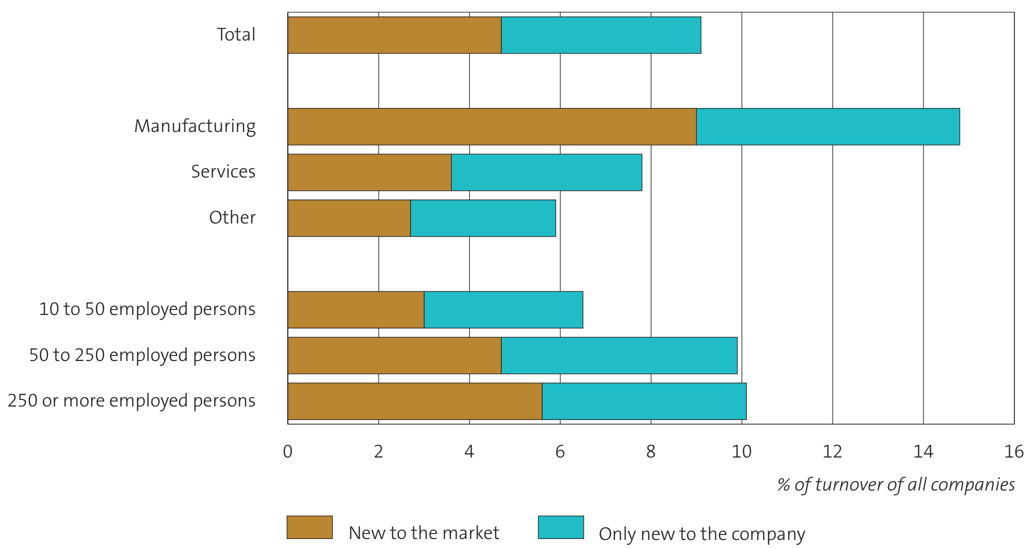
companies that in the period 2008–2010 introduced new or significantly improved products on average obtained a quarter of their turnover from these innovations.

The average share in company turnover was between 24 and 27 percent in the manufacturing, services and other sectors. The differences between these sectors are therefore minimal. Smaller companies on average obtained a larger share of their turnover from new or significantly improved products than larger companies.

Figure 6.2.6 illustrates the share in the turnover of all companies in the Netherlands realised with innovative products: 9 percent. About half of this was products that were new to the market. The other half was achieved with products that had already been introduced to the market by other companies, but that were new to the relevant company. A relatively large share of turnover was achieved with innovative products in the manufacturing sector: 15 percent. A significant share of this (9 percent) was achieved with products that were not only new to the relevant company, but to the overall market as well. In the services sector and in the 'Other' sector, the share 'only new to the company' was greater than the share 'new to the market'.

Large companies with 250 or more employed persons derived somewhat more turnover from innovative products than companies with 10 to 50 employed persons. This is primarily due to the fact that large companies achieve relatively more turnover from products that are new to the overall market.

**6.2.6 Total share in turnover of new or significantly improved products, 2010**




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

### Innovation expenditures primarily allocated to R&D and equipment acquisition

The sections above dealt with the results ('outputs') of innovation: the new products or processes and the share in turnover achieved with these innovations. The sections that follow deal with the 'input' into innovation, namely the expenditures incurred by companies in support of innovative activities.

The expenditures for innovation incurred by a company are divided into eight categories:

- In-house R&D: R&D carried out with own personnel (also see Section 7.1);
- Outsourced R&D: R&D carried out by other companies and institutes under contract to the relevant company;
- Purchase of products, such as advanced machines, equipment or software not developed in-house;
- Purchase of external knowledge, such as patent licenses;
- Internal and external training for personnel, specifically focused on the development and/or introduction of new or significantly improved products and processes;
- Activities in support of the market introduction of new or significantly improved goods and services, including market research and advertising in support of the product's introduction;
- Design: activities for the purpose of designing, improving or changing the shape or appearance of new or significantly improved goods and services;
- Other preparations: procedures and technical preparations for the implementation of innovations (insofar as these are not already included in one of the previously mentioned categories). For example, this includes feasibility studies, tests, routine software development, new machine parks and industrial engineering.

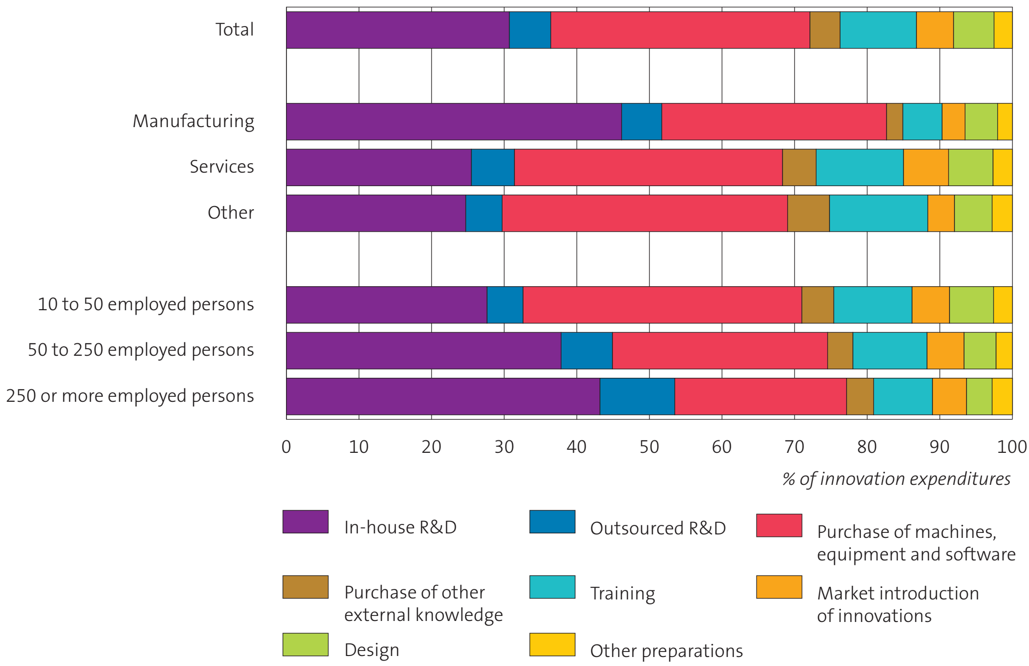
Figure 6.2.7 illustrates the breakdown of the innovation expenditures of (technologically) innovative companies into these categories.[2)] An average innovator spends almost one third of its innovation expenditures on in-house R&D (31 percent). The amount spent on outsourced R&D is much lower; on average 6 percent of the company's innovation expenditures. The other major cost item is the purchase of machines, equipment and software (36 percent). Personnel education and training costs amounted to 11 percent in 2010. The other categories consume only a small share of the total innovation expenditures.

Companies in the manufacturing sector allocate a larger share of their innovation expenditures on in-house R&D than companies in other sectors, which spend more on machines, equipment and software. In the three different sectors identified, the share of

2) It is impossible to clearly derive the total innovation expenditures of companies in the Netherlands from the Innovation Survey. This is due to the issue that the expenditures on outsourced R&D of one company can consist of the in-house R&D of another company (the company to which the R&D was outsourced). If both companies are included in the survey's random sample, this could result in double counting. This is why these sections only review the distribution across the different types of innovation expenditures of companies.

outsourced R&D is approximately the same. The cost item of personnel training is twice as high in the services sector and the 'other' sector as it is in the manufacturing sector.
It is understandable that large companies spend a larger share of their innovation expenditures on in-house R&D and a smaller share on the (external) purchase of machines and software. Smaller companies that often do not have their own separate R&D department are more often forced to purchase this externally. At the same time it is interesting to note that large companies allocate more of their innovation expenditures to outsourced R&D than small companies.

**6.2.7 Innovation expenditures by category, 2010**




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

### Half of large companies work in partnership on innovation

Many companies work in partnership with other companies or institutions on their innovative activities. Three in ten innovators worked in partnership with other parties in the period 2008–2010. Among the larger companies (250 or more employed persons), this figure rose as high as 50 percent.

For 10 percent of innovators this was a foreign partner (Table 6.2.8). Collaboration generally takes place within the EU, but 2 percent of innovators partners or also partners with companies or institutes in the United States in relation to their innovation. Another 2 percent of innovators collaborate with partners in the emerging economies of China and India.

### 6.2.8 Partnership and innovation, 2008–2010

| | Number of companies | % of innovators |
|---|---|---|
| Innovators | 20,249 | |
| Partnering innovators | 6,000 | 30 |
| of which: | | |
| with other companies within the group | 2,044 | 10 |
| with suppliers of equipment, materials, components or software | 4,633 | 23 |
| with customers | 2,267 | 11 |
| with competitors or other companies in the sector | 1,591 | 8 |
| with consultants, commercial laboratories or private R&D institutes | 1,934 | 10 |
| with universities or other institutes of higher education | 1,415 | 7 |
| with government or public research institutes | 1,051 | 5 |
| Partnered with countries abroad | 2,082 | 10 |
| of which: | | |
| with other EU countries | 1,908 | 9 |
| with the United States | 473 | 2 |
| with China or India | 376 | 2 |
| with other countries | 402 | 2 |

Souce: Statistics Netherlands, Innovation Survey, 2008–2010.

Companies most often partnered on innovation with their suppliers. Customers also played an important role, as did consultants, commercial laboratories and private R&D institutes. Partnerships with other companies within the group also were a frequent occurrence. Companies were not as likely to partner with public research institutes on the realisation of innovations.

In response to the question as to which partners were most important to innovative activities, almost half of companies identified their suppliers. Customers were identified by only 12 percent of companies as the most important partner in innovation. This is striking given that it is customers who are the potential buyers of the innovative products.

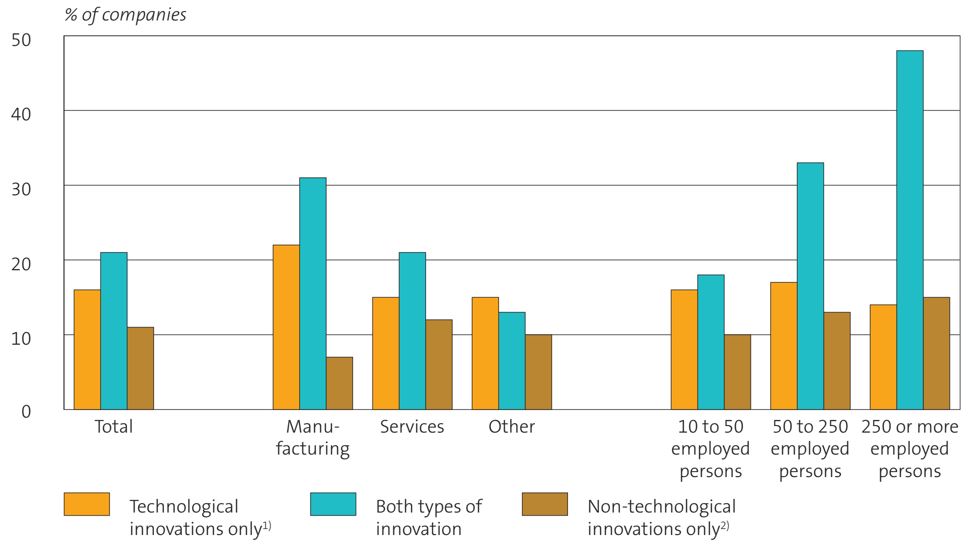
# 6.3 Non-technological innovation

The importance of non-technological innovation was addressed in Section 6.1. The following sections deal with the different types of non-technological innovation. In addition, analogous to the section on technological innovation, the differences by sector are discussed.

### Manufacturing also very strong in non-technological innovation

Thirty-eight percent of companies in the manufacturing sector implemented a non-technological innovation in the period 2008–2010 (Figure 6.3.1). Thirty-one percent of manufacturing companies were technologically innovative as well as non-technologically innovative and 7 percent exclusively implemented non-technological innovations. Over half were technologically innovative. The focal point of the innovative character of the manufacturing sector therefore clearly is on technological innovation. Nevertheless, the manufacturing sector also is the most active sector in the area of non-technological innovations.

**6.3.1 Technological and non-technological innovations by sector and company size, 2008–2010**




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

[1] This concerns product and/or process innovation(s).
[2] This concerns organisational and/or marketing innovations.

Thirty-three percent of companies in the services sector were non-technologically innovative. In the services sector the group with purely non-technological innovations (12 percent) is smaller than the group with purely technological innovations (15 percent), similar to the situation in the manufacturing sector. However, the difference is not as large as in the manufacturing sector. The focus on technological innovations is therefore much lower in the services sector.
Almost half of large companies (250 or more employed persons) were engaged in technological as well as non-technological innovations. This share in smaller companies was not nearly as large.
Figure 6.3.1 provides an initial overview of the relationship between technological and non-technological innovations. The capita selecta (section 4.3) of the Statistics Netherlands publication *Kennis en economie 2008* (Knowledge and the economy 2008, only available in Dutch) devotes attention to new combinations of existing innovation indicators. Such combinations provide deeper insight into the relationship of various aspects of innovation (Statistics Netherlands, 2009b).

## Organisational innovations just outrank marketing innovations

Organisational innovations occurred somewhat more frequently than marketing innovations in the period 2008–2010: among 23 percent and 21 percent of companies, respectively. The implementation of new business practices for organising procedures (for example, knowledge management or the redesign of business processes) was the most often applied organisational innovation. The most often implemented marketing innovation was the use of new media or new techniques for product advertising. Over 15 percent of companies applied such marketing innovations.
Table 6.3.2 makes a distinction between (technological) innovators and non-innovators. The number of companies with non-technological innovations is more than three times as high among the group of innovators (57 percent) as it is among the group of non-innovators (17 percent). Innovators therefore far more often also implement non-technological innovations than companies that do not implement product and/or process innovations. All different forms of non-technological innovations are far more often implemented by innovators than non-innovators. Nevertheless, there is a considerable group of companies that have implemented organisational or marketing innovations, but no (technological) innovations (11 percent). These are the companies that in the broad definition of innovation are designated as innovator, but not in the classical definition (see Section 6.1).

### 6.3.2 Non-technological innovations, 2008–2010

| | Total | Innovators | Non-innovators |
|---|---|---|---|
| | *% of companies* | | |
| Total non-technological innovations | 32 | 57 | 17 |
| Organisational innovations | 23 | 44 | 11 |
| New business practices for organising procedures[1] | 17 | 35 | 6 |
| New methods of organising work responsibilities and decision making[2] | 15 | 28 | 7 |
| New methods for organising external relationships with other companies or institutions[3] | 9 | 18 | 4 |
| Marketing innovations | 21 | 38 | 10 |
| Drastic changes to the aesthetic design or packaging of goods and services[4] | 4 | 10 | 1 |
| Use of new media or techniques for advertising products[5] | 15 | 26 | 8 |
| New methods for positioning a product in the market or new sales channels[6] | 9 | 18 | 3 |
| New methods for pricing goods or services[7] | 6 | 13 | 2 |

Source: Statistics Netherlands, Innovation Survey, 2008–2010.

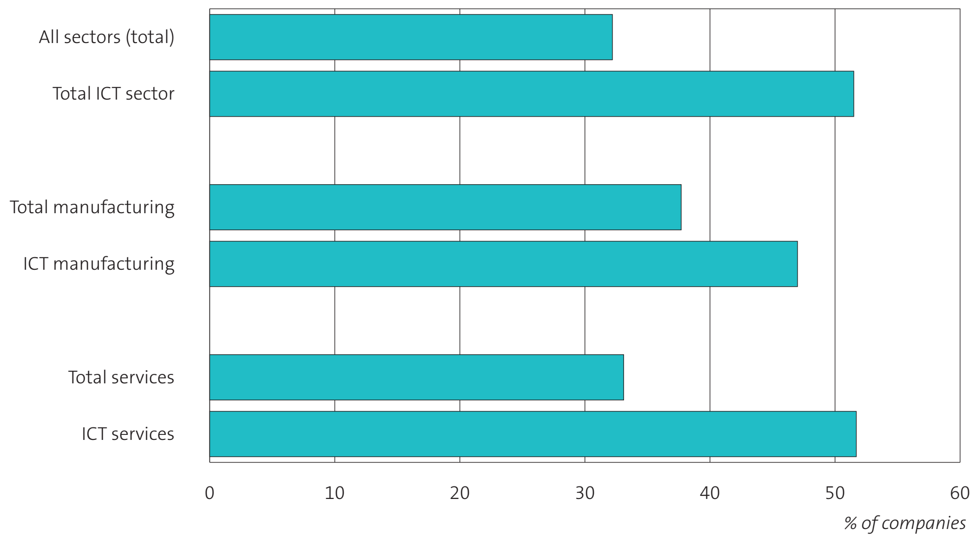
1) Supply chain management, redesign of business processes, knowledge management, lean production, quality management, etc.
2) Commissioning of a new system of employee responsibilities, teamwork, decentralisation, merger or division of departments, education and training systems, etc.
3) Entering into alliances, partnerships, outsourcing or subcontracting for the first time.
4) Other than changes that concern the functional or use characteristics of the product (the latter are product innovations).
5) Making initial use of new advertising media, a new brand image, loyalty cards, etc.
6) Making initial use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentations, etc.
7) Making initial use of variable pricing in relation to demand, discount systems, etc.

#### ICT sector also strong in non-technological innovation

The ICT sector is not only strong in technological innovation, but in organisational and marketing innovation as well. More than half of companies in the ICT sector implemented a non-technological innovation in the period 2008–2010 (Figure 6.3.3). Organisational innovations as well as marketing innovations occurred more frequently in the ICT sector than in the other sectors.

Companies in the ICT manufacturing sector more often applied non-technological innovations than companies in the entire manufacturing sector. This also applies to the ICT services sector, in which the difference with the entire sector is even greater.

### 6.3.3 Companies with non-technological innovation in the ICT sector, 2008–2010




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

# 6.4 Factors hampering innovation activities

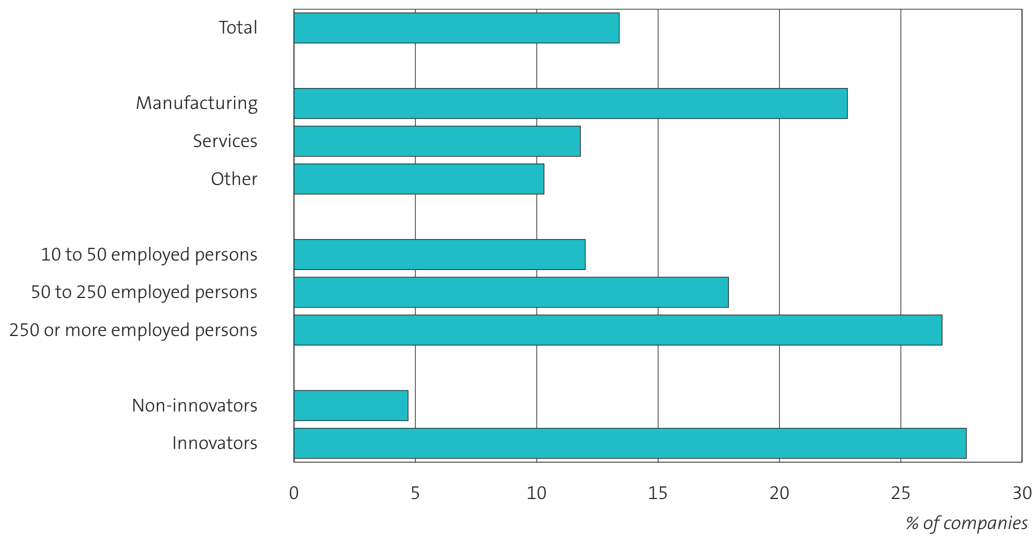
This section addresses the problems that companies encounter when they want to develop new products or processes. These obstacles can be financial in nature, however, a lack of knowledge or suitable personnel can also obstruct a company's innovative intentions. In addition, the sales market can play a role in the decision to innovate or not to innovate. For example, the demand for an innovative product has to be sufficiently high.

**One in eight companies encounter issues with innovation**

Of all companies, 13 percent experienced issues with innovation in the period 2008–2010 (Figure 6.4.1). This concerns 13 percent of all companies: companies that succeeded in introducing a new or significantly improved product or process, companies that developed activities in this area but did not complete any innovations and companies that did not carry out any innovative activities.

Twenty-eight percent of technologically innovative companies experienced issues in realising innovations. This is illustrated in the bottom part of Figure 6.4.1. Five percent of the non-innovators experienced issues as a result of which they were unable to develop the desired innovative activities.
Companies in the manufacturing sector encountered issues almost twice as often as companies in the services sector and the 'other' sector. Almost one in four companies in the manufacturing sector experienced issues with their innovative activities. Large companies with 250 employed persons or more experienced issues more than twice as often as small companies with 10 to 50 employed persons.

### 6.4.1 Companies that experienced issues with innovative activities, 2008–2010

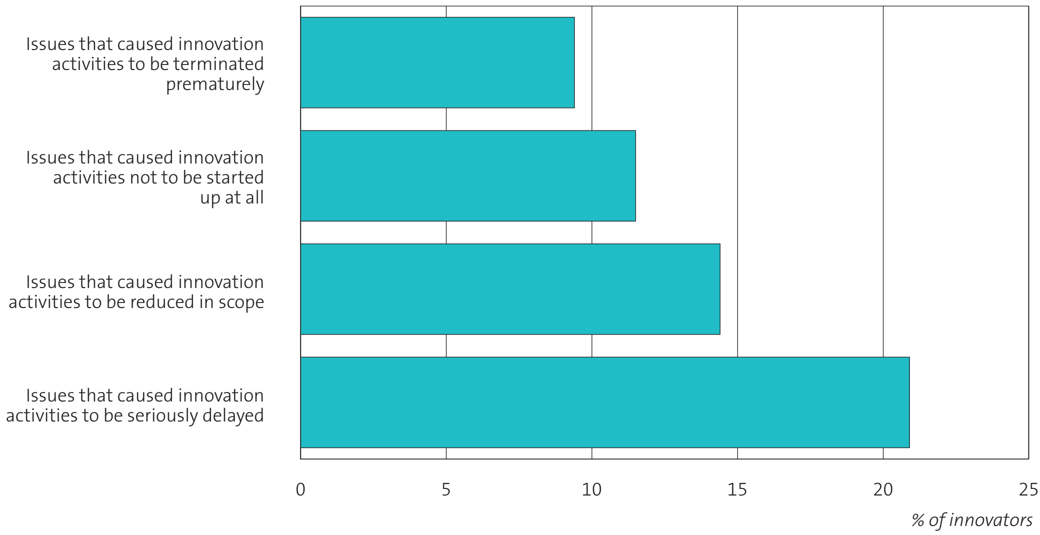



Source: Statistics Netherlands, Innovation Survey, 2008–2010.

### Innovation often delayed due to issues

Figure 6.4.2 illustrates the impact of issues on the innovative activities of innovators. Twenty-one percent of innovators experienced delays in their innovative activities due to issues. Fourteen percent of innovators reduced the scope of their innovative activities due to issues. Twelve percent of innovators failed to start certain innovative activities at all, and 9 percent prematurely terminated innovations, due to issues.

**6.4.2 Companies that experienced issues with innovative activities, 2008–2010**




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

# Costs are greatest innovation issue

Table 6.4.3 further breaks down the different types of issues. In addition, the impact on the innovative activities is identified for each issue.

Companies that experience issues with innovation, most often cite costs as the issue. A lack of sufficient financial resources within their own company is an issue for 17 percent of innovative companies. Approximately 6 percent as a consequence did not start up an innovative activity at all.

### Lack of market demand important reason not to innovate

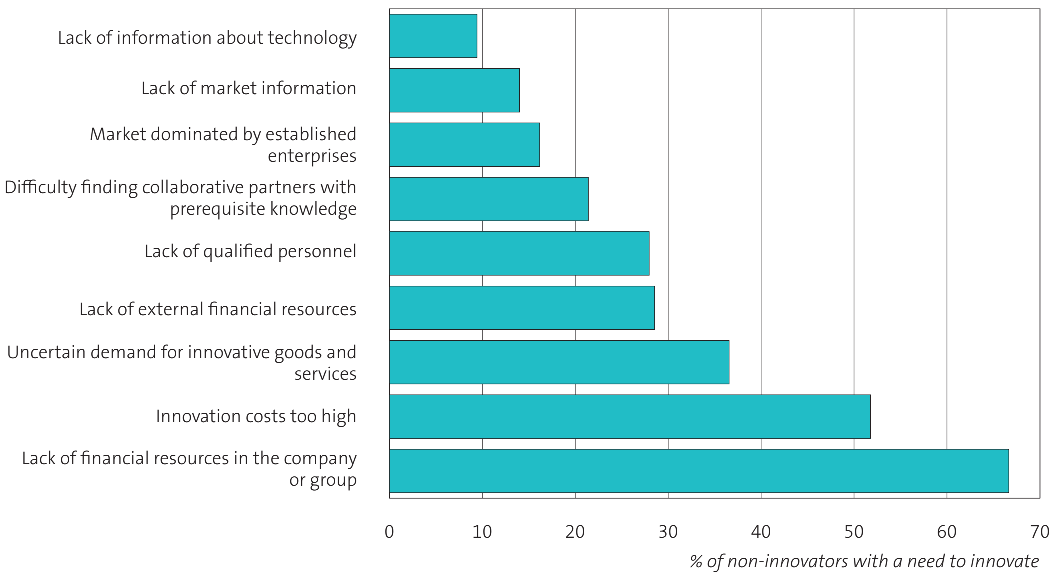
Almost two in three companies did not develop any innovative activities in the period 2008–2010. There are various reasons for a company not to be innovative. Almost all non-innovative companies (96 percent) consider that they do not have a need for innovative activities. Twenty-nine percent of these companies considered that they did not need new innovations in the 2008–2010 period due to earlier developed innovations. Almost half (48 percent) of companies without a need for innovation indicated that there was no market demand for new products or services.

### 6.4.3 Impacts of issues, by type of issue, 2008–2010

| | Experienced issues | Due to issues, innovation activities in the period 2008–2010 were | | | |
|---|---|---|---|---|---|
| | | Not started | Prematurely terminated | Seriously delayed | Reduced in scope |
| | *% of innovators* | | | | |
| **Costs issues** | | | | | |
| Lack of financial resources in the company or group | 17 | 6 | 3 | 8 | 7 |
| Lack of external financial resources | 11 | 5 | 2 | 4 | 4 |
| Innovation costs too high | 14 | 5 | 3 | 5 | 5 |
| **Knowledge issues** | | | | | |
| Lack of qualified personnel | 11 | 2 | 1 | 6 | 3 |
| Lack of information about technology | 8 | 1 | 1 | 5 | 2 |
| Lack of market information | 7 | 2 | 1 | 3 | 2 |
| Difficulty finding collaborative partners with prerequisite knowledge | 8 | 2 | 1 | 4 | 2 |
| **Market issues** | | | | | |
| Market dominated by established enterprises | 6 | 2 | 1 | 2 | 2 |
| Uncertain demand for innovative goods or services | 11 | 3 | 2 | 4 | 4 |

Source: Statistics Netherlands, Innovation Survey, 2008–2010.

### 6.4.4 Issues causing non-innovators not to develop innovative activities, 2008–2010




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

Four percent of non-innovators in the 2008–2010 period indicated that while they had a need for innovations they did not initiate work on such activities due to the issues they experienced. Financial reasons primarily played a role in this regard. Two thirds of these companies lacked the financial resources to start working on innovation. In addition, the costs of the required innovations were too high for many companies. A lack of information was far less important as a reason for abandoning innovations (see Figure 6.4.4).

# 6.5 Stimulating creativity and innovation

Companies can develop activities within the organisation designed to stimulate employees to contribute ideas about new products or process improvements as a means of promoting innovation. For example, brainstorming sessions can be held to discuss product or process improvements. Another method is to compose multidisciplinary work groups with employees from different parts of the company, for example. Job rotation of employees among different departments within the company can contribute to improving the distribution of knowledge and creativity throughout the organisation. A company can educate and train employees in developing new creative ideas. In addition, a company can stimulate innovation by rewarding employees that come up with innovative ideas. A reward like this can be financial, but it can also be recognition, or the opportunity to further develop the idea. In the Innovation Survey 2008–2010, companies were asked about the measures they are taking to stimulate the creativity of their employees as a means of promoting innovation within the company. This question was put to companies

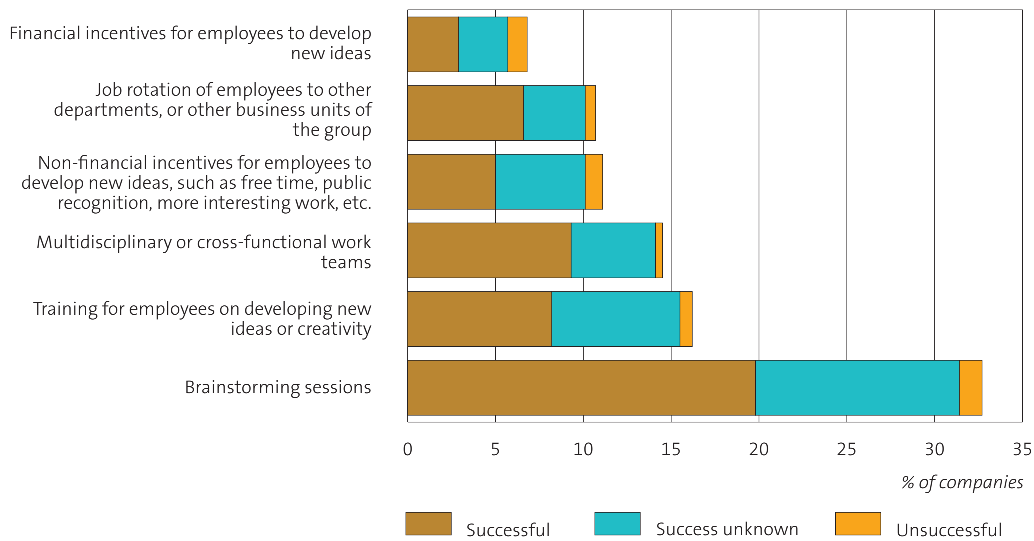
**One in three companies hold brainstorming sessions**

that had successfully introduced a new or improved product to the market, as well as to non-innovative companies. In addition, the survey questioned respondents about the success of these measures.

### Brainstorming sessions most often used to stimulate creativity

Brainstorming sessions are the most common form of stimulating creativity in companies. Almost one in three companies in the period 2008–2010 held brainstorming sessions on innovation. Brainstorming sessions were also most often experienced as successful; namely by one fifth of all companies. The other methods in Figure 6.5.1 were applied far less often. Financial rewards for employees who come up with creative new ideas are the least common method of all the methods mentioned in Figure 6.5.1.

**6.5.1 Use of methods designed to stimulate new ideas and creativity, 2008–2010**

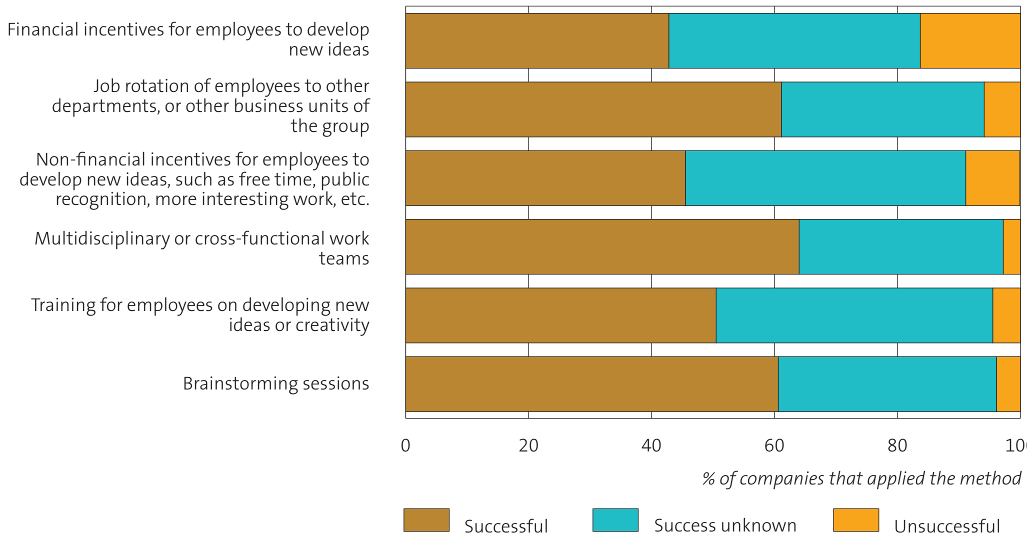



Source: Statistics Netherlands, Innovation Survey, 2008–2010.

A possible explanation of the fact that not many companies use financial incentives to stimulate innovation is that this method often is not successful. Figure 6.5.2 illustrates the success of methods designed to promote innovation in the companies that applied these methods. Of the specified forms, financial rewards is most often designated as unsuccessful.

Job rotation, cross-functional work groups and brainstorming sessions most often lead to success. More than 60 percent of companies that applied these methods experienced these forms of stimulating creativity and innovation as successful. For all categories, it was not clear to a large share of companies (30 to 45 percent) whether the method used was successful or not. It is consequently not very easy to establish the success of these methods.

### 6.5.2 Success of methods designed to stimulate new ideas and creativity, 2008–2010




Source: Statistics Netherlands, Innovation Survey, 2008–2010.

#### Innovators more actively stimulate creativity

In the period 2008–2010, companies with technological innovations more often applied innovation stimulating methods than companies without such innovations. Table 6.5.3 illustrates the differences between innovators and non-innovators in the application of methods that promote creativity and innovation. All forms were more often used by innovators than non-innovators. In addition, the methods used more often led to success among innovators than among non-innovators. Nevertheless, the methods used were often successful for non-innovators as well.

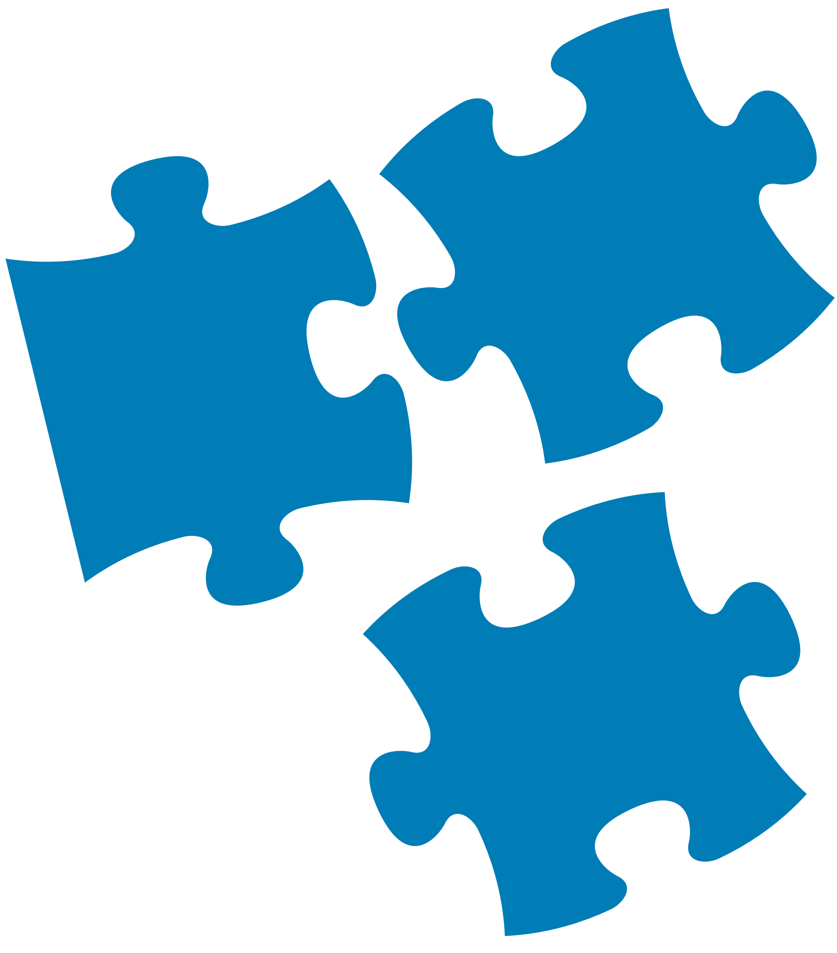
### 6.5.3 Use and success of methods, among innovators and non-innovators, 2008–2010

| | Method used | Method successful | Success unknown | Method unsuccessful |
|---|---|---|---|---|
| | *% of innovators* | *% of innovators that applied this method* | | |
| Brainstorming sessions | 56 | 67 | 30 | 3 |
| Cross-functional work teams | 28 | 67 | 30 | 3 |
| Employee job rotation | 16 | 58 | 35 | 6 |
| Financial incentives | 12 | 47 | 41 | 12 |
| Non-financial incentives | 20 | 48 | 44 | 8 |
| Employee training | 26 | 53 | 42 | 4 |
| | *% of non-innovators* | *% of non-innovators that applied this method* | | |
| Brainstorming sessions | 19 | 49 | 45 | 6 |
| Cross-functional work teams | 6 | 56 | 41 | 3 |
| Employee job rotation | 8 | 65 | 30 | 5 |
| Financial incentives | 4 | 34 | 42 | 24 |
| Non-financial incentives | 6 | 41 | 48 | 11 |
| Employee training | 10 | 46 | 49 | 5 |

Source: Statistics Netherlands, Innovation Survey, 2008-2010.

# R&D and patents

# 7



# R&D and patents

## 7.1 Research and Development

- R&D expenditure 11 billion euro in the Netherlands
- More than 100,000 R&D working years
- R&D intensity increases in 2010
- In international terms, the Netherlands is not a leading country
- Most R&D still carried out in the manufacturing sector

## 7.2 Patents

- Dutch parties apply for a relatively high number of patents
- Almost one third of all Dutch patent applications concerned ICT
- Number of Dutch high-tech patent applications has decreased
- Dutch ICT sector makes extensive use of intellectual property rights

**Research and development is of major importance to innovation, ICT and other technology. Research & development (R&D) is used as a means by companies and public organisations to develop not only pure theoretical knowledge, but practically applicable results that continuously improve products and technologies as well. Much of this knowledge is protected by patents and other intellectual property rights.**

# 7.1 Research and Development

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 stock of knowledge, including knowledge of man, culture and society, and the use of this 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 specific development initiatives geared towards new products and/or processes. The emphasis in fundamental research is on increasing scientific knowledge. Knowledge institutes like universities and research institutes focus mainly on this kind of research. Applied research and development is directed primarily towards finalising the development of ideas into new or significantly improved processes and manufacturable products. This kind of research is relatively often 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). Chapter 6 covers these and other types of innovation in greater depth. 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.

**Definition of R&D**

In its surveys, Statistics Netherlands asks companies and institutes about their R&D expenditure and working years. In this connection, it is important to be aware of the precise activities encompassed by R&D. Research carried out within an R&D framework seeks to achieve originality *and* innovation. It therefore entails a creative and systematic search for solutions to practical problems, such as those pertaining to production. R&D also includes strategic and fundamental research in which the principal focus is on acquiring background knowledge and increasing pure scientific knowledge rather than on achieving immediate economic benefits or solutions to problems. In addition, R&D encompasses the development, and finalising the development, of ideas or prototypes into usable processes and manufacturable products.

R&D does *not* include the following activities:

- Routine measurements or checks and market research;
- Education and training;
- Work performed in relation to patents and licences;
- Making purchased technology or advanced (production) equipment operational;
- Rewriting existing software and/or making software that has already been marketed customer-specific;
- Industrial design, unless this concerns a systematic search for ergonomic improvements.

Unless otherwise stated, R&D expenditure in this publication means expenditure for R&D performed by a company's own staff in the Netherlands. It does not matter in this regard whether the R&D work is financed by the company concerned itself or whether the company is performing the work for other companies or institutes in return for payment. This definition of R&D expenditure therefore does not include R&D activities of companies based in the Netherlands that are performed abroad. Conversely, the definition includes R&D activities performed in the Netherlands that are financed from abroad.

R&D financing with the aid of WBSO grants is not deducted.[1)] This means that a company's expenditure on subsidised R&D staff counts as R&D expenditure even if the company recovers part of this expenditure through payroll tax. This approach was used to make the figures comparable in international terms.

[1)] Promotion of Research and Development Act. This Act provides for a tax stimulus for (private) R&D by reducing the payroll tax owed for R&D staff.

## R&D expenditure 11 billion euro in the Netherlands

R&D expenditure in the Netherlands amounted to almost 11 billion euro in 2010 (Table 7.1.1).[1)] Following a minor decline from 2008 to 2009, R&D expenditure once again rose in 2010, by 5 percent. Viewed over a longer period R&D expenditure is on an upward trend.

The Dutch business sector performed almost half of all R&D in 2010 (48 percent). Institutions of higher education (universities, university medical centres and colleges for higher professional education (hbo)) jointly accounted for 40 percent of the total R&D expenditure in the Netherlands. 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 expenditure at companies dropped in 2008 and 2009, possibly as a result of the economic recession. This drop was offset to some extent by institutions of higher

[1)] This amount concerns only the R&D at companies and institutes with at least 10 employed persons and the R&D expenditure in higher education.

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. In 2010, company expenditures on R&D once again rose by 6 percent in relation to the year before. However, this still doesn't bring company R&D expenditures back up to 2007 levels.

### 7.1.1 R&D conducted with in-house staff: expenditures, working years and R&D intensity, 2000–2010

| | 2000 | 2006 | 2007 | 2008 | 2009[1] | 2010[1] |
|---|---|---|---|---|---|---|
| | *mln euro* | | | | | |
| **R&D expenditure** | | | | | | |
| Total | 8,089 | 10,175 | 10,343 | 10,502 | 10,408 | 10,892 |
| of which: | | | | | | |
| Companies | 4,457 | 5,480 | 5,495 | 5,263 | 4,900 | 5,218 |
| Public research institutes[2] | 1,049 | 1,260 | 1,259 | 1,259 | 1,327 | 1,279 |
| Institutions of higher education + UMCs | 2,583 | 3,435 | 3,589 | 3,980 | 4,181 | 4,395 |
| | *FTE* | | | | | |
| **R&D working years** | | | | | | |
| Total | 91,313 | 97,835 | 93,788 | 93,432 | 87,874 | 100,544 |
| of which: | | | | | | |
| Companies | 47,509 | 52,841 | 49,246 | 48,019 | 42,336 | 54,139 |
| Public research institutes[2] | 13,726 | 12,765 | 12,140 | 12,182 | 11,416 | 11,424 |
| Institutions of higher education + UMCs | 30,078 | 32,229 | 32,402 | 33,231 | 34,122 | 34,981 |
| | *%* | | | | | |
| **R&D expenditure as a percentage of GDP** | | | | | | |
| Total | 1.94 | 1.88 | 1.81 | 1.77 | 1.82 | 1.85 |
| of which: | | | | | | |
| Companies | 1.07 | 1.01 | 0.96 | 0.89 | 0.86 | 0.89 |
| Public research institutes[2] | 0.25 | 0.23 | 0.22 | 0.21 | 0.23 | 0.22 |
| Institutions of higher education + UMCs | 0.62 | 0.64 | 0.63 | 0.67 | 0.73 | 0.75 |

Source: Statistics Netherlands, National Accounts and R&D surveys.

[1] R&D expenditure as a percentage of GDP is provisional due to the provisional character of the GDP.
[2] Including private non-profit organisations (PNPs).

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 research institutes constituted only a small part of total R&D expenditures.

## Companies perform almost half of all R&D in the Netherlands

### More than 100,000 R&D working years

More than 100,000 working years were spent on R&D in the Netherlands in 2010. Here too, staff at companies accounted for approximately half of the total. The working years devoted by companies on R&D once again sharply increased in 2010, following a sharp decline in 2008 and 2009. The working years spent on R&D by the higher education sector had already been steadily increasing in these years.
The observed number of R&D working years at companies and research institutes fluctuates from year to year (also see the text box 'Accuracy of the figures'). To obtain an accurate picture it is best to observe the trend over a period of at least two years.

#### Accuracy of the figures

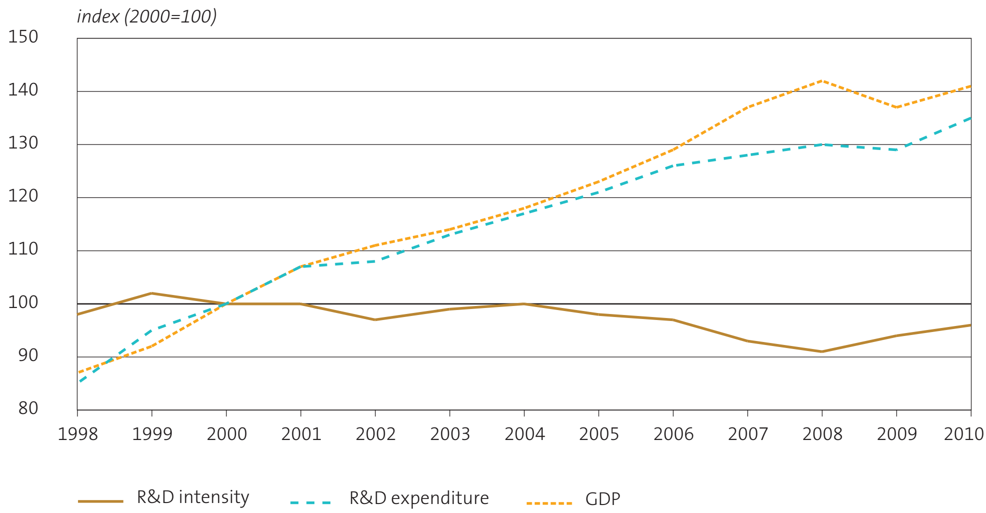
The figures concerning R&D in the Netherlands specified in this section are taken from, among other sources, Statistics Netherlands surveys. These surveys are carried out on a sampling basis, which means that not all companies expected by Statistics Netherlands to have potentially performed R&D activities 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 sampling basis in any case means that a margin of error must be taken into account when interpreting results. Amounts in Table 7.1.1 are given in millions of euro, for example. This does not mean, however, that the figures are known to an accuracy of 1 million euro. R&D expenditure for 2010 as included in the aforesaid table, for example, must be interpreted as 10,892 million euro with a margin of error of 50 million euro.

### R&D intensity increases in 2010

Table 7.1.1 also specifies what is referred to as the R&D intensity. This is defined as R&D expenditure divided by GDP and expresses the amount of R&D expenditure as a percentage of the total economy. Although R&D expenditure has been on an upward trend for some time, the rate of growth has been somewhat less than the rest of the economy. The R&D intensity of the Netherlands therefore fell from 1.97 percent in 1995 to 1.85 percent in 2010. This effect is illustrated in Figure 7.1.2. This diagram separately displays the R&D expenditure and GDP trends. Until 2005, the R&D expenditure and the GDP grew at the same rate. In the period 2006–2008, the GDP grew much faster than the R&D expenditure, as a result of which the R&D intensity declined in those years. In 2009, the start of the economic recession, the GDP dropped significantly in comparison to the year before. R&D expenditure also dropped in this year, but at a lower rate than the GDP, as a result of which R&D intensity went up. In 2010, R&D expenditure as well as the GDP resumed growth. Due to the fact that R&D expenditure grew at a somewhat faster rate than the GDP, the R&D intensity once again increased slightly.

# R&D intensity rises to 1.85

**7.1.2 R&D expenditure and GDP trends, 1998–2010[1)]**




Source: Statistics Netherlands, R&D Surveys and National Accounts.

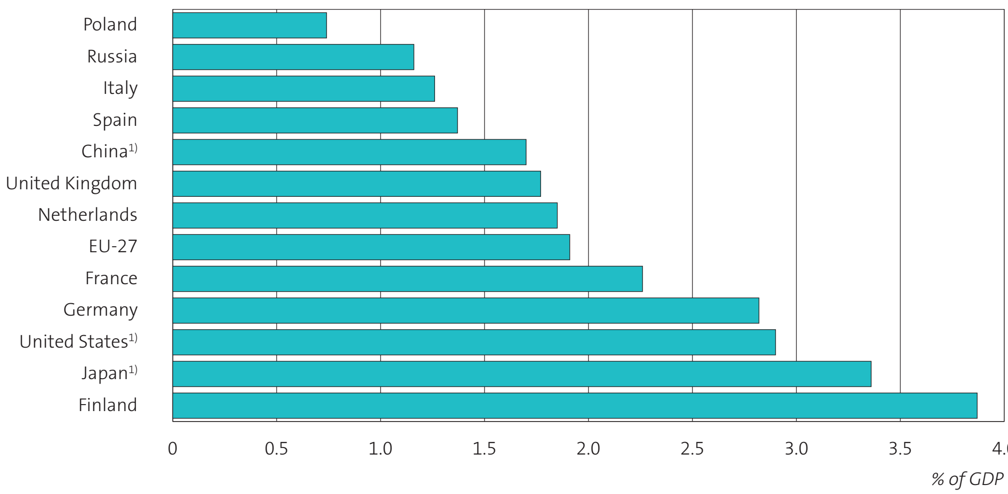
[1)] 2009 and 2010: provisional figures for the GDP and R&D intensity.

## In international terms, the Netherlands is not a leading country

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. Figure 7.1.3 illustrates the R&D intensity for a group of benchmark countries

in 2010. R&D intensity in the Netherlands has been lower than average in the EU for a number of years. The Netherlands also scores lower than the United States and Japan. R&D intensity has been growing fast for several years in China, which is especially interesting given the strong growth of the Chinese GDP. However, R&D intensity in the Netherlands is still higher than that of the large economies of Spain, Italy and the United Kingdom.
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 compared to many other countries. Indeed, the Dutch manufacturing sector is relatively small. The manufacturing sector generally accounts for more R&D than the services sector, although R&D can be performed in the services sector as well.

**7.1.3 R&D intensity, 2010***




Source: OECD Main Science and Technology Indicators January 2012.

[1] 2009 instead of 2010.

This probably explains in part why the Netherlands' performance is below the EU average. Only a few countries achieved the European objective of 3 percent by 2010. This includes the Northern European countries Denmark, Finland, Sweden and Iceland (not an EU country). Outside Europe, Japan and South Korea have an R&D intensity of more than 3 percent.

### Most R&D still carried out in the manufacturing sector

Table 7.1.4 further breaks down the R&D activities of companies by sector and company size, measured in terms of the number of employed persons. The manufacturing sector still spends the highest amount on R&D. The share of the manufacturing sector did decline, however, from 75 percent in 2006 to 68 percent in 2010. The share of the services

### 7.1.4 R&D companies, expenditure and personnel by sector and company size, 2000–2010[1)2)]

| | 2000 | | 2006 | | 2008 | | 2010 | |
|---|---|---|---|---|---|---|---|---|
| | *number* | *% of total* | *number* | *% of total* | *number* | *% of total* | *number* | *% of total* |
| **R&D companies** | 3,837 | 100 | 3,434 | 100 | 3,186 | 100 | 4,603 | 100 |
| Manufacturing | 1,945 | 51 | 1,746 | 51 | 1,645 | 52 | 1,907 | 41 |
| Services | 1,572 | 41 | 1,530 | 45 | 1,358 | 43 | 2,329 | 51 |
| Other | 320 | 8 | 158 | 5 | 183 | 6 | 367 | 8 |
| 10 to 50 employed persons | 1,990 | 52 | 1,841 | 54 | 1,737 | 55 | 2,755 | 60 |
| 50 to 250 employed persons | 1,172 | 31 | 1,151 | 34 | 1,052 | 33 | 1,392 | 30 |
| 250 or more employed persons | 675 | 18 | 441 | 13 | 396 | 12 | 456 | 10 |
| | *mln euro* | *% of total* | *mln euro* | *% of total* | *mln euro* | *% of total* | *mln euro* | *% of total* |
| **R&D expenditure** | 4,457 | 100 | 5,480 | 100 | 5,263 | 100 | 5,218 | 100 |
| Manufacturing | 3,385 | 76 | 4,094 | 75 | 3,758 | 71 | 3,541 | 68 |
| Services | 877 | 20 | 1,200 | 22 | 1,307 | 25 | 1,483 | 28 |
| Other | 195 | 4 | 186 | 3 | 198 | 4 | 195 | 4 |
| 10 to 50 employed persons | 265 | 6 | 421 | 8 | 390 | 7 | 542 | 10 |
| 50 to 250 employed persons | 590 | 13 | 992 | 18 | 862 | 16 | 1,110 | 21 |
| 250 or more employed persons | 3,602 | 81 | 4,068 | 74 | 4,012 | 76 | 3,566 | 68 |
| | *FTE* | *% of total* | *FTE* | *% of total* | *FTE* | *% of total* | *FTE* | *% of total* |
| **R&D personnel** | 47,509 | 100 | 52,841 | 100 | 48,019 | 100 | 54,139 | 100 |
| Manufacturing | 33,292 | 70 | 33,533 | 63 | 31,760 | 66 | 31,522 | 58 |
| Services | 12,053 | 25 | 16,765 | 32 | 14,369 | 30 | 20,522 | 38 |
| Other | 2,164 | 5 | 2,543 | 5 | 1,890 | 4 | 2,095 | 4 |
| 10 to 50 employed persons | 6,071 | 13 | 8,694 | 16 | 7,496 | 16 | 10,467 | 19 |
| 50 to 250 employed persons | 8,293 | 17 | 14,356 | 27 | 10,647 | 22 | 13,770 | 25 |
| 250 or more employed persons | 33,145 | 70 | 29,791 | 56 | 29,877 | 62 | 29,903 | 55 |

Source: Statistics Netherlands, R&D Surveys.

1) From 2008 the breakdown by sector is in accordance with the Standard Industrial Classification (SIC) 2008. The SIC 1993 applies to earlier years.
2) For the year 2000 company size is based on the number of employees (10 to 50 employees; 50 to 200 employees; 200 or more employees).

sector rose. Large companies, albeit small in number, accounted for the lion's share of R&D expenditure. However, the share of the largest companies (250 or more employed persons), declined slightly in recent years.
The rise in the number of R&D working years in 2010 primarily occurred in the services sector. The R&D personnel complement in the services sector was larger than ever in 2010. The number of working years in the manufacturing sector was virtually the same as in 2008. An increase is evident in every size class, which is relatively highest for the smallest companies (10 to 50 employed persons).
The number of companies with its own R&D activities was significantly higher in 2010 compared to previous years. The service sector here too shows the largest increase. The number of companies engaged in R&D also increased significantly in the manufacturing sector.
The number of small companies (10 to 50 employed persons) with their own R&D activities also rose sharply in 2010 in relation to 2008. Large companies also experienced an increase, although on a far less spectacular scale.
Detailed long-term figures are contained in the statistical annex to this publication. The statistical annex can be consulted online at www.cbs.nl/ICT-knowledge-economy.

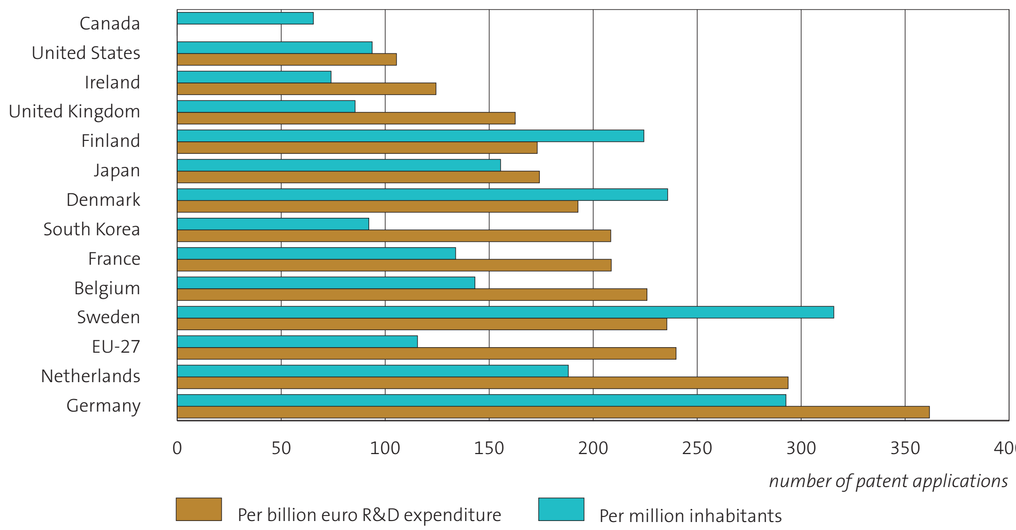
# 7.2 Patents

A patent is an intellectual property right that can be issued by authorised bodies. A patent gives its owner the legal right to exclude others from the production, use, sale and offers for sale or import of the patented invention. The protection applies for the duration of the patent. Patents can be granted to, for example, companies, universities, institutes or private parties, provided that the invention meets the criteria for patentability. To be eligible for a patent, an invention must be novel, non-obvious and amenable to industrial application. 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. If a high number of patents are applied for, this 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 have opened these registrations in digital form and made them available for

statistical purposes.[2)] These registrations also include a number of characteristics of the patent application, which makes it possible to break down patent applications according to areas of technology, such as ICT. This in turn reveals the areas 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 2012). Patent applicants must complete additional actions in some member states for the patent to become effective in that country. For example, this concerns the translation of the patent's conclusions into the country's official language. In addition, the indicators presented in this section are classified according to year, based on the priority date. This is the date of the first application for a patent irrespective of where in the world. It is therefore 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 a patent application by each patent-granting organisation.

### 7.2.1 Patent applications filed with the European Patent Office, international, 2008*




Source: Eurostat.

2) 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 patent applications at patent-granting organisations in approximately 80 countries.

**Dutch parties apply for a relatively high number of patents**

In 2008, Dutch parties filed 294 patent applications with the EPO for each billion euro of R&D expenditure. Of the countries in Figure 7.2.1 only Germany has a higher number (362). The number of patent applications per billion euro declined in the Netherlands as well as Germany in comparison to previous years. In the Netherlands this is primarily due to the fact that the number of patent applications decreased. However, in Germany the number of patent applications roughly stayed the same, but R&D expenditures sharply increased. A small group of large companies accounts for a large proportion of Dutch patent applications. For example, in 2008 almost 70 percent of all Dutch EPO patent applications came from companies with at least 500 employed persons. This group only represented 15 percent of the total number of Dutch companies that filed a patent application with the EPO in 2008.[3)]
In 2008, the number of Dutch patent applications per billion euro (294) was higher than the EU average (240). Of the countries in Figure 7.2.1, the United States filed the lowest number of patent applications per billion euro of R&D expenditure with the EPO (105 in 2008). It must be noted in this regard that the United States is not an EPO member and that parties from the United States file a comparatively higher number of patent applications in their home markets (OECD, 2009b).

# Dutch patent applications are well above the EU average

For the purpose of making international comparisons, it is also possible to scale the number of patent applications according to a country's population. According to this method, Sweden is the country with the highest number of patent applications filed with the EPO. In 2008, Swedish parties filed 316 patent applications per million inhabitants. The corresponding figure for the Netherlands that year was 188. Germany (293), Denmark (236) and Finland (224) also outranked the Netherlands. Measured in terms of population size, the Netherlands therefore occupies fifth place, while it ranks second when this number is scaled according to R&D expenditure. This has to do with the fact that R&D expenditure in the Netherlands is relatively low (see Section 7.1). The reverse is true for Sweden, because that country's R&D expenditure is very high. With 74 and 65 EPO patent

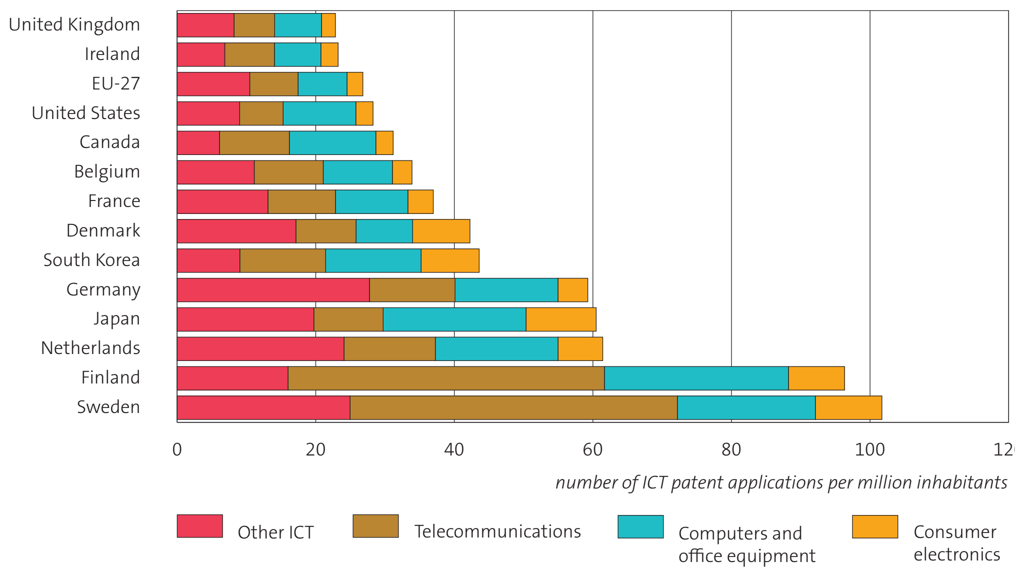
3) The relevant figures are contained in the statistical annex to this publication. The statistical annex can be consulted online at www.cbs.nl/ICT-knowledge-economy.

applications per million inhabitants respectively, Ireland and Canada had the lowest numbers in the group of benchmark countries. A small number of patent applications, however, does not necessarily mean that the R&D efforts of a country are less fruitful. Indeed, parties can also opt to protect their inventions in other ways, such as by means of secrecy. Furthermore, as regards Canada, most Canadian parties probably tend to turn to other patent offices (such as the Canadian or American national patent office) rather than to the EPO.

### Almost one third of all Dutch patent applications concerned ICT

Twenty-nine percent of all patent applications filed with the EPO by Dutch parties in 2008 concerned ICT. With 43 percent, South Korea had the largest proportion of ICT patent applications in the total. Relatively more ICT patent applications were also filed from Canada, Finland and Japan than from the Netherlands. The EU average in 2008 was 21 percent. Furthermore, applicants for ICT patents do not necessarily need to belong to the ICT sector, but can also form part of other sectors.

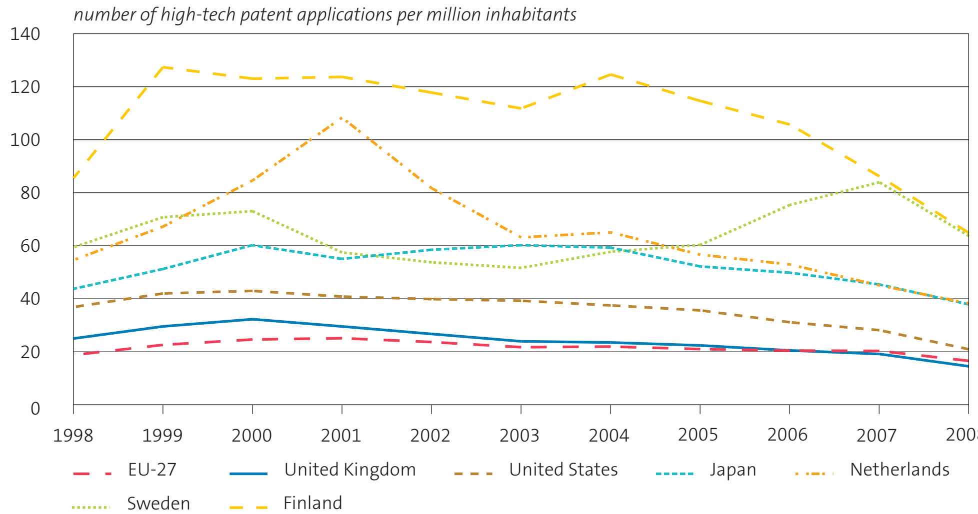
**7.2.2 ICT patent applications filed with the European Patent Office, international, 2008**




Source: Eurostat.

In the ICT categories 'Other ICT' and 'Telecommunications', the Netherlands was among the top three benchmark countries in 2008 (see Figure 7.2.2). Twenty-four patent applications per million inhabitants were filed from the Netherlands in the category 'Other ICT', which includes semi-conductors for example. Of the group of benchmark countries, Germany scored highest in this category, with 28 patent applications, followed by Sweden (25). In the 'Telecommunications' technology area, only Sweden (47) and Finland (46) scored higher than the Netherlands (13), although the difference is significant. Dutch parties filed 18 patent applications per million inhabitants in the ICT category 'Computers and office equipment'. Following a peak of 66 patent applications per million inhabitants in 2001, this number has steadily declined. Parties from Finland (27), Japan (21) and Sweden (20) filed more patent applications in this area than the Netherlands in 2008. That year, Dutch parties filed 6 patent applications per million inhabitants in the category 'Consumer electronics'. This average number is comparable to other benchmark countries. Japan and Sweden in particular scored high in this area. The Netherlands for years was the country with the highest number of patent applications in the field of consumer electronics. Indeed, the corresponding figure for 2001 was 50 per million inhabitants. As such, the Netherlands far outranked the other benchmark countries at the time.

**7.2.3 High-tech patent applications filed with the European Patent Office, international, 1998–2008**




Source: Eurostat.

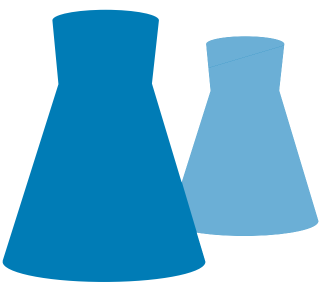
### Number of Dutch high-tech patent applications has decreased

Thirty-eight high-tech patent applications per million inhabitants were filed with the EPO from the Netherlands in 2008. The number of high-tech patent applications filed with the EPO by Dutch parties has been declining since 2004. A similar trend is evident among almost all benchmark countries in Figure 7.2.3. By contrast, an increase is evident in Sweden since 2004. However, the number of high-tech patent applications in Sweden was also at a lower level in 2008 than in 2007.
One fifth of all Dutch patent applications filed in 2008 were for high-tech patents. Of the benchmark countries in Figure 7.2.3, Finland had the highest proportion of high-tech applications in the total, namely 29 percent. In Japan, the proportion of high-tech patents (24 percent) was also higher than in the Netherlands.

### Dutch ICT sector makes extensive use of intellectual property rights

Intellectual property rights encompass more than just patents. They also apply to registered industrial designs and registered trademarks, as well as established copyrights. Of all innovators in the ICT manufacturing industry, 39 percent made use of an intellectual property right in the period 2008–2010. Twenty-seven percent of companies in the ICT services sector did so.[4)] In the other sectors of the economy, 18 percent of innovators used at least one of the forms of intellectual property protection. Nineteen percent of innovative companies in the ICT manufacturing industry applied for a patent in the period 2008–2010 (Figure 7.2.4). In this sector, mainly large companies with at least 250 employed persons applied for patents (50 percent of innovators).

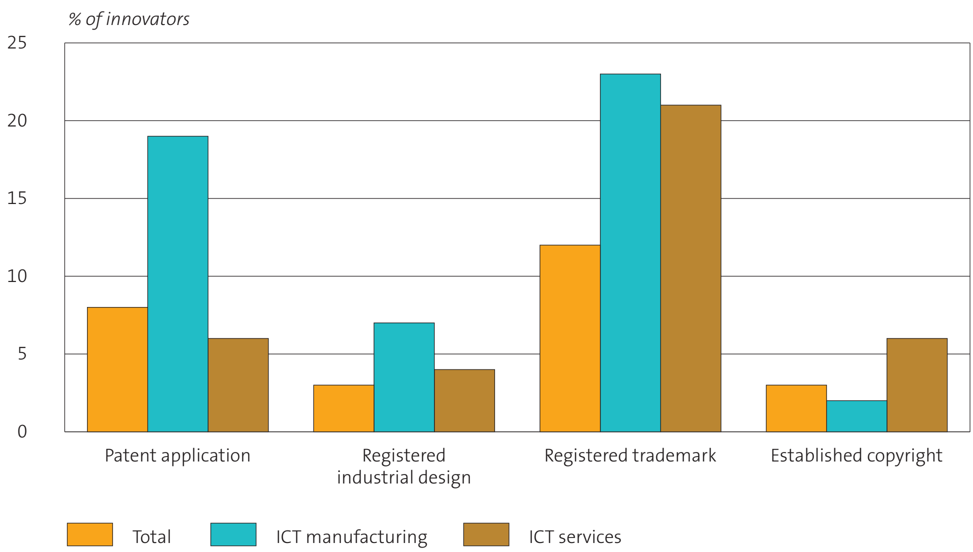
## Half of large innovative companies apply for patents



[4)] The 'Innovator' concept is described in the Glossary at the end of this publication.

Applying for patents is a less frequent occurrence in the ICT services sector (6 percent of innovators), while trademarks are registered more often (21 percent). The low percentage in this sector is linked to the fact that services lend themselves less well to patenting. Relatively few Dutch innovators establish a copyright or register an industrial design (both 3 percent). Innovators in the ICT services sector establish a copyright more often than average (6 percent). Seven percent of innovative companies in the ICT manufacturing sector registered an industrial design in the period 2008–2010.

### 7.2.4 Use of intellectual property rights by innovators, 2008–2010




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

The figures presented in this section must be interpreted with a measure of caution. R&D expenditure (Figure 7.2.1), 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. Indeed, it is more customary to patent inventions in some sectors than others.

# Capita selecta

# 8

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# Capita selecta

## 8.1 Continuing vocational training

- Investing in human capital
- Over three quarters of enterprises train their employees
- High level of CVT in construction industry
- Four in ten employees take CVT courses
- More men than women take CVT courses
- Almost 1,200 euro per participant
- Spending primarily on external trainers
- Most attention was focused on technical, practical and job-specific skills
- Most CVT courses are provided by private institutes
- Innovative enterprises offer more courses
- Innovators focus more of their training on customer-handling skills

## 8.2 The internet as a data source for producing statistics

- Introduction
- The internet as a data source: concept and measurement techniques
- Non-technological aspects at least as important
- Potential IaD benefits
- Actual practice
- Pilots
- The initial experiences with IaD
- Examples from actual practice
- Example 1: Smartphone measurements
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- Conclusions

## 8.3 Explaining productivity growth, the Solow residual disentangled

- The challenge: disentangling the Solow residual
- Mechanism exposed: R&D capital approach linked to semi/fully endogenous growth theory
- The determinants of the Solow residual placed in a broad overall framework
- Empirical explanation of the Solow residual in labour productivity development
- Empirical explanation of private R&D expenditure as a factor of private R&D capital
- Decomposition analysis of the contribution of explanatory factors to the Solow residual
- Policy implications

**This chapter contains three contributions that supplement the subjects discussed elsewhere in this publication. The following three articles are included in the sequence presented below:**

- ***Continuing vocational training*. This article describes the findings of the five-yearly Statistics Netherlands survey that measures the way in which and the degree to which enterprises invest in training and courses for their own personnel.**
- ***The internet as a data source for producing statistics*. This article describes the key results of the Statistics Netherlands research programme that explores opportunities for using the internet as a source of data for developing statistics.**
- ***Explaining productivity growth, the Solow residual disentangled*. This article written by Piet Donselaar (Dutch Ministry of Economic Affairs, Agriculture and Innovation) provides an analysis of the Solow residual: the part of labour productivity growth that remains after the contribution of the growth in the amount of physical capital per unit of labour has been deducted from it.**

**The articles in this chapter broaden and deepen the themes that are addressed elsewhere in the present publication.**

# 8.1 Continuing vocational training

*This contribution outlines the results of the 'Continuing Vocational Training Survey'(CVTS). This is a five-yearly harmonised survey of enterprises, conducted in all EU countries. The Dutch Survey was conducted among a sample of approximately 5,500 enterprises with 10 or more persons employed in the private sector. This means that the 'Public Administration, Government Services and Compulsory Social Security', 'Education' and 'Health and Welfare' sectors are excluded from consideration. In addition, enterprises in the 'Agriculture, Forestry and Fishing' sector were also excluded from the survey. The data concerns continuing vocational training (CVT) completed in 2010. The key focus of this article is on enterprises that invest in CVT, with the ICT sector and so-called innovators receiving special attention.*

*Authors: Jeroen Nieuweboer and Jack Claessen, Statistics Netherlands*

### Investing in human capital

Enterprises improve their competitive position by investing in human capital through means of providing additional training and retraining their employees. These investments stimulate economic growth and employment. Enterprises this way play an important role in redressing imbalances on the labour market. In addition to the private sector, the government also attaches a great deal of importance to sufficiently developing the knowledge and skills of the Dutch labour force. Indeed, well-educated employees are better able to find new work within an acceptable time frame in the event of dismissal. The government encourages additional training and retraining through schemes such as grants and tax allowances. Continuing vocational training consists of training that is fully or partially paid by the employer and that enables employees to expand their knowledge or keep it up to par. The Continuing vocational training survey provides insight into the efforts of enterprises related to employee education and training. The survey addressed the following questions:

- How many enterprises provide their employees with an opportunity to take training or make it mandatory for them to do so?
- Which sectors have a high rate of CVT?
- What are the differences between large and small enterprises?
- What is the breakdown by employee gender?
- What type of training is provided?
- Who provides the training?

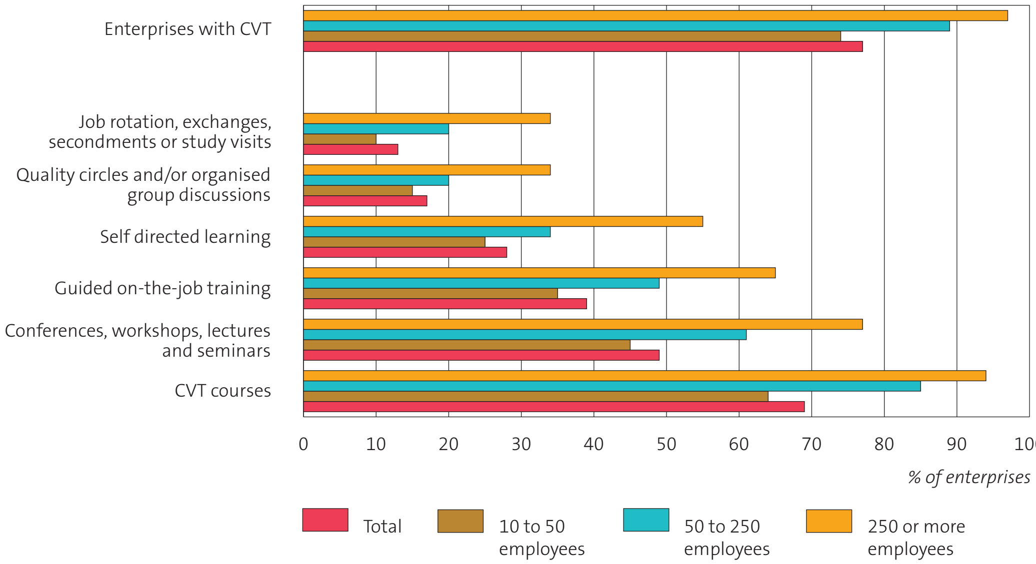
Continuing vocational training can be split into two groups: first, CVT courses taken by employees, and second, other training activities. The other training activities include:

- Attendance at conferences, workshops, lectures and seminars;
- Guided on-the-job training;
- Self directed learning;
- Quality circles and/or organised group discussions;
- Job rotation, exchanges, secondments or study visits, provided that the primary objective is to acquire knowledge and skills or to maintain such skills up to par.

**Over three quarters of enterprises train their employees**

More than three quarters of enterprises in 2010 facilitated some form of CVT (77 percent). Larger enterprises are more inclined to provide CVT than smaller enterprises. Three quarters of small enterprises provided some form of CVT. This figure was 89 percent for medium-sized enterprises and as high as 97 percent for large enterprises (Figure 8.1.1).
In almost seven in ten enterprises (69 percent) employees took CVT courses in 2010. Half of enterprises sent employees to conferences, workshops, lectures or seminars. In almost 28 percent of enterprises, employees were engaged in self directed learning. Quality circles and/or organised group discussions (17 percent) and job rotation, exchanges, secondments and the like (13 percent) were used less frequently. The share of enterprises that, in addition to courses, also use other forms of CVT increases in proportion to the size of the enterprise.

## 8.1.1 CVT in enterprises by type of training, 2010




Source: Statistics Netherlands, CVTS 2010.

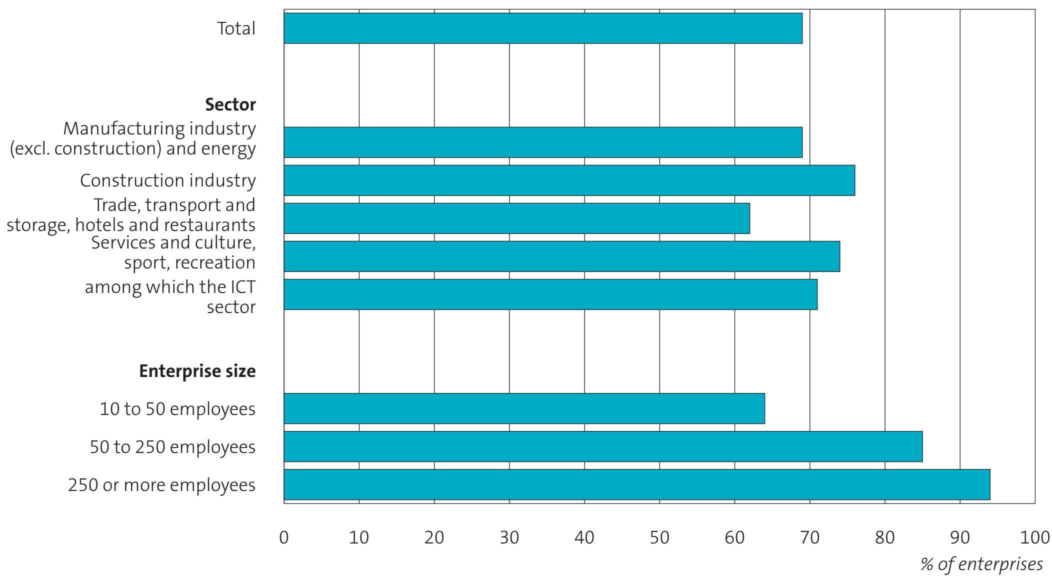
CVT courses are by far the most important tool for enterprises to educate and train their employees. The survey has collected various data on this, such as the number of participants, the hours invested, the subjects and the expenditure on CVT courses. The following paragraphs purely relate to CVT courses.

## Employees take CVT courses in seven in ten enterprises

### High level of CVT in construction industry

The share of enterprises that sent employees on course was above average in the 'Construction Industry' (76 percent) and in the 'Services Sector' (74 percent). At 62 percent, the share in the 'Trade, Transport and Hotels and Restaurants' sector was lowest among the various sectors differentiated in the survey. Seventy-one percent of enterprises in the 'ICT Sector' sent their employees to CVT courses (Figure 8.1.2).[1)]

**8.1.2 Enterprises with CVT courses, by sector and enterprise size, 2010**




Source: Statistics Netherlands, CVTS 2010.

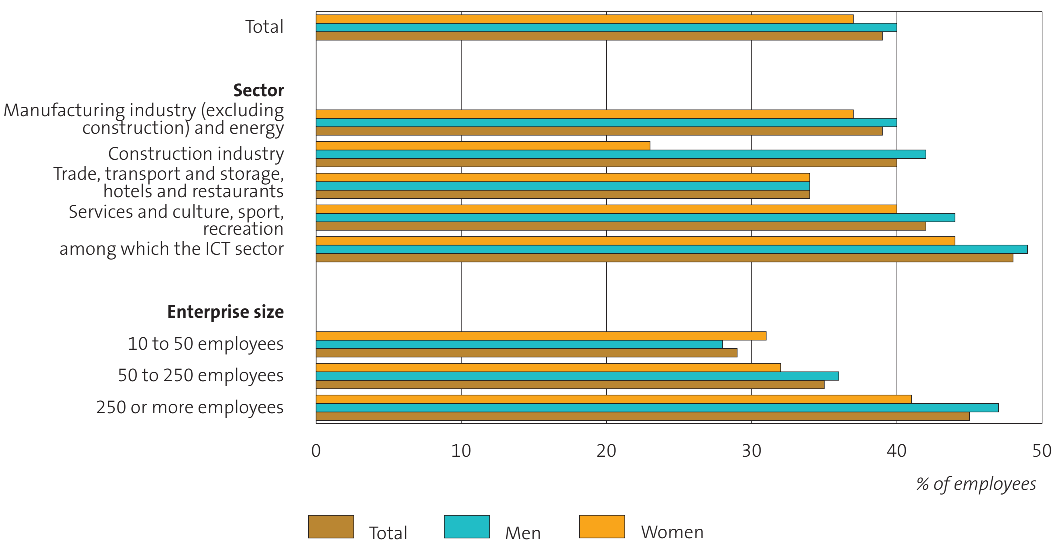
Additional figures with a detailed breakdown by sector are contained in the statistical annex to this publication. The statistical annex can be consulted online at www.cbs.nl/ICT-knowledge-economy. It is evident from the detailed figures that the 'Energy, Water and Waste Management' and 'Specialist Business Services' sectors score highest. Employees in almost nine in ten enterprises in these sectors attended CVT courses. At 46 percent this share was the lowest in the 'Hotels and Restaurants' sector. There are significant differences between large and small enterprises. Large enterprises more often provide CVT courses than small enterprises do. Sixty-four percent of small enterprises (10 to 50 employees) provided CVT courses to their employees. This figure was 94 percent among large enterprises (250 or more employees).

1) Section 2.2 includes a definition of the scope of the ICT sector.

### Four in ten employees take CVT courses

Of the 3.7 million employees in the surveyed enterprise population, over 1.4 million went to CVT courses in 2010. This is almost four in ten employees (Figure 8.1.3). Here too the share of employees varied by sector and enterprise size. In the ICT sector almost half of employees went to CVT courses (48 percent). There are significant differences in the proportions within the sectors included in Figure 8.3.1. This is evident in Table 8.1.2 of the statistical annex. At 62 percent of employees, the 'Energy, Water and Waste Management' sector had the highest relative share of participants. The share of participants was also high in the 'Mineral Extraction' and the 'Lease and Trade in Immoveable Property' sectors (57 percent and 55 percent, respectively). At 24 percent the 'Hotels and Restaurants' sector had the lowest proportion of participants.
The share of participants increases in proportion to the size of the enterprise. On average 39 percent of employees went to CVT courses in 2010. The corresponding figure for large enterprises was 45 percent, for medium-sized enterprises it was 35 percent and for small enterprises 29 percent.

**8.1.3 Employees taking CVT courses, by sector and enterprise size, 2010**




Source: Statistics Netherlands, CVTS 2010.

### More men than women take CVT courses

Men more often attend CVT courses than women do. In total, in 2010 a somewhat higher share of men (40 percent) than women (37 percent) took a CVT course. It is notable that in small enterprises more women than men participated in CVT courses, while significantly more men took a CVT course in larger enterprises. There were significant differences across sectors. This difference was highest in the 'Construction Industry': 42 percent of men versus 23 percent of women. In other sectors there were barely any differences ('Other Services'; 'Transport and Storage') or by contrast a larger proportion of women took a CVT course ('Culture, Sport and Recreation'). Nevertheless, the pattern is that in most sectors more men than women take CVT courses. A possible explanation is that women more often work part-time and employers do not as readily invest in part-time workers. Another possible explanation is the difference in the activities performed by men and women in different business groups. The nature of the job can play a role in an enterprise's decision to provide CVT courses to employees. For example, in the 'Construction Industry' relatively many women work in administrative positions, while construction positions are often filled by men.

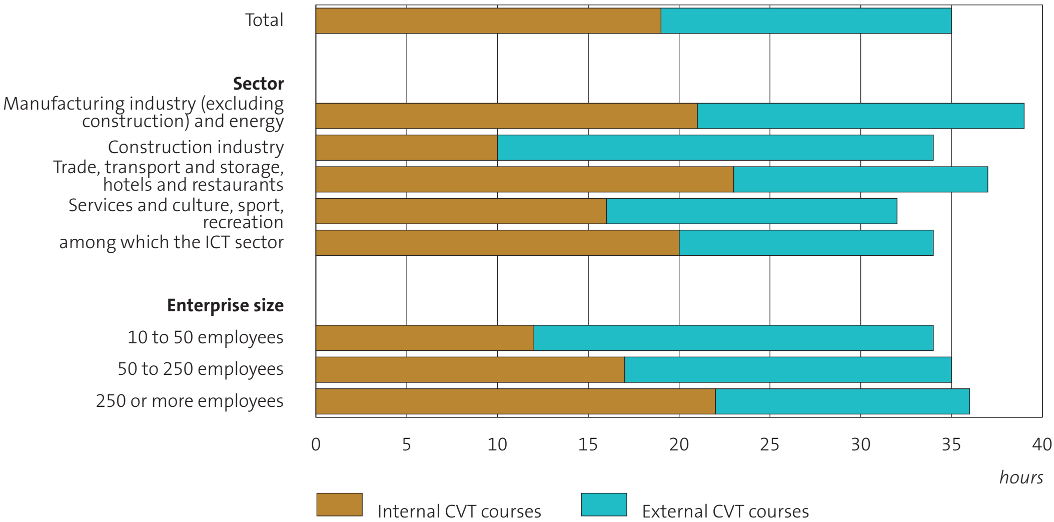
# Large enterprises more often organise internal CVT courses

### Participants spend almost one working week on CVT courses

In 2010, the average participant spent almost a full working week on CVT courses: 35 hours (Figure 8.1.4). Over half of this time consisted of internal CVT courses; the remaining hours were spent on external CVT courses. Internal CVT courses are developed and organised by the enterprise itself.[2)] External CVT courses are designed by other agencies, possibly by a parent company or a subsidiary. At 39 hours, the average participant in the 'Manufacturing Industry (excluding construction) and Energy' sector spent the most time on course. At 32 hours, this figure was lowest in the 'Services and Culture, Sport and Recreation' sector. The variances in terms of enterprise size are minor. The time per participant is approximately 35 hours regardless of enterprise size. It is notable, however, that the proportion of internal CVT courses increases with the number of employees in the enterprise. This indicates that larger enterprises more often organise their own CVT courses, while smaller enterprises more often contract for their CVT courses.

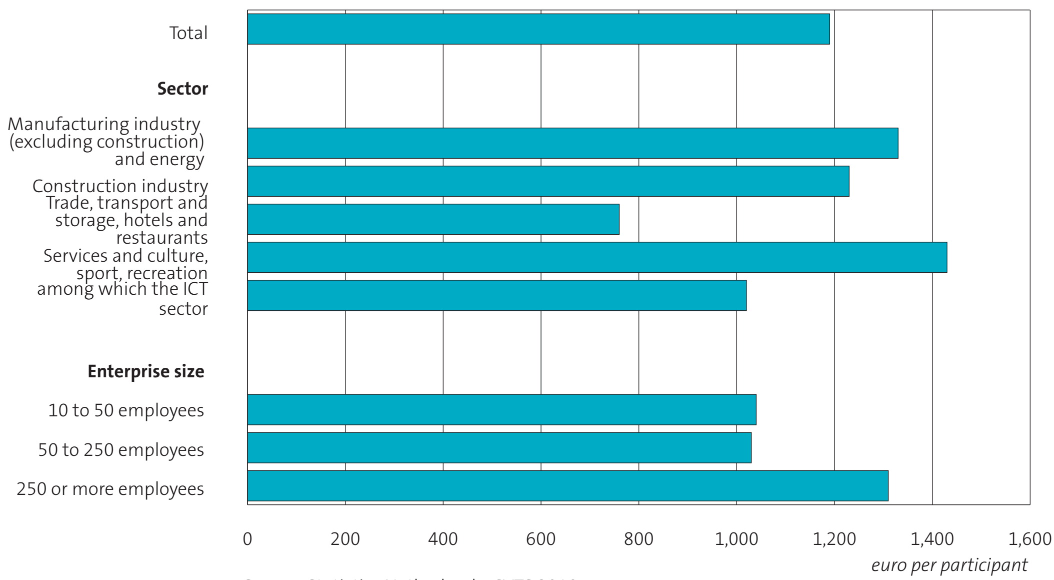
2) Internal CVT courses may be held outside enterprise premises, for example at a conference resort.

## 8.1.4 CVT course hours per participant, 2010




Source: Statistics Netherlands, CVTS 2010.

## 8.1.5 CVT course expenditure, by sector and enterprise size, 2010[1)]



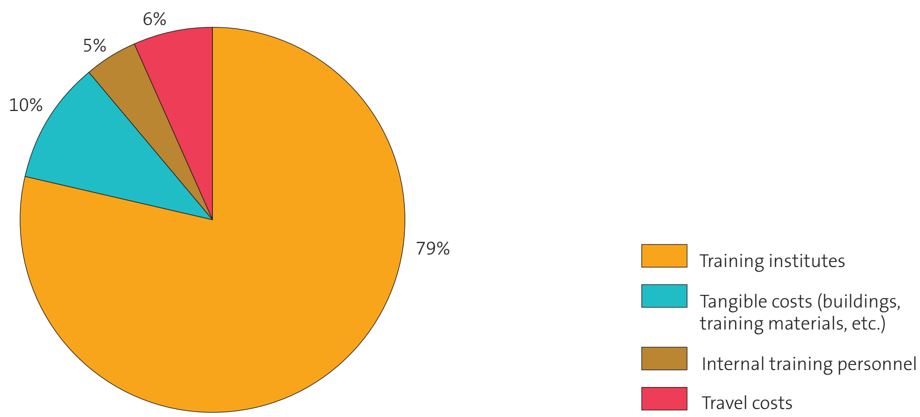

Source: Statistics Netherlands, CVTS 2010.

[1)] Excluding lost working hours.

### Almost 1,200 euro per participant

In 2010, enterprises in total spent over 1.7 billion euro on CVT courses for their employees. This is exclusive of lost working hours. The expenditure per employee amounted to almost 460 euro. Converted to participants this represents 1,190 euro per participant (Figure 8.1.5). The expenditure per participant was highest in the 'Services and Culture, Sport and Recreation' sector (1,430 euro). This equals to 610 euro per employee. At 760 euro, the enterprises in the 'Trade, Transport and Hotels and Restaurants' sector spent the lowest amount per participant (260 euro per employee). The expenditure in the 'ICT sector' was 1,020 euro per participant or 490 euro per employee.
The expenditure per participant was over 1,000 euro in small and medium-sized enterprises. Large enterprises spent approximately 30 percent more per participant (1,310 euro). If the lost working hours are included in the costs, the expenditure on CVT courses amounts to almost double. In 2010, the average expenditure including the lost working hours amounted to 2,270 euro per participant and 880 euro per employee.

**8.1.6 Breakdown of CVT course expenditure, 2010[1)]**




Source: Statistics Netherlands, CVTS 2010.

1) Excluding lost working hours.

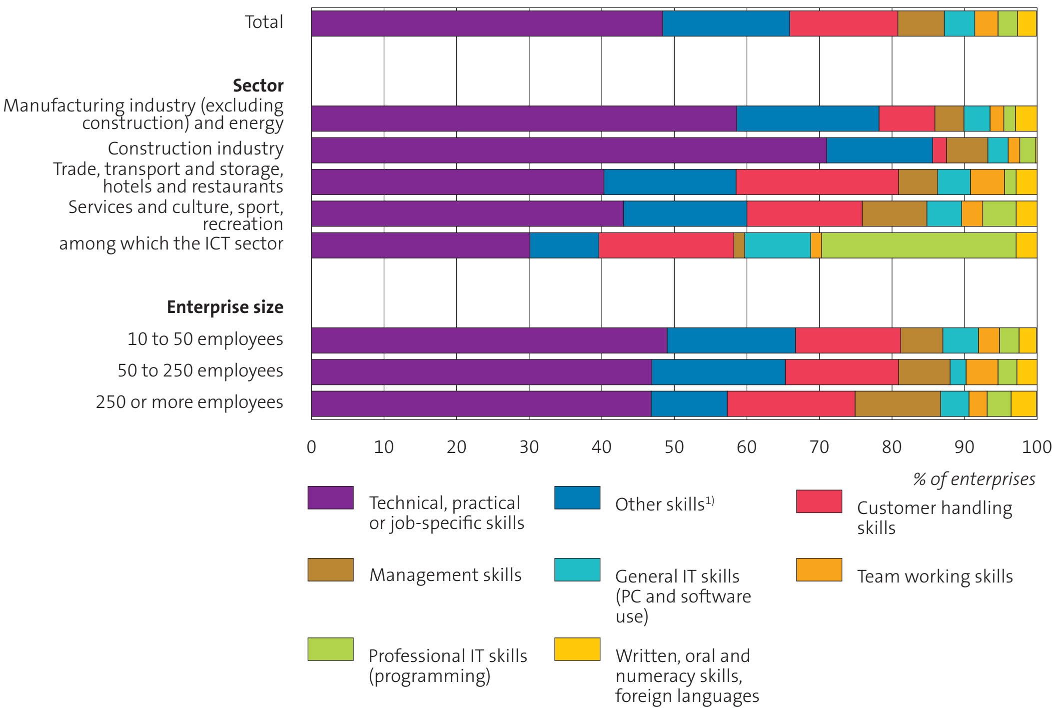
### Spending primarily on external trainers

In 2010, four fifths of CVT course expenditure (excluding lost working hours) was spent on training institutes that organised the CVT courses (Figure 8.1.6). Ten percent was allocated to tangible costs for buildings, equipment and study materials. In addition, 6 percent went to cover travel and accommodation expenses related to the CVT courses. The remaining 5 percent was for the labour costs of internal personnel organising the CVT courses.

### Most attention was focused on technical, practical and job-specific skills

In almost half of enterprises (48 percent) most CVT course hours were devoted to developing technical, practical and job-oriented skills (Figure 8.1.7). For 15 percent of enterprises, customer handling skills was the subject to which most training time was allocated. Management skills was the most important course subject for 6 percent of enterprises. Only a small proportion of enterprises spent the most CVT course time on other skills, such as IT skills, written, oral and numeracy skills. Of all enterprises, 18 percent spent the most CVT course time on skills other than those mentioned above. These probably involve very specific skills focused on the enterprise itself.

### 8.1.7 Most important CVT course subjects, 2010

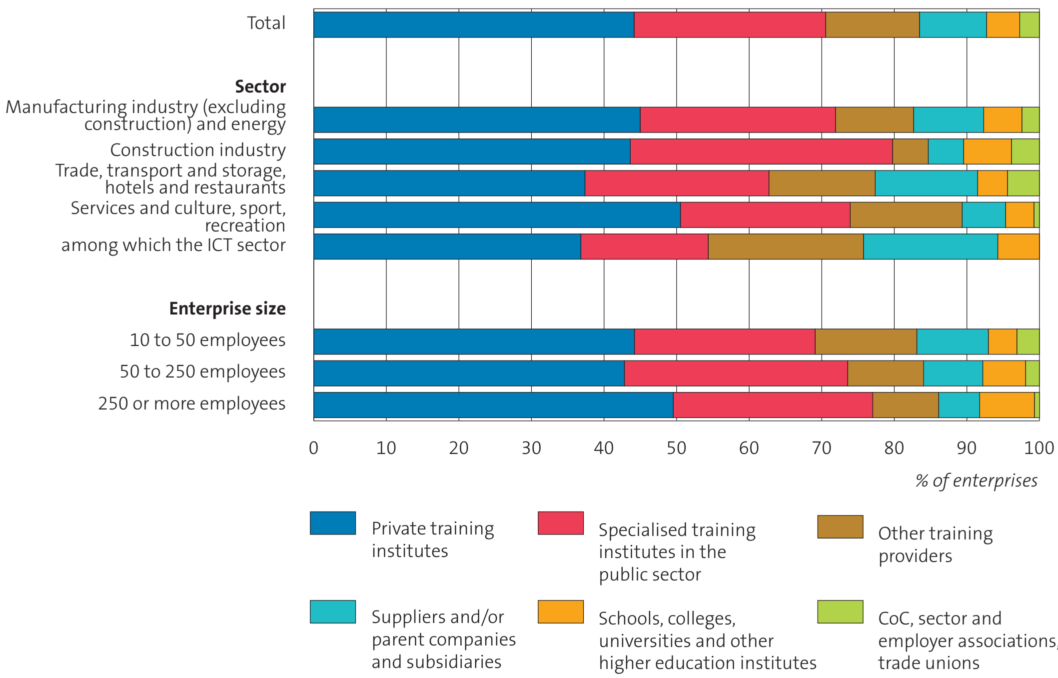



Source: Statistics Netherlands, CVTS 2010.

[1] The Other Skills category includes elements such as administrative skills and problem solving skills.

In the 'Construction Industry' almost 70 percent of enterprises devoted most CVT course time to technical, practical and job-oriented skills. A large number of enterprises in the 'Manufacturing Industry (excluding construction) and Energy' sector also spent the most time on these subjects. The corresponding percentage in the 'ICT sector' was 30 percent, while 27 percent of enterprises devoted most of their CVT course time on IT skills. In the 'Trade sector' 40 percent of enterprises allocated most CVT course hours to technical, practical and job-oriented skills, while 22 percent invested most of their CVT course time in customer handling skills. From these sector-specific differences it is evident that the subjects in which enterprises invest most CVT course time are dependent on the activities in which these enterprises are involved.
There are no major differences between large and small enterprises in terms of the most time-intensive CVT course subjects. It is striking, however, that large enterprises more often invest most of their CVT course time in management skills than do small enterprises.

### 8.1.8 Most important executing agency for external CVT courses, 2010




Source: Statistics Netherlands, CVTS 2010.

## Most CVT courses are provided by private institutes

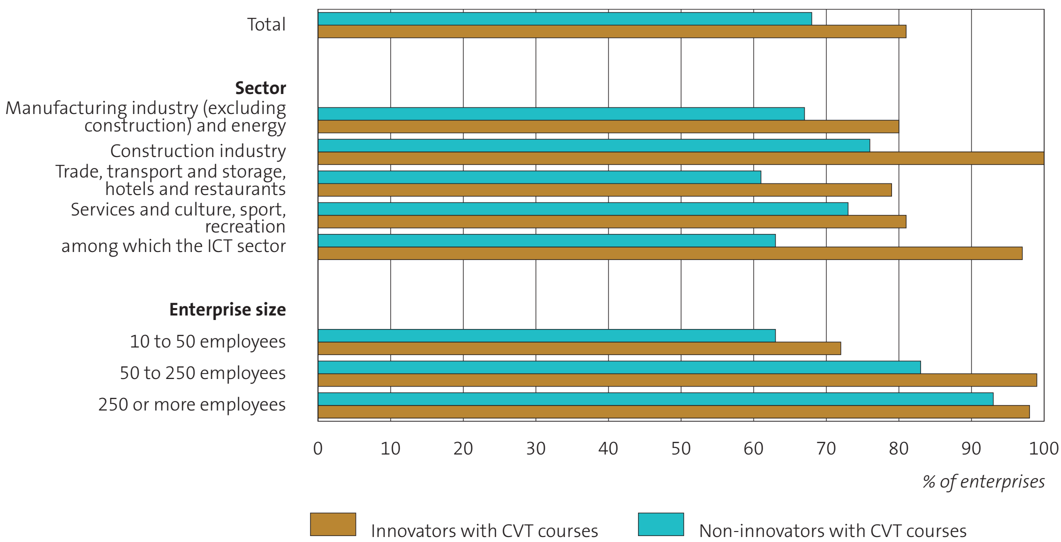
In 2010, enterprises allocated almost half (47 percent) of all CVT course time to external courses, designed and organised by external training agencies. Parent enterprises and subsidiaries are also considered external in this respect.
Private training institutes most often organise external CVT courses: in 2010 this was the most commonly used form of external CVT course in 44 percent of enterprises (Figure 8.1.8). In over one quarter of enterprises (26 percent) most external CVT courses were provided by specialised training institutes from the public sector, such as Regional Training Centres (ROCs). In almost one in ten enterprises most CVT course time was organised by the suppliers of installations, machines and equipment and/or parent enterprises and subsidiaries. Higher education institutions, and sector and employer associations were less frequently the most important supplier of CVT courses.

## Innovative enterprises offer more CVT courses

The CVTS asked enterprises whether they were engaged in innovative activities in 2010.[3] In this case, innovative activities include the introduction of new or significantly improved goods or services and the application of new or significantly improved production processes.[4] This makes it possible to present data about vocational training separately for innovators and non-innovators. The findings indicate that innovation is a differentiating characteristic for enterprises in terms of vocational training. Innovative enterprises more often provided CVT courses than non-innovative enterprises (81 percent versus 68 percent). This applies to all sectors, as well as the different enterprise sizes. It is striking that in the ICT sector the innovators were above average in terms of offering CVT courses while the non-innovators scored below average.
Innovators barely spent more on each participant (1,220 euro) than non-innovators (1,180 euro). In the 'Trade, Transport and Storage, Hotels and Restaurants' sector innovators spent noticeably more than non-innovators: 1,000 euro versus 670 euro per participant. By contrast, non-innovative enterprises in the 'Services and Culture, Sport, Recreation' sector and in the 'ICT sector' spent more on CVT courses per participant than their innovative counterparts. Non-innovators among the smallest and largest enterprises spent more on CVT courses per participant than innovators. The reverse was true for medium-sized enterprises.

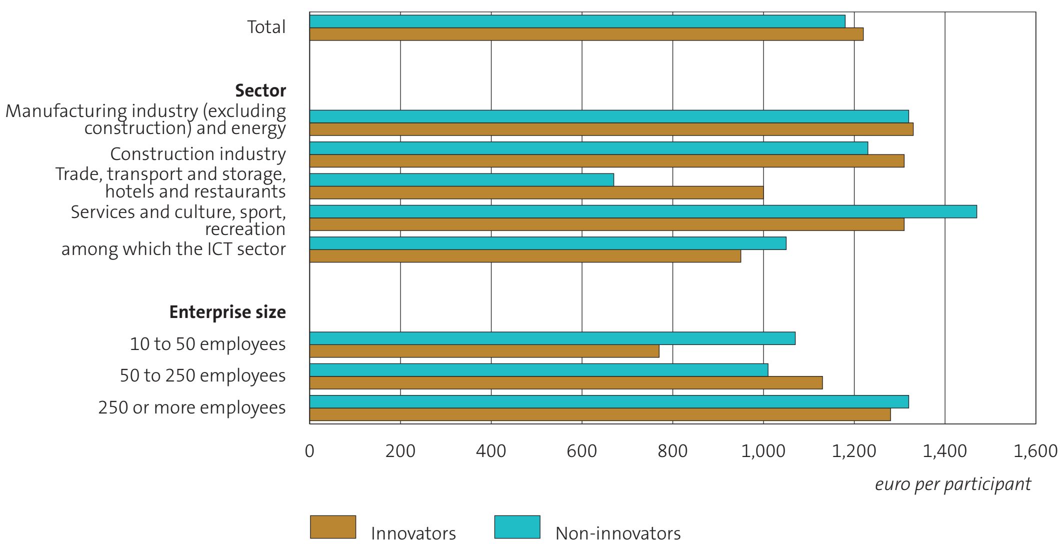
[3] This data is not entirely consistent with the findings of the Statistics Netherlands Innovation Survey. The reporting period of the Innovation Survey is three years (2008–2010); the reporting period of the CVTS is exclusively limited to 2010. In addition, each survey uses a different sample and somewhat varying populations.
[4] Chapter 6 contains more information about innovation in enterprises.

### 8.1.9 Innovators and non-innovators with CVT courses, 2010




Source: Statistics Netherlands, CVTS 2010.

### 8.1.10 Expenditure on CVT courses, innovators and non-innovators, 2010

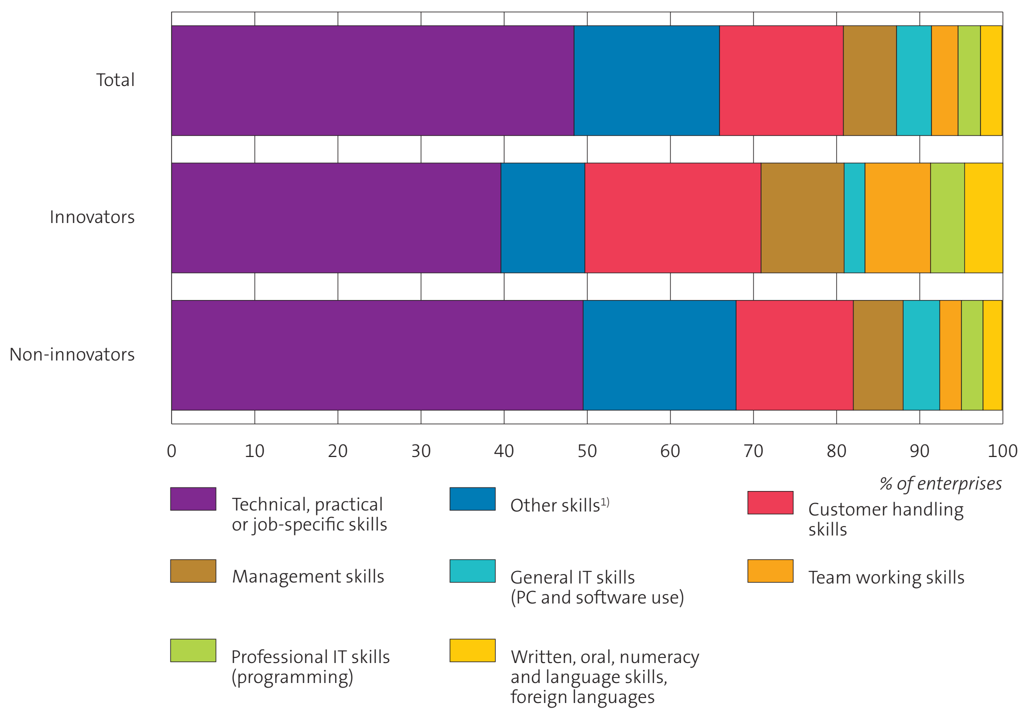



Source: Statistics Netherlands, CVTS 2010.

**Innovators focus more of their training on customer-handling skills**

In 2010, innovators, more often than non-innovators, invested most of their CVT course time in customer handling skills (21 versus 14 percent), management skills (10 versus 6 percent) and team working skills (8 versus 3 percent). The increased interest in these three subject areas was at the expense of the technical, practical and job-specific skills, among other things (40 versus 49 percent). The latter category was also the most important for innovators, however.
Additional figures about CVT provided by innovative enterprises are contained in the statistical annex to this publication. The annex can be consulted online at www.cbs.nl/ICT-knowledge-economy.

**8.1.11 Most important CVT course subjects, innovators and non-innovators, 2010**




Source: Statistics Netherlands, CVTS 2010.

[1] The Other Skills category includes elements such as administrative skills and problem solving skills.

# 8.2 The internet as a data source for producing statistics

*This contribution describes some of the results of the programme 'Impact ICT', which is conducted by Statistics Netherlands in 2011 and 2012. This innovative two-year programme is set up to investigate the extent to which the internet can be used as a new data source for producing statistics. In addition to the potential benefits and drawbacks of using the internet as a data source, this article also addresses the methodological aspects involved in such an innovative data collection method. This is illustrated in more detail by three examples.*

*Authors: Nico Heerschap and Andries Kuipers, Statistics Netherlands*

**Introduction**

The internet has become an indispensable infrastructure for society. A growing proportion of our supply of information, communication and economic transactions are now conducted via the internet. This is increasingly blurring the distinction between the physical and the virtual world. The internet has been fully integrated into our society. This does not only mean that Statistics Netherlands needs to produce statistical information about the nature and scope of the use of internet. It also means that it has become useful to investigate to what extent the internet itself can be used as a data source for producing statistics. This is possible because internet activities leave behind digital footprints that can be observed using new technologies, 24 hours per day, 7 days per week. The research is also relevant because the internet contains a growing amount of useful information. The available information does not need to be related only to the internet as a phenomenon, but can also pertain to data about the 'old economy'. A few examples of this are the prices of goods and services, the characteristics of homes and the number of job vacancies where the internet fulfils an important intermediate function. The main questions are: what internet data can be used for producing new statistics, for the integration into existing statistics or to potentially entirely replace existing statistics and traditional methods of data collection.

**The internet as a data source: concept and measurement techniques**

The internet as a data source (IaD) first of all concerns innovative techniques for searching for and retrieving information available on the internet. The data collected this way can

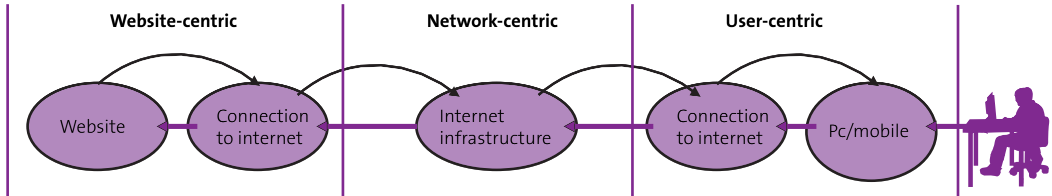
then be used to produce statistics, generally after editing the data. An example of this is the collection of prices of goods and services on the internet using special software ('internet robots') for the purpose of calculating inflation figures.
IaD also includes techniques that can observe and record internet-related activities of individuals who use the internet as a communication vehicle. These kinds of techniques therefore do not solely use the internet as a source of data. An example of this is the installation of software ('apps') on mobile telephones that enables the use of these phones by participants to be recorded. Other examples include the use of information stored on tags (RFIDs) during the transport of goods or containers and the use of software to measure the actual speed of an internet connection and the associated type of internet connection.
To structure all the possibilities provided by IaD, these techniques are divided into three groups, see Figure 8.2.1 (Dialogic, 2008):

1. *User-centric approach*. This concerns the installation of software ('apps') on mobile devices, such as smartphones and tablets, as well as desktops. The software in the background records, among others, the user's internet surfing, calling and SMS behaviour, the location (GPS) and the time at which the activities take place. This is referred to as \`self-filling questionnaire\`. The information is encrypted and automatically transmitted via a (mobile) internet connection to a highly secure central storage facility that serves as the basis for analysing the data. An entirely different possibility is the use of smartphones as a new platform for obtaining information via an internet questionnaire. In this case, the user him/herself actively answers questions.
2. *Network-centric approach*. This consists of the measurement of data flows at various internet hubs. This can involve the measurement of the quantity of data that flows past that point, the data's origin and its destination. It may also involve analysis of the data's content. In the latter case this technique is referred to as deep packet inspection (DPI). This technique is rather sensitive from a privacy perspective.
3. *Website-centric approach*. This concerns the use of software (internet robots or crawlers) that search the internet for the desired information. It can involve a single or multiple websites. It can also involve scanning ('scraping') a segment of the internet, for example the Dutch language segment.

**Non-technological aspects at least as important**

IaD is more than a set of innovative technologies. It especially concerns the processes and the methodology underlying the technology, such as the translation of unstructured data contained on web pages into useful statistical information, the categorisation and standardisation of the collected data, the removal of duplicate data, the ability to process and analyse large quantities of data ('big data'), the recruitment of sufficient participants (smartphone studies) and especially the translation of internet data into representative

### 8.2.1 Overview and examples of IaD techniques




**Website-centric**

*Examples:*
- Robots/spiders
- Acquisition of data from the website owner
- Use of website search terms or search engines
- Use of social media information
- Measurement of data flows at the transition to the internet infrastructure (see DPI)

**Network-centric**

*Examples:*
- Measurement of data flows
- Measurement of the origin and destination of data flows
- Deep packet inspection (DPI): inspecting the content of data flows

**User-centric**

*Examples:*
- Pure self-filling questionnaire
- Self-filling questionnaire supplemented with questions (pop-ups)
- PC or smartphone as the survey platform, supplemented with the registration of the location
- Measurement of data flows at the transition to the internet infrastructure (see DPI)

Source: Dialogic, 2008.

statistical information. In short, in addition to the technology, IaD primarily concerns the processing of the collected internet data and the associated methodology required to arrive at representative statistics for a country, population group, a sector or a certain phenomenon. The desired statistical output ultimately is the determining factor.

Finally, IaD has a legal dimension. To start with, there are laws related to copyrights and database law that set limits in terms of what individuals or organisations can retrieve from the internet and what they can use, process and publish. In addition, privacy and the confidential treatment of collected internet data play a role. For example, Statistics Netherlands is required to report any surveys that involve the data collection of personal data to the Statistics Netherlands Data Protection Official in advance. This Official acts as the representative of the Dutch Data Protection Authority (CBP). If so requested, a Privacy Impact Assessment (PIA) must be carried out. This involves the identification of objectives, risks and the implemented risk control measures. Provided that all legal matters have been properly addressed, this does not need to be an obstacle preventing the use of IaD.

The use of IaD outside statistical agencies is already a common practice. IaD is also increasingly attracting the attention of policymakers and institutions such as the Netherlands Bureau for Economic Policy Analysis (CPB), De Nederlandsche Bank (DNB) and the Netherlands Institute for Social Research (SCP).[5)] IaD is also increasingly viewed as a good possibility by the scientific world, especially for producing fast and new statistics, as well as for supplementing already existing statistics.

### Potential IaD benefits

The use of IaD potentially has a wide range of benefits:

1. *Fast(er) statistics*. Since observation is almost real-time, it is not only possible to publish statistics faster and more often, it is also possible to identify new developments, trends and turning points faster. For example, the start of a crisis or a reversal on the labour market.
2. *New statistics*. By installing software on smartphones it is, for example, possible to measure upload and download speeds or calling behaviour, in addition to the frequency and duration of the use of mobile services. These are variables that are difficult or impossible to measure using traditional surveys.
3. *Greater detail and improved quality*. Due to the high volume of information that is often available on a single subject on the internet, it becomes possible to publish at a more detailed level, for example by region. The link with existing statistics makes it possible to improve the quality of the statistics themselves. The quality of the data is also improved because IaD measures the actual behaviour instead of asking about the perceived behaviour after the fact.
4. *Reduced or no burden*. Since respondents are not asked any questions, there is no burden or in the event of the (partial) replacement of the traditional data collection, the existing burden can be reduced. This last point does not only involve the replacement of existing questions or surveys with internet observation. By using internet data as supporting information it also becomes possible to reduce the sample size for an existing survey or allocate it more efficiently.
5. *Potentially lower operating costs*. Since the data collection uses a higher degree of automation, less human effort, for example, is required for the data collection process.

### Actual practice

The experience gained by Statistics Netherlands over the last year with a number of IaD-related pilots shows that actual practice is unruly. Sometimes, at the start of a project it seems that the benefits are ripe for the picking, while in actual practice this often turns

[5)] At DNB the focus, among others, is on the Billion Prices Project (BPP) of the Massachusetts Institute of Technology. This project focuses on the data collection of prices of products and services on the internet. This information is used to calculate the consumer price index and inflation figures on a daily basis http://bpp.mit.edu. The SCP is focused on a pilot involving smartphone measurements.

out to be somewhat disappointing. Generally this is not due to the technology, but much more so due to the processes required to ultimately transform the raw internet data into sound statistics. Possibilities differ sharply by IaD technique and by area of application. For example, the use of internet robots for collecting information about job vacancies posted on the internet as yet does not yield any satisfactory results. In spite of the high volume of internet job vacancies, the representativeness of these data appears to be rather poor and as yet no methods have been found to properly correct for this. On the other hand, the use of internet robots for the collection of prices of products and the characteristics of homes available for sale does seem to offer sound statistical opportunities.
So it is clear that there are opportunities for using IaD for producing statistics or as a supplement to existing statistics; however, serious hurdles remain to be overcome.

### Pilots

Statistics Netherlands began experimenting with IaD in 2009. The experiments involved the collection of prices for airline tickets and petrol with the aid of internet robots (Bosch et al., 2010). Although the experiment in itself was a success, it was discontinued because the costs of the development and deployment of internet robots were much higher than the costs of the manual collection of a few prices each month.
Research was initiated in 2010 into the statistical possibilities of using the location data of mobile telephones (De Jonge et al., 2012). In addition, the possibility of using Twitter by analysing tweets (short text messages) was investigated[6]. At the end of 2010 a number of IaD pilots were bundled under a two-year research programme 'Impact ICT'. This temporary programme (2011–2012) serves as a driver. The objective is to research the possibilities of applying IaD with a specific focus on actual statistics such as the information society, the internet economy, job vacancies, price observation, the housing market and transport and logistics. The programme is jointly financed by the Ministry of Economic Affairs, Agriculture and Innovation. Table 8.2.2 displays the projects that entered the execution phase within the programme in 2011 and 2012.

### The initial experiences with IaD

A number of IaD pilots were executed in the context of the 'Impact ICT' programme in 2011. The key experiences are presented below.

[6] See Daas et al. (2011).

### 8.2.2 Projects and results of the 'Impact ICT' programme, 2011–2012

| Project | Proof of concept successful? | Continued in 2012? | Favourable candidate for implementation? | Comments |
|---|---|---|---|---|
| **1. Mobile telephone and smartphone studies** | | | | |
| – Smartphone measurement as a self-filling questionnaire | Yes | Yes | +++ | Challenges: recruitment of respondents (privacy aspect), recruitment of a representative panel and the quality of the required infrastructure and software. |
| – Smartphones as a survey tool | Unknown | Start 2012 | Unknown | Continuation of research dating from 2010. |
| – Location data of mobile telephones | Unknown | Start 2012 | Unknown | Data of an external party. |
| **2. Infrastructure and broadband access** (app on desktops) | Yes/No | No | No | Data of an external party available over the period 2003–2010. Technique (self-filling questionnaire) is easily deployable, however representativeness of self-selected panel is not guaranteed. |
| **3. Internet robots** | | | | |
| – Price observation | Yes | Yes | +++ | Own internet robots deployed. |
| – Housing market | Yes | Yes | +++ | Own internet robots deployed. The usefulness of third party internet data about the housing market is currently being assessed. |
| – Job vacancies | Unknown | Yes | + | Data from an external party. Challenge: representativeness of the data. Further research will be conducted in 2012 on the basis of a number of developed scenarios. |
| – Web shops | Yes | No | - | For figures about web shops in the context of the internet economy, the data about the SIC 47.91 group and other SIC groups in the retail trade sector in which companies are asked to break down their sales by sales channel, including the internet, will be used first. In addition, research will be conducted into alternative sources within and outside Statistics Netherlands. |
| **4. C-to-C market** | Yes | Yes | ++ | (Internet) statistics can be developed on the basis of the data from an external party. Challenge: representativeness of the figures. |
| **5. Track and trace** | Unknown | Yes | Unknown | The project is still in the research phase. |
| **6. Internet panel** | N/A | Start 2012 | Unknown | Start in 2012. Concerns a preliminary analysis. |

Source: Statistics Netherlands.

1. IaD does not have to involve new or fast statistics. There are also good opportunities in combining internet data with existing statistics. For example, the internet can provide supporting information for producing greater detail, better quality and a smaller random sample. In addition, internet data could serve to compose fast indicators for tracking developments and trends ('beta indicators'). The possibility of linking internet data to existing statistics or delineated population groups significantly increases the probability of successful applications.

2. There would appear to be good opportunities related to the use of internet robots for price observation and the housing market. In addition, the use of smartphones also has potential as a self-filling questionnaire or as a new survey platform. The fact that smartphone studies can record location data and time also offers opportunities for statistics that are somehow related to mobility and location, such as mobility behaviour, use of time, tourism and transport. One challenge related to smartphone studies is the recruitment of sufficient numbers of respondents prepared to participate in these types of studies and consequently the possibility of composing representative figures.
3. Many IaD projects run into the problem of representativeness. Without a link to existing statistics or frameworks, it sometimes remains unclear exactly what was observed and what the quality of the observation was. The technology and the collection of the internet data itself is often not the largest problem encountered by IaD applications. Based on the collected and processed internet data fast and/or new internet statistics can often be created. However, the question remains whether these can ultimately meet the quality criteria Statistics Netherlands imposes on itself. The challenges that play a role in this regard include the translation of unstructured data (contained on web pages for example) into useful statistical information, removal of duplicate data (job vacancies and housing) and classification and categorisation. The challenge therefore is not only related to the data collection, it is far more often related to the methodology used in the processing and analysis phases.
4. The methodological challenges related to IaD not only pertain to aspects of representativeness, but also to the problem of dealing with large quantities of data ('big data'), linking data sets, dealing with mixed mode observation and substantive statistical matters. The latter for example concerns estimates based on proxies, estimates based on trends, the development of beta indicators (of lesser quality) and the development of new statistics, such as new methods for calculating consumer price index figures.
5. IaD offers opportunities for improving the quality of statistics. For example, it enables actual behaviour to be measured rather than inquiring about perceived behaviour after the fact. By relating internet data to existing statistics, it is also possible to improve the statistics qualitatively. On the other hand, as indicated, a fair bit of processing of the collected internet data is required to come up with acceptable statistics. During such processing, assumptions are often made that have not been or cannot be properly tested. This affects the quality of the ultimate statistics. During the production of beta indicators concessions are often made in terms of the quality of the figures in favour of speed.
6. A reduction in the burden imposed on companies is an important IaD benefit. Opportunities in this regard are still being investigated in 2012. The burden on individuals can also be limited, for example through the use of apps on smartphones, tablets or desktops.

7. Finally, it should be noted that the traditional way of producing statistics does not always go hand in hand with the implementation of IaD. The use of IaD requires a different way of thinking. The starting point is the unlimited quantity of data on the internet from which the desired statistical information is to be extracted. This could require concessions to be made in terms of representativeness. The available internet data often do not exactly match the variables defined for the output. This means that proxies have to be used (approximations). Finally, internet data is a better fit for statistics that describe trends than for measuring levels. When it comes to measuring levels it would appear that traditional methods are more suitable. This is precisely why the combination of internet data with existing statistics offers good opportunities.

**Examples from actual practice**

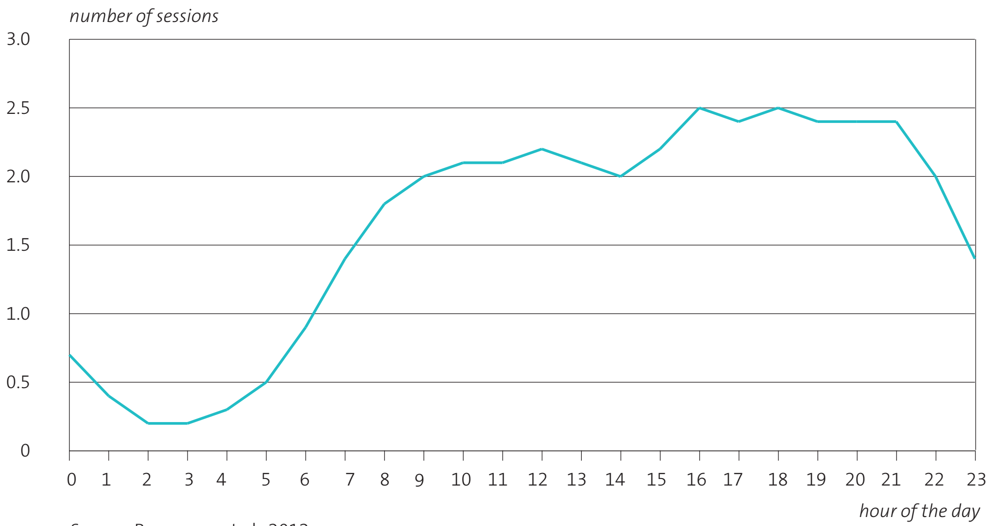
The next segment of this article provides three practical examples of the application of IaD. The examples describe the experience gained by Statistics Netherlands through means of pilot studies in this area.

**Example 1: Smartphone measurements**

Smartphones make it possible to collect data and to obtain insight into, for example, consumer behaviour or mobility in innovative ways. Projections call for more and more people to become owners of such intelligent mobile telephones.[7)] In 2011, Delft University of Technology carried out a pilot for Statistics Netherlands that involved the tracking of 130 volunteer smartphone owners for a month on the basis of a research app these volunteers installed on their mobile telephone (an app as a self-filling questionnaire). This pilot was successfully completed at the end of 2011. A separate report was produced that extensively covered this research and the associated results (Bouwman et al., 2012).
The data logs obtained via the smartphones provide good insight into various aspects such as the frequency and the duration of the use of mobile services (Figures 8.2.3 and 8.2.4), visits to websites (surfing behaviour), calling and SMS behaviour, data consumption and traffic, and internet connections. In addition, the location was recorded every five minutes.
Experiments were also conducted with a number of so-called ‘pop-up surveys’ during the research. That is to say, immediately after the use of an application on the smartphone the respondent was asked additional questions about his/her motivation to use that specific application. In the case of this research, these pop-up surveys were invoked after the use of

7) In 2011, half of households with internet access used a mobile telephone for this purpose. Chapter 4 extensively deals with a variety of topics, including the use of the mobile internet by households and individuals.

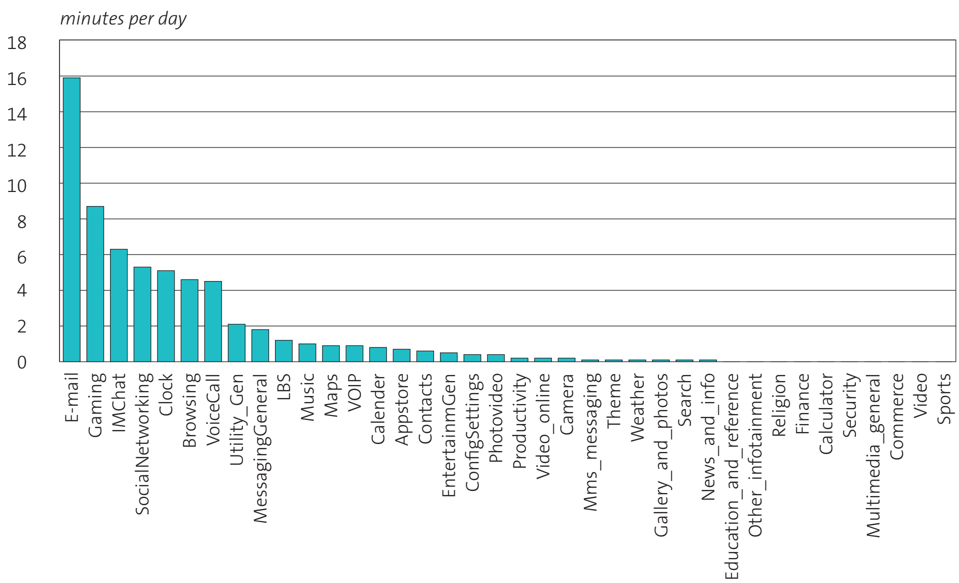
## 8.2.3 Smartphone use: number of sessions per user, by hour of the day[1)]




Source: Bouwman et al., 2012.

1) Average over 28 days; n=128; figures are not necessarily representative.

## 8.2.4 Smartphone use: duration per type of mobile service[1)]

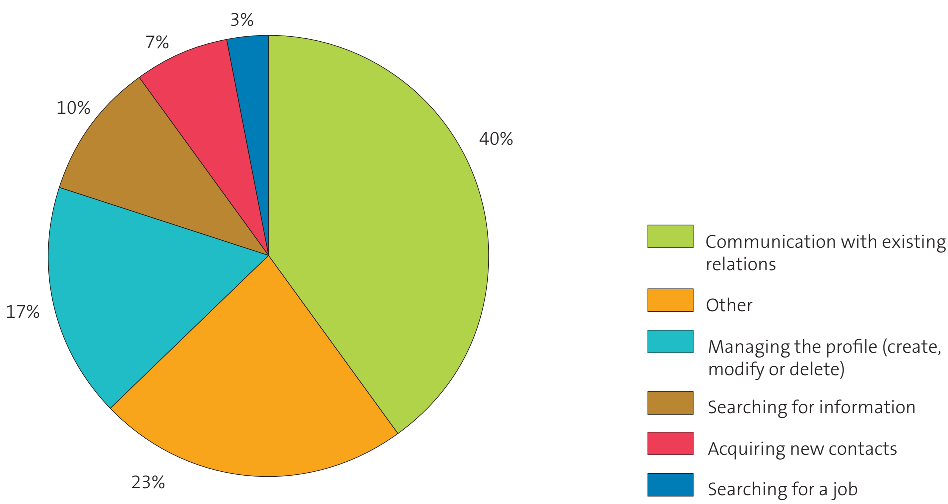



Source: Bouwman et al., 2012.

1) Average over 28 days; n=128; figures are not necessarily representative.

social media. In addition, respondents were asked about their motivations in complementary surveys. These surveys were also used to ask participants about their opinion about the research and to make a comparison between what the respondent does (smartphone measurements) and what the respondent says he/she is doing (traditional survey).
This new method of data collection, using a combination of smartphone measurements, pop-up surveys and complementary surveys, provides a very rich and reliable collection of data. Firstly, it provides good opportunities for conducting research into behaviour related to mobile services or internet surfing, and, for example, social cohesion (Figure 8.2.5). Secondly, it enables research with a location or mobility component to be conducted, such as mobility behaviour, use of time, tourism and spatial research.
This method of using smartphones has the potential of taking scientific research to a higher level. The smartphone measurements provide insight into actual behaviour; the pop-up surveys and the complementary surveys provide insight into motives and other variables that cannot be observed using smartphone measurements. Important benefits are the new research possibilities (including frequency and duration), better data quality, greater detail and a minimum burden for the respondent.

### 8.2.5 Reasons for using Facebook[1)]




Source: Bouwman et al., 2012.

[1)] Concerns pilot research: figures are not necessarily representative.

The participants in the research were generally positive about their participation in the study and would be prepared to participate again in the future. They also indicated that they barely modified their behaviour while they were being tracked. On the other hand, privacy was a key reason for potential participants to refuse to participate in the study or to opt out during the study. It is therefore important for a follow-up study that during the recruitment of respondents even more attention should be devoted to privacy and guarantees that the collected data logs will be treated as confidential and will be properly secured. This is necessary in order to obtain a sufficient number of participants. Otherwise it will be difficult to generate representative figures.

**Example 2: Internet robots**

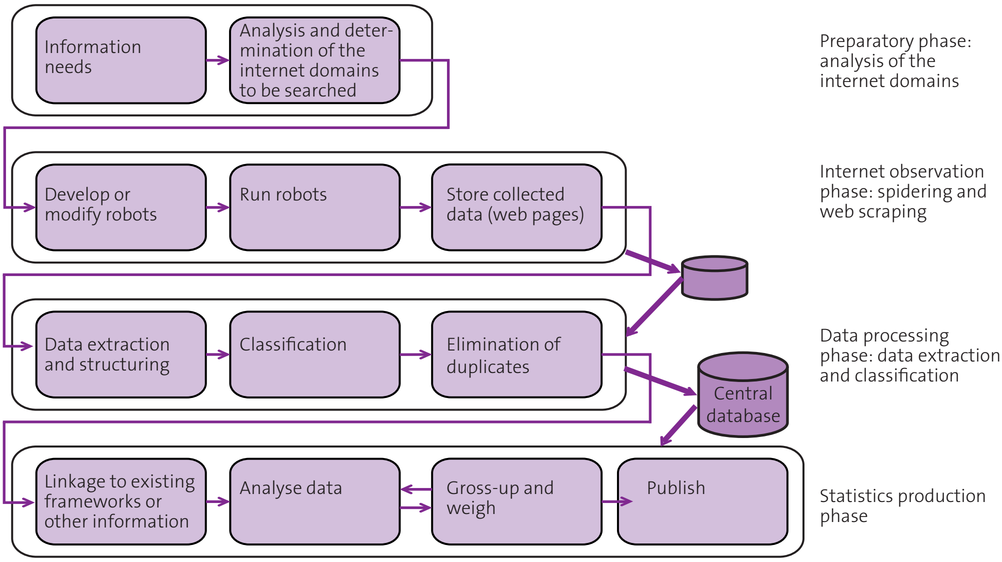
Another area with a great deal of potential for the application of IaD techniques is the use of internet robots, also referred to as 'crawlers' or 'spiders'. This involves software that searches the internet for the desired information, retrieves it and then stores it in a central database. The search for information may be limited to one or multiple websites, for example ads for homes that are for sale or websites that post job vacancies. It can also involve scanning a large segment of the internet, for example the Dutch language segment ('web scraping'). For example, this may involve searching for all web pages that contain the words 'home' or 'job vacancy'. Such searches can be conducted 24 hours per day, 7 days per week.

The data stored in the central database then form the basis for producing statistics (Figure 8.2.6). However, before statistics can be produced, a series of operations must usually be performed on the data. First, the desired information must be extracted from the retrieved web pages. This data must then be structured and if necessary, classified, so that, for example, a single record is created for each internet job vacancy with the company name, address, region, job vacancy title, number of working hours and required educational level. It is also possible that the job vacancy is posted at more than one website. To obtain a dataset with unique job vacancies requires the duplicates to be removed.

Based on the dataset that is created this way, fast and new statistics can in fact be created on the basis of so-called beta indicators. These statistics do not necessarily have to be representative. For example, companies are not likely to post all of their job vacancies on the internet. Better opportunities are created when the collected internet data can be linked to existing statistics or delineated population frames. For example, homes that are for sale can relatively easily be linked to data in the land registry. The same only applies to a limited degree to job vacancies because the job posting does not always include an address, for example. For an elaborate report of the research into the possibilities and impossibilities of developing job vacancy statistics via the internet, the reader is referred to the final report on this pilot (Heerschap et al., 2012).

Another example of the use of internet observation with the use of internet robots is the data collection of prices of goods and services. Statistics Netherlands began experimenting

### 8.2.6 Producing statistics using internet robots




Source: Heerschap et al., 2012.

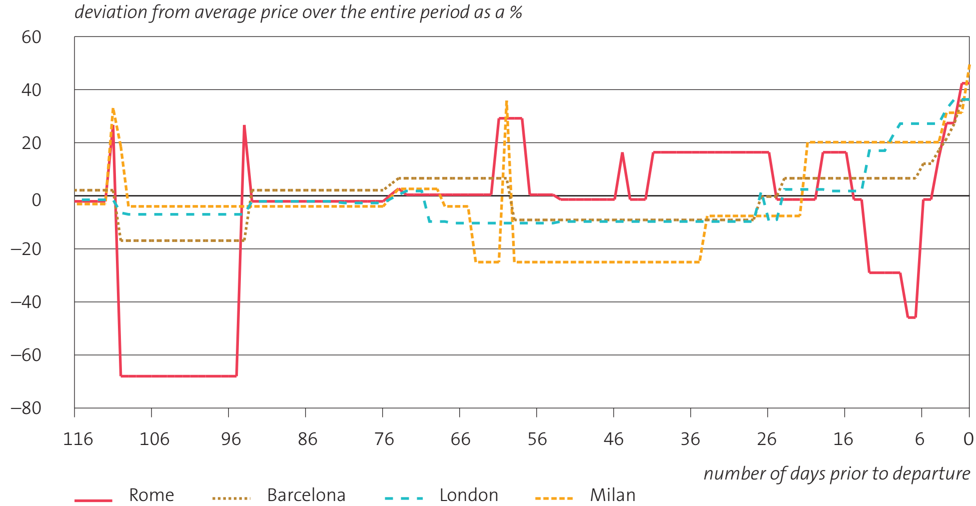
in this area in 2009. The first area subjected to pricing observation was the price of airline tickets. These prices are currently manually observed each month at the same point in time. Data collection using internet robots was further expanded in recent years to include the prices of petrol, cinemas, driving schools and clothing.

Price observation using internet robots makes it possible to observe more prices over a longer period of time. An advantage of this approach is that developments and trends can be identified much faster. For example, it should be possible to compose consumer price index figures or inflation figures on a daily basis. This creates a completely different picture of the price of a product or service. For instance, the prices of airline tickets vary sharply over a longer period (Figure 8.2.7). That raises the question what the ‘actual’ selling price of that product really is.

In addition to new possibilities, greater detail and especially faster data collection and publication, this method of internet observation can also reduce the burden on companies. Indeed, they no longer need to be asked to supply price information.

In addition to these benefits, the key question here too is: how representative is the price information observed on the internet. The assumption is that the difference between internet prices and prices in the physical world is increasingly blurring. Furthermore, it makes sense to primarily look at trends. The pros and cons must be considered of, on the one hand, the current situation using a limited number of observations at a specific point in time and, on the other hand, a large number of internet observations spread over a longer period.

**8.2.7 Example of price observation using crawlers: prices of airline tickets from 116 days prior to departure**




Source: Bosch et al., 2010.

In summary: the use of internet robots as an instrument of data collection has a large number of benefits, such as faster statistics on the basis of beta indicators, more detail, less administrative burden for companies and probably lower operating costs. However, depending on the area of application a great deal of work remains before reliable statistics can be produced. This is not so much due to the technology used, but rather due to the methodology involved in the subsequent processing steps. In particular, the step from statistics based on internet data to representative statistics is relevant. One option is to start by publishing fast beta indicators of lesser quality that nevertheless do provide some insight into trends and developments. The need for fast figures on the part of policymakers is high, especially in times of crisis. Furthermore, the internet data can serve to support existing statistics and as a means of reducing the burden imposed on companies.

### Example 3: Infrastructure and broadband access

A third example concerns the data collection of the speed of an internet connection using a self-filling questionnaire (CBS et al. 2012). There are various research agencies and companies that offer the possibility of installing a programme over the internet that measures the actual speed of an internet connection at a specific point in time. It is important to Statistics Netherlands to gain insight into such measurement methods. This specific case is relevant because it appears to be increasingly difficult for respondents to the Statistics Netherlands' survey *ICT use by households and individuals* to answer the question concerning the type of internet connection. In addition, the question in its current form is losing its value. This is because the question only focuses on the type of internet connection (ADSL, cable and the like). In 2011, 89 percent of households with internet access already had a broadband connection. The type of connection therefore is no longer a differentiating characteristic that can, for example, be used to explain differences in internet use. Indeed, the term 'broadband' now covers speeds ranging from 2 Mbps to 100 Mbps. The broadband characteristic by itself is therefore not sufficient, for example, to develop a picture of the market for advanced broadband services or to break down the adoption of higher speed broadband by individual and household characteristics as a means of determining which population groups are leaders in this area.

# IaD: methodology represents a greater limitation than technology

More generally, Statistics Netherlands is interested in the operation of such measurement methodologies because it is once again an example of 'measuring' responses without imposing any additional burden on respondents. In comparison with the use of traditional questionnaires, such innovative methods furthermore can potentially improve the quality of the answers provided.

The firm iPing Research has been measuring the internet speed of primarily private individuals for years. This is effected via a programme installed by the participants themselves (self-filling questionnaire). Users can download this programme from different sites on the internet. It is up to interested parties themselves to install this programme. This means that the panel is established through means of self-selection on the part of participants. iPing Research has made the data collected this way for the period 2003–2010 available to the Statistics Netherlands project. At its peak in 2005 this panel comprised more than 100,000 participants with almost 16 million associated internet speed measurements. By 2010, this had dropped to less than 20,000 participants and over 8 million speed measurements. Stratix Consulting has expertise in processing and interpreting such data and in consultation with Statistics Netherlands analysed this dataset. One of the most important questions for analysis concerned the representativeness of the panel. Indeed, this is not a classical random sample from a specific population, but a sample for which participants registered themselves. In other words, these are participants who are aware of the existence of the programme and are interested in measuring the speed of their internet connection(s). The representativeness of the panel was tested as follows:

- By comparing the data with the distribution of all households across municipalities in the Netherlands as available to Statistics Netherlands.
- By comparing the data with the proportion of ADSL and other broadband connections as observed in the Statistics Netherlands *ICT use by households and individuals* survey and comparable data of the Independent Post and Telecommunications Authority of the Netherlands (OPTA).
- By comparing the data with the characteristics of members of the panel who formed part of the panel in 2005 and 2006, but were not acquired via self-selection, and instead were approached asking them to install the programme for a period of time on their computer.

First, the distribution of households and individuals in the panel across municipalities in the Netherlands did not match the distribution of all households across municipalities as available to Statistics Netherlands. By recalibrating the sample using the number of households per municipality or region it should be possible to correct for this. However, at this point in time this would be no more than a very basic correction. This is because the background characteristics (age, gender and the like) of the panel's participants are unknown or virtually unknown. Second, the ADSL internet connection appears to be somewhat overrepresented on the panel. This was initially established by comparing the proportion of ADSL and other broadband connections as observed in the Statistics Netherlands *ICT use by households and individuals* survey. This was confirmed by making a comparison with the OPTA data concerning the proportion of ADSL and other broadband connections provided by the most important suppliers in the Netherlands. It is difficult to correct for this because the number of households and individuals with ADSL and other broadband connections for the population to be described as a whole is unknown.
A third check of the representativeness came from the panel itself. In 2005, the panel members of a market research agency were asked to install the programme on their computer(s). A fairly large number of people responded to this request at the time. As a result in 2005 and 2006 there were a sufficient number of participants in the panel that had decided to participate in some other way than self-selection. These participants are viewed here as a random sample or at least as a sample that has come about in an entirely different way from the 'regular' panel recruitment. The advantage of this sub-panel is that the same data is available for this group of participants and for the 'regular' participants on the panel. This comparison showed that the (measured) speed of the internet connection of the group of participants created on the basis of self-selection was much higher than that of the participants recruited from the market research agency's panel. In other words, members of the iPing panel registering on the basis of self-selection have high-speed internet connections. This is intuitively understandable. Indeed, these are people who are aware of the existence of the programme, have the skills required to install/uninstall the programme *and* are interested in measuring the speed of their internet connection. It is understandable that these individuals also have a high-speed internet connection.

A possible application of the measurement technique outlined here is to integrate this data collection method into the *ICT use by households and individuals* statistics if these statistics are going to be collected over the internet instead of by telephone. The internet use by households and individuals can also be directly linked to the measured speed of the internet connection and the background characteristics of the household and individual, respectively.

Two examples of analyses that can be performed on the basis of the panel data are given below. The purpose is to primarily illustrate the type of analyses that are possible on the basis of the collected data. In this respect we are ignoring the reduced representativeness of the panel's members established earlier in this section, especially in terms of the target variable itself: the speed of the internet connection.

One of the panel's most important variables is the relationship between the internet speed actually experienced by a user (measured speed) on the one hand and the advertised speed on the other hand. The latter refers to the speed a user is entitled to expect on the basis of his/her subscription. To be able to make this comparison, the panel's members at the time of programme installation are asked to identify the particulars of their subscription (speed, cost, technology and ISP). This data is available for the larger part of the panel's members.

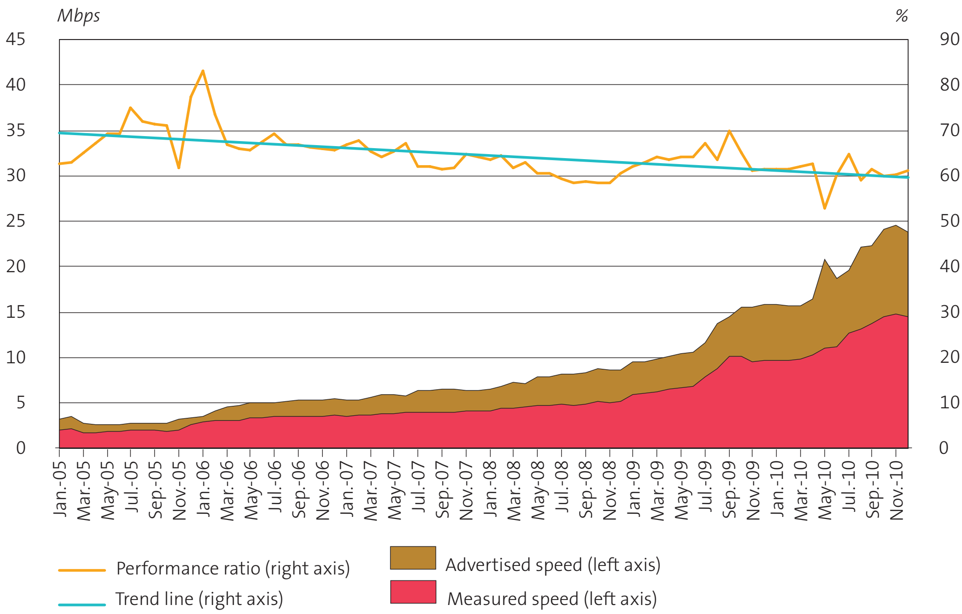
The advertised speed of the internet connections used by panel members has steadily risen over the period 2005–2010. The actually measured speed is more or less keeping pace with this. The average advertised and measured internet speeds in 2005 were approximately 2.9 Mbps and 2.0 Mbps respectively and approximately 20.0 Mbps and 12.1 Mbps respectively in 2010. The key jumps in Figure 8.2.8 are highly correlated to changes in the offer on the market for broadband internet. The ratio of the measured speed and the advertised speed of the relevant internet connections is referred to as the performance ratio. Throughout the entire period, this performance ratio fluctuated between 60 and 70 percent and showed a somewhat declining trend. This variance may have been caused by a variety of factors and is definitely not necessarily due to the internet provider. A possible explanation, for example, is the speed limitations inherent in the customer's equipment. Increasingly more consumers make use of a wireless home network that, most certainly in the case of high-speed broadband connections, significantly limits the internet speed.

A second observation from the panel data is the more or less stable rate of an internet subscription over the years compared to the patently obvious decrease in the price of the supplied Mbps download speed (Figure 8.2.9).[8)] The average monthly subscription rate in the Netherlands is therefore fairly stable.[9)] The reason is that people hold on to a

8) An elaborate description of the price trends of the telecommunication sector is contained in Section 3.4 of this publication which also focuses on the role of quality improvements (faster internet connections).

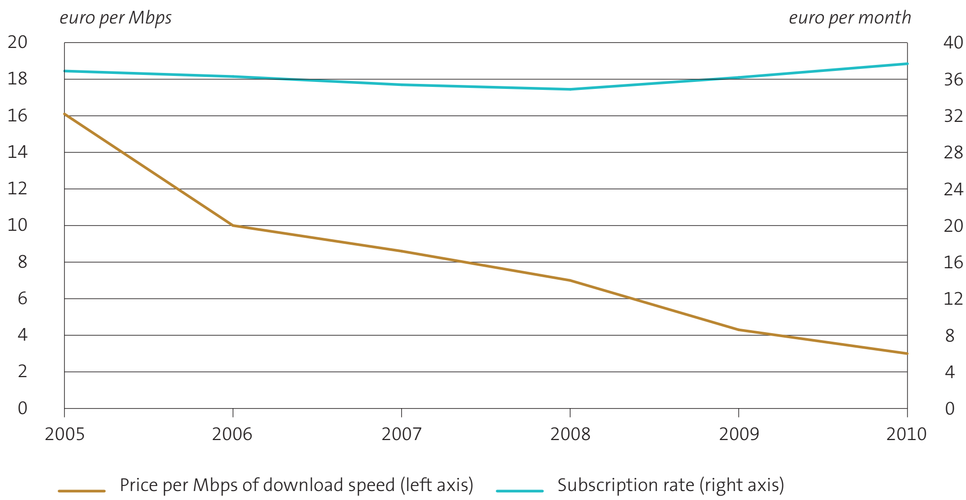
9) The average subscription rates as measured on the basis of the iPing population also include dual and triple play subscriptions. This is particularly the case for cable and optical fibre subscriptions.

### 8.2.8 Advertised and measured download speeds of internet connections




Source: iPing Panel (processed by Stratix and Statistics Netherlands).

### 8.2.9 Price per Mbps of download speed and subscription rate of internet connection




Source: iPing Panel (processed by Stratix and Statistics Netherlands).

subscription type whose price remains highly fixed. For example, people opt for an 'ADSL Fast' or 'Silver Cable' subscription and move in tandem when suppliers increase the speed of these services. Suppliers try to avoid price reduction or entice users to buy a more expensive or faster internet connection.
The market therefore is primarily segmented on the basis of people's readiness to pay a certain amount for the internet (potentially inclusive of TV and telephony). This segmentation is fairly stable. In terms of the broadband market as a whole, a stable average price per subscription means that the growth in revenue is tightly connected to growth in market share and the sale of services with new and faster technologies, at an additional cost.

## Conclusions

It is likely that IaD and IaD-related techniques will play a role in the future in producing official statistics. In spite of the fact that many obstacles remain to be overcome, the results of the pilots conducted in 2011 indicate that there are good opportunities for integrating IaD into the statistical process. The future will show whether this will consist of a gradual and restrained integration or a 'revolution'.
Outside the statistical agencies, IaD has become a common technique and IaD-based figures are increasingly attracting the attention of policymakers. The opportunities to use IaD in the future for producing statistics will not as much depend on the limitations of the technology and the collection of internet data itself, but rather on the possibilities of solving the methodological issues that crop up during the subsequent phase. IaD also requires a different way of thinking from the current culture of producing statistics. Meeting the need for statistical information ultimately remains the starting point.
There appear to be good opportunities related to the use of internet robots (e.g. price observations, the housing market and beta indicators) and the use of smartphones (e.g. behaviour, mobility and location). The use of IaD does not always need to be for new statistics. It is especially the combination of IaD with existing statistics and the use of IaD to supplement existing statistics that appear to offer good opportunities. Various benefits can be achieved this way, such as greater detail, the availability of supporting information to improve the allocation of samples, and trend figures as a supplement to level figures obtained using traditional methods.

# 8.3 Explaining productivity growth, the Solow residual disentangled

*The Solow residual is a well-known concept in the literature for the part of labour productivity growth that cannot be explained by growth in the amount of physical capital per unit of labour. Innovation and human capital are key factors underlying the Solow residual. This article deals with the disentanglement of the Solow residual. It concerns a summary analysis based on the PhD thesis 'Innovation and Productivity: The Solow Residual Disentangled', on the basis of which the author obtained his doctorate at Erasmus University Rotterdam in November 2011.*

*Author: Piet Donselaar, Ministry of Economic Affairs, Agriculture and Innovation*

Labour productivity growth to a large extent determines a country's growth in (material) prosperity. The Solow residual plays an important role in labour productivity growth. It is the part of labour productivity growth that remains after the contribution of the growth in the amount of physical capital per unit of labour has been deducted from it. Explaining the Solow residual represents a major scientific challenge. It also has a great deal of relevance to macroeconomic policy, because it makes apparent how additional growth in prosperity can be generated. This article discusses the key components and results of the author's PhD thesis *Innovation and Productivity: The Solow Residual Disentangled* (Donselaar, 2011). The thesis contains a theoretical and empirical disentanglement of the Solow residual by:

1. exposing the mechanisms underlying the Solow residual;
2. placing the determinants of the Solow residual in a broad overall framework;
3. providing a far-reaching empirical explanation of the Solow residual;
4. identifying the contribution of the explanatory factors using a decomposition analysis for four OECD countries, including the Netherlands, over the period 1970–2006.

The article is structured as follows: first, the challenge related to disentangling the Solow residual is explained in further detail. The disentanglement is then discussed along the lines specified above. The article concludes with some policy implications.

### The challenge: disentangling the Solow residual

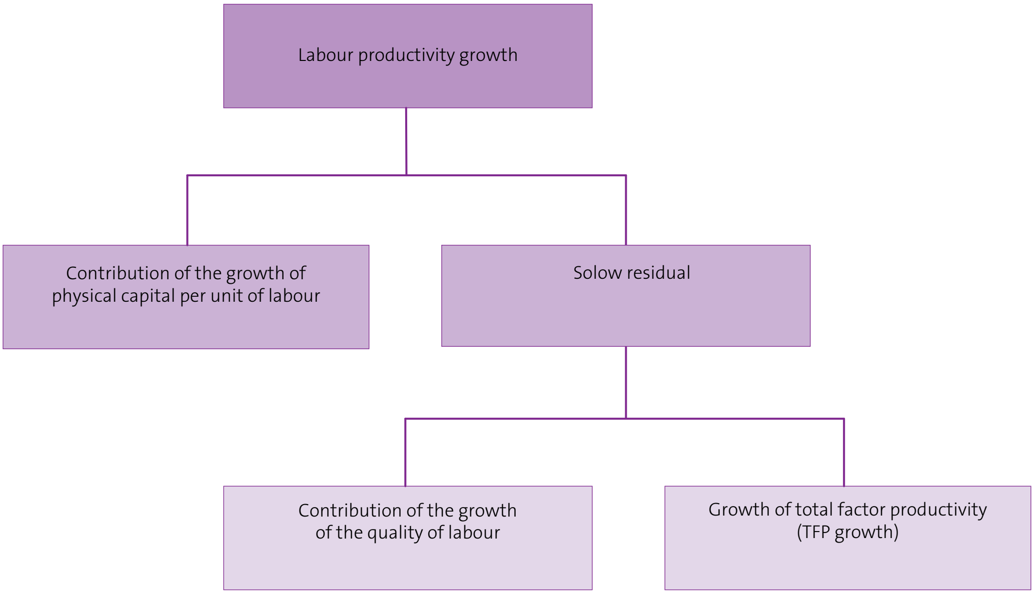
The Solow residual refers to Solow's growth accounting analysis dating back to 1957. On the basis of a few neoclassical assumptions, Solow developed an accounting method for breaking down labour productivity growth into a contribution of the growth of the amount of physical capital per unit of labour and an unexplained residual factor.[10] Solow's analysis, which was carried out with data for the United States over the period 1909–1949, resulted in a large residual that represented almost 90 percent of labour productivity growth. Prior to this, comparable growth accounting analyses were available with less strongly developed fundamentals based on the neoclassical theory. An example of this is an analysis by Abramovitz (1956), which was also based on data for the United States over an extended period and that roughly produced the same results.

Both authors (Solow, 1957; Abramovitz, 1956) related the residual to technological change; however, they were aware of the fact that the residual involved an unexplained component of economic growth that comprised more than just 'pure' technological change, such as, for example, developments in the quality of labour. The neoclassical growth theory was unable to explain this residual. Neoclassical theory considered technological change an exogenous (that is, external, unexplained) factor, often designated as 'manna from heaven'. Furthermore, knowledge about the influence of the quality of labour on productivity had not yet been highly developed. Abramovitz (1956) considered the residual as a measure of our ignorance about the causes of economic growth. In doing so, he presented a major challenge for economic science.

The total factor productivity growth (TFP growth) concept is related to the Solow residual. In the case of this residual, not only the contribution of the growth in the amount of physical capital per unit of labour is deducted from labour productivity growth, but in principle also the contribution of the improvements in the quality of labour. Quality improvements in labour reflect changes in the amount of human capital per unit of labour. The TFP growth that follows as a residual after taking into account quality improvements in labour (see Figure 8.3.1 for a graphical representation) to a stronger degree than the Solow residual represents the part of labour productivity growth that can be attributed to 'pure' technological change. Prior to the analyses carried out by Solow (1957) and Abramovitz (1956), Kendrick (1955) had already developed the total factor productivity concept and had worked it out in-depth as a measure of the efficiency of the production process, defined as the ratio of generated output to total factor inputs. Within the factor inputs he already took account of the quality of labour. The total factor productivity concept does not occur in the articles written by Solow (1957) and Abramovitz (1956).

[10] These assumptions are: perfect competition on product markets and constant returns to scale in the total of the capital and labour production factors. Under these assumptions, it can be deduced that the output elasticity of physical capital within a production function corresponds to the share of capital income in the value added. The principle that then applies is that the contribution of the growth in the amount of physical capital per unit of labour to labour productivity growth can be quantified by multiplying the growth rate in the amount of physical capital per unit of labour from year to year by the share of the capital income in the value added. Growth accounting nowadays is also often applied without using the specified neoclassical assumptions as the starting point. In that case, the share of the capital costs in the total costs of capital and labour constitutes the weight for the contribution of the growth of physical capital per unit of labour to labour productivity growth. For the approach from this more advanced perspective, see Hall (1990) and Balk (2010).

### 8.3.1 TFP growth and the Solow residual in labour productivity growth




Mankiw, Romer and Weil (1992) incorporated human capital as an endogenous (that is, dependent, explained) factor into the neoclassical growth theory originally developed by Solow (1956) and Swan (1956). It has since become reasonably feasible to take explanatory factors for human capital as a separate determinant of labour productivity development into account within neoclassical growth models. In addition, since the second half of the eighties semi/fully endogenous growth models have been developed that supplement the neoclassical framework with endogenous technological change. The common characteristic of the semi/fully endogenous growth models is that technological change is considered dependent on knowledge development, with an important role for Research & Development (R&D). However, there are different streams within semi/fully endogenous growth theory with highly divergent implications for the way in which R&D affects TFP growth. The approaches are highly theoretical in nature and have been tested empirically only to a limited extent. Furthermore, a limitation of the various semi/fully endogenous growth models is that they are approaches that are primarily related to the global (i.e. worldwide) level of knowledge development. The reason is that spillovers of knowledge development (external effects resulting from the diffusion of knowledge) and the obsolescence of previously acquired knowledge within these models apply at the global level. As such, they as yet fail to specifically identify how TFP growth can be explained at the individual country level.

Empirical analyses have devoted a lot of attention to explaining the TFP component in labour productivity development at the individual country level (or the individual sector or company level). These analyses make extensive use of R&D capital and catching up variables and do not establish a direct relationship with semi/fully endogenous growth theories. R&D capital reflects a cumulative amount of R&D effort over a series of years, adjusted for depreciations related to the obsolescence of previously acquired knowledge. Within the often used R&D capital approach, the growth of R&D capital is viewed as an explanatory factor of TFP growth. Catching up refers to the additional TFP growth that technologically following countries can achieve by pulling themselves up to technologically leading countries that are at a higher level of technological development. At the global level of the semi/fully endogenous growth models this aspect can be disregarded.

In actual practice it is evident that R&D capital and catching up variables lend themselves very well to explaining TFP development. This raises the question as to the added value provided by semi/fully endogenous growth models in this respect. In fact, there are two separate worlds that do not fit together very well: the theoretically oriented semi/fully endogenous growth models and the empirical explanation of productivity growth. The thesis referred to above, establishes a connection between the semi/fully endogenous growth theory at the global level and the R&D capital approach at the individual country level. The method used to do this is discussed in the next part of this article.

Diverging approaches to design the R&D capital and catching up variables are used in the empirical analyses conducted at the individual country level, causing the literature to project a diffuse picture in this area as well. In addition, there is still a lot of ambiguity concerning the determinants of labour productivity development, aside from the R&D capital and catching up variables. Empirical studies differ significantly for various variables and the design of mechanisms. A further limitation is that in separate analyses only certain sub-aspects are generally analysed, while there is a need for a total framework that simultaneously includes as many factors and mechanisms as possible to explain labour productivity development. This also produces more accurate empirical results because it reduces the distortion of coefficients due to the omitted variables bias. The thesis attempts to create clarity in a number of areas. The areas of strength developed in available prior research was as much as possible used as a basis in this regard. Different pieces of the puzzle were put together to develop a broad integrated picture of the role played by different variables and mechanisms in labour productivity development.

### Mechanism exposed: R&D capital approach linked to semi/fully endogenous growth theory

Semi/fully endogenous growth theory indicates that R&D can be viewed as a key factor underlying TFP growth. However, this theory does not make it perfectly clear how TFP growth can be made endogenous at the country level. First, the question is which version of the semi/fully endogenous growth theory best describes reality. To gain insight into this requires empirical testing. Second, as already mentioned above, another limitation is that semi/fully endogenous growth models are especially relevant for explaining TFP growth at the global level. Both of these limitations are addressed in the thesis by first empirically testing different R&D-based semi/fully endogenous growth models at the global level and then directly linking this to the modelling of R&D in the explanation of labour productivity development at the individual country level.

Three main streams of semi/fully endogenous growth theory have been tested empirically at the global level. These are represented by the models developed by Romer (1990), Jones (1995) and Young (1998). According to the Romer (1990) model, TFP growth is linearly dependent on the absolute size of the R&D efforts. Jones (1995) developed a model in which the growth of the R&D efforts is the determining factor for TFP growth in the long term. An increase in the size of the R&D efforts (in relation to a certain basic path with a certain growth in R&D efforts) would have a positive (albeit declining) influence on TFP growth during an extended transition period. Young's model (1998) assumes that TFP growth is linearly dependent on the size of the R&D efforts in relation to the size of the labour force, combined with the growth of the labour force. The Romer (1990) and Young (1998) models are fully endogenous growth models. The Jones (1995) model is a semi-endogenous growth model, since a higher level of R&D expenditure does not lead to permanent higher productivity growth in this model.

Crucial in these models is how intertemporal knowledge spillovers are modelled within the underlying knowledge production functions. In these knowledge production functions, the R&D efforts combined with the existing stock of technological knowledge are determinant for the amount of new technological knowledge that is developed in a specific year. If the intertemporal spillovers from the existing knowledge stock are very high (in this case have an elasticity of 1 or higher in the knowledge production function), then a higher level of R&D effort can increase the growth rate of the knowledge stock year after year without a decline of that growth effect over time. The TFP growth rate would then also be positively affected each year without a declining pattern. If the intertemporal spillover effects are moderate (in this case a value smaller than 1 of the relevant intertemporal spillover elasticity), then the impact on the growth rate of the knowledge stock and consequently the impact on the growth rate of the TFP as well, will asymptotically diminish to zero over time.

For the empirical test of the semi/fully endogenous growth models, the Romer (1990), Jones (1995) and Young (1998) models were translated into equations designed to explain TFP development at the global level. This was accomplished by linking TFP development to the development of the technological knowledge stock at the global level in accordance with the knowledge production functions of the three growth models.[11] For the empirical estimates performed over the period 1970–2006, the strongest empirical support was found for the Jones (1995) model and the least for the Romer (1990) model.

The R&D capital approach, which is often used as part of the empirical analyses at the individual country level, can subsequently be linked to the knowledge production function at the global level in the Jones (1995) model. The R&D capital approach can be closely tied into this by bringing the modelling of the depreciations in relation to the obsolescence of previously acquired knowledge in line with the knowledge production function. This bridges the gap between the theoretically oriented semi/fully endogenous growth models and the R&D capital approach frequently used in empirical research. The R&D capital approach by default assumes a fixed depreciation rate on the R&D capital of the previous year. The knowledge production function in the Jones (1995) model implicitly assumes a depreciation rate on the technological knowledge in the previous year that is dependent on the amount of newly developed technological knowledge in proportion to the stock of technological knowledge in the previous year. This depreciation approach can be considered applicable at the global level and has been integrated as an innovative element into the R&D capital approach at the individual country level. The fixed depreciation rate on the R&D capital in the previous year has been replaced by a variable depreciation rate that is dependent on the size of the R&D efforts (as a measure of the amount of newly developed technological knowledge) at the global level in proportion to the stock of R&D capital in the previous year at the global level. This makes it easier to interpret the R&D capital approach and also makes it more realistic. This also offsets the limitations of the traditional R&D capital approach already identified by Griliches (2000, page 54): “It is obvious that such capital does not depreciate just because of the efflux of time or mechanical wear and tear. The obsolescence of private R&D results is clearly a function of the activity of others and is unlikely to occur at a constant rate.”

**The determinants of the Solow residual placed in a broad overall framework**

The starting point for the empirical analyses conducted to explain the Solow residual at the individual country level is that labour productivity development has three main components: TFP development, a direct contribution of the development of the amount of physical capital per unit of labour, and a direct contribution of the development of the amount of human capital per unit of labour. TFP development and the direct contribution of the development of the amount of human capital per unit of labour together form the Solow residual. It is possible to design separate explanatory variables and mechanisms for these two components.

[11] The global level in this respect was approximated by aggregating data for 20 OECD countries for which it was possible to compile long time series over the period 1970–2006 for the empirical analyses at the individual country level in the thesis.

Based on available data at the individual country level, the amount of human capital per unit of labour can primarily be represented by the average years of education of the population (between the ages 25 to 64 inclusive). In addition, the potentially negative impact of the labour participation rate (number of persons employed in proportion to the population) on the amount of human capital within the deployed labour is taken into account. The reason for this is that a higher labour participation rate can go hand in hand with the deployment of less productive labour. Since the deployment of labour expressed in hours worked is important in this respect, the number of hours worked per person employed can also play a role in this regard. For example, it is possible that less productive individuals more often work part-time, which would have an upwards impact on the average labour productivity per hour worked.
TFP development can mainly be explained on the basis of innovation, and the development of R&D capital and catching up can be considered as the most important factors here. In terms of the stock of R&D capital, foreign R&D capital is distinguished from domestic capital and both are broken down into private and public R&D capital. Foreign R&D capital affects the domestic TFP via international spillovers of knowledge. The same applies to catching up on the understanding that the impact of catching up is dependent on the technological gap between a country and technologically leading countries. In addition, various other factors were taken into account that can have an impact on TFP development, for a large part, once again, running via innovation. Examples include: the sector composition (related to the share of high-tech and medium high-tech sectors in the economy), the economy's openness (indicator of international competition and economies of scale that can be achieved on international markets), the net capital income share of the business sector (indicator of the profitability of companies), the tax and contributions burden, entrepreneurship and the state of the business cycle.
The number of hours worked per person employed can also play a role in the TFP. This variable was referred to earlier in relation to a potential composition impact on the amount of human capital per unit of labour. However, the number of hours worked per employed individual can also have a direct impact on labour productivity via the TFP. For example, a reduced number of hours worked per person employed has a direct positive impact on labour productivity if it results in less fatigue at work, people working harder during the available hours and/or more work being performed outside the official working hours. The number of hours worked per person employed functions as an explanatory variable for both sub-effects in the empirical analysis carried out.
ICT was not included as a separate factor in the empirical analysis. ICT has a direct impact on the labour productivity growth via the growth in the amount of physical capital per unit of labour. In growth accounting analyses it is customary to distinguish ICT capital from other capital in the growth of the amount of physical capital per unit of labour. In this thesis this approach was also used in making growth accounting calculations. In this context, a further analysis concluded that the quality improvements in ICT capital over the last few decades have made a strong contribution to the growth of the total stock of

physical capital and along this path had a considerable impact on labour productivity growth in various OECD countries. In addition, ICT is of significance to TFP growth. First, this concerns an impact via technological change in the ICT-producing sector through various means, such as R&D efforts. Second, TFP development can be positively impacted through the 'smart' integration of ICT capital into production and innovation processes. This is primarily a factor in ICT-intensive services sectors. Scientific knowledge is still less tangible in terms of the last-mentioned channel. There are indications that competition, entrepreneurship and innovation (including non-technological innovation, such as organisational changes) have an impact on the TFP effects resulting from the use of ICT capital.[12)]

Since domestic R&D capital in a country is accrued through means of R&D expenditure, it is also important to have insight into the explanatory factors underlying the R&D expenditure trends in explaining labour productivity development in a country. In this regard, a distinction is made between private and public R&D expenditure (expenditure for R&D carried out privately and publicly, respectively). Public R&D expenditure to a large degree can be considered exogenous because it depends for a large part on government financing of public R&D. On the other hand, private R&D expenditure can be empirically explained on the basis of a large number of factors for which variables are available. This is why the thesis contains a separate empirical explanation of private R&D expenditure at the individual country level. This contributes to creating an integral overview of the determinants of labour productivity development and within that TFP development.

As explanatory factors for private R&D expenditure, among others, the following factors were taken into consideration: the sector composition, government financing of private R&D, public R&D, public-private interaction with respect to public R&D, the protection of intellectual property domestically and abroad, the stock of high-grade knowledge domestically and abroad (relevant to the domestic R&D business climate in comparison to the foreign business climate, for example), the openness of the economy, the net capital income share of the business sector, the real interest rate, the availability of bank credit, the private R&D intensity at the global level and the state of the business cycle.

**Empirical explanation of the Solow residual in labour productivity development**

The empirical explanation of the Solow residual was carried out within an equation designed to explain labour productivity development. The equation was empirically estimated in a panel analysis for twenty OECD countries over the period 1970–2006. The empirical estimates were produced on the basis of the co-integration methodology in accordance with the Engle and Granger (1987) two-step method. The long-term equilibrium relationships

12) For considerations in this context see, for example, Van Ark (2007), Buijink (2007) and Timmer (2007).

in levels were first estimated, after which the short-term dynamics were estimated on the basis of an error correction mechanism for the movement in labour productivity.

For the development of the amount of physical capital per unit of labour as an explanatory factor for labour productivity development, a coefficient that varies over time was incorporated a priori in accordance with the growth accounting methodology (related to the share of capital income in the value added, as explained in the first footnote of this article). The other explanatory variables – expressed as movements – reflect explanatory factors for the Solow residual. A number of key findings of the empirical estimates are discussed below.

The average years of education of the population (between the ages 25 to 64 inclusive) as a variable for the amount of human capital per unit of labour was found to have a highly significant elasticity of 0.40. This elasticity is in line with the findings of earlier research conducted by Bassanini and Scarpetta (2002). However, the elasticity is lower than that found in later research conducted by Arnold, Bassanini and Scarpetta (2007). That research gave the impression that the average years of education, in addition to direct impacts, also had considerable external effects on labour productivity. This is not confirmed here.

The labour participation rate (number of persons employed in proportion to the population) as a supplementary variable for the amount of human capital per unit of labour was estimated to have a highly significant elasticity of −0.43. In addition, the number of hours worked per person employed (that partly can be considered in relation to the amount of human capital per unit of labour as well as a variable that can directly affect the TFP) was also found to have significant negative elasticity, namely −0.53.

Elasticities were obtained for domestic private and public R&D capital that have a positive dependence on a country's share in the global stock of R&D capital. As this share increases, the spillovers to a greater extent remain within national borders. A positive dependence on the openness of the economy was found for the elasticities of foreign private and public R&D capital, in line with earlier research conducted by Coe and Helpman (1995). This means that a country benefits more from international spillovers of knowledge as the economy is more open. For the Netherlands, the elasticities for domestic private and public R&D capital amounted to 0.07 and 0.05 respectively, with 2006 as the most recent year of the estimating period. The elasticities for foreign private and public R&D capital are 0.05 and 0.04, respectively.

The elasticities found for private R&D capital are 1.5 times as high as those for (domestic and foreign) public R&D capital. With due consideration to the size of public R&D in relation to private R&D, it can be deduced from the 2006 R&D figures for the Netherlands that an additional euro in private R&D in the Netherlands on average would contribute almost 30 percent more to labour productivity in the Netherlands than an additional euro invested in public R&D. An increase in private R&D in the Netherlands would over the long term impact the size of the gross domestic product with a multiplier effect of almost 11, and an increase in public R&D with a multiplier effect of over 8. The calculated long-term multipliers for both categories of R&D can be considered as very high.

# An increase in private R&D in the Netherlands would over the long term impact the GDP with a multiplier effect of 11

In interpreting the multipliers it is relevant to take into consideration that a significant share of public R&D is not focused on science in support of technology development and innovation in companies. In terms of these elements of public R&D, a lower multiplier can be assumed than the multiplier mentioned above for public R&D in total. However, this also implies that for public R&D focused on directions that are highly relevant for technology development and innovation in companies (the natural and technical sciences primarily come to mind) a higher multiplier can on average be expected. The multiplier for these components of public R&D could significantly rise above the multiplier that on average applies to R&D conducted in companies.

In addition to the impacts of domestic and foreign R&D capital, the catching up mechanism was found to have an important role. A catching up variable in which the technological gap between countries is measured on the basis of the number of granted American patents in relation to the size of the labour force, turns out to have strong explanatory power for the labour productivity development in a country. In addition, an interaction effect of R&D capital intensity was found in the catching up effect. This indicates the importance of carrying out own R&D in order to utilise foreign technological knowledge.

**Empirical explanation of private R&D expenditure as a factor of private R&D capital**

An R&D intensity was used as dependent variable in the empirical explanation of private R&D expenditure as a factor of private R&D capital: the R&D expenditure in relation to the size of the gross domestic product. The R&D expenditure as the numerator and the gross domestic product as the denominator are expressed as volumes, with a sharper price trend applying to the R&D expenditure than to the gross domestic product. Government financing of private R&D, the relative price of R&D (price of R&D in comparison to the price of the gross domestic product), the sector composition, the stock of high-grade knowledge domestically compared to that held abroad, the protection of intellectual property domestically and abroad, the availability of bank credit and the global private R&D intensity were found to have strong effects. Furthermore, the R&D capital of higher educational institutions and research institutes, public-private interaction with respect to R&D capital of higher educational institutions, the net capital income share of the business sector, the openness of the economy and the state of the business cycle were found to have significant influences, with the latter having a negative influence. The real interest rate does not emerge as having an influence.

From a policy perspective, the influence of government financing of private R&D is of special importance. Government financing constitutes a direct instrument that enables government to influence the R&D expenditure of companies. In government financing of private R&D, a distinction is made between R&D tax incentives and other government financing of private R&D. Other government financing includes grants, credits and government R&D contracts awarded to companies. Government financing through means of R&D tax incentives, as well as other government financing appears to have a significant influence. For the R&D tax a multiplier effect (additional R&D expenditures per euro of government financing) of 0.93 was estimated.[13)] A multiplier of 1.15 was found for other government financing of private R&D. These multipliers do not differ significantly so that it is not possible to formulate a strong conclusion about the impact of grants/credits in comparison to fiscal R&D incentives. In addition, it should be noted that both variables comprise a wide range of schemes, as a matter of fact the schemes that applied in the twenty OECD countries over a long period of time in the past (1970–2006). This is why the multipliers found cannot be considered to apply directly to single schemes in the various countries.[14)] With regard to credits, the amounts returned to the government in the form of redemptions and interest payments must be taken into consideration. If a correction is made for this, the multiplier for credits could potentially far exceed the 1.15 value.

In addition to government financing of private R&D, public R&D capital has an influence on private R&D expenditures. Companies can build on developed public knowledge in their private R&D efforts. The R&D capital of higher educational institutions and the R&D capital of research institutes were incorporated as separate categories of public R&D capital in the empirical estimates. Semi-elasticities were estimated for the impact of these categories on private R&D expenditures. These can be converted into multipliers

13) This multiplier is derived from the estimated impact of a marginal cost reduction in R&D due to fiscal R&D incentives on the size of private R&D expenditures. The calculations were based on 'conventional' fiscal R&D facilities, such as the Promotion of Research and Development Act (WBSO) and as of 2012 the Research & Development Deduction (RDA) in the Netherlands. In this type of schemes, the tax allowance is dependent on the total amount spent by a company on R&D. In case of an 'incremental' R&D incentive, the tax allowance is dependent on the size of the R&D expenditures above a certain (company-dependent) basic amount. In this way the costs of R&D 'at the margin' can be more sharply reduced with a certain amount of fiscal R&D incentives. As a result, the multiplier of an incremental scheme could be higher than that of a conventional scheme. However, this is contrasted by greater complexity and – for some forms – the possibility of a company to adopt a strategic behaviour (causing R&D expenditures to fluctuate such that maximum profit is derived from the scheme). The possible multipliers for incremental facilities were not estimated.

14) WBSO evaluations produced higher multipliers than the 0.93 value found in this research. Explaining the variances is not a simple task. One factor that at least plays a role is that the evaluations determined the effect using data at the individual company level. The benefit of this is that the number of observations is very high and furthermore that they are also specifically related to the Netherlands. The drawback is that it is difficult to check for an inverse impact of the size of the R&D expenditures on the acquired WBSO. This last point received a great deal of attention in the WBSO evaluations. In particular, a lot of progress was achieved in the last evaluation (Verhoeven, Van Stel and Timmermans, 2012); an acceptable solution seems to have been found to the causality issue.

that reflect the impacts of additional R&D expenditures of higher educational institutions and research institutes on private R&D expenditures in the long term. Using the private R&D intensity in the Netherlands in 2006 as a starting point, it can be deduced from the estimated semi-elasticities that an additional euro spent on R&D by higher educational institutions would result in an additional 0.23 euro spent on R&D by companies and that an additional euro spent on R&D by research institutes over the long term would result in an additional 0.46 euro spent on R&D by companies.

The sector composition has a major influence on the private R&D intensity in a country. Two sector composition variables were found to have significant positive influences: the share of the manufacturing industry in the value added of the total economy and the share of the high-tech and medium high-tech sectors in the value added of the manufacturing industry. In a number of countries, the sector composition development during the period 1970–2006 made a positive contribution to the development of private R&D intensity. Ireland and Finland benefited most from sector composition development, with positive impacts on private R&D intensity in 2006 in comparison to 1970 calculated at 87 and 75 percent respectively. The Netherlands received a negative contribution from sector composition development, estimated at 18 percent.[15)]

The protection of intellectual property and the openness of the economy are factors that experienced a positive trend internationally. These factors made a positive contribution to the development of private R&D intensity in the different countries during the period 1970–2006. Both factors greatly contributed to explaining the rising trend of the nominal private R&D intensity that occurred in many countries. For the development of private R&D intensity in volume terms, this is contrasted by a negative influence of the rising trend in the relative price of R&D (defined as the price of R&D in comparison to the price of the gross domestic product). The −0.94 elasticity calculated for this variable implies that the volume of R&D expenditure responds slightly less than proportionally to the relative increases in the price of R&D, so that a relative increase in the price of R&D does have a somewhat positive influence on the nominal R&D intensity.

**Decomposition analysis of the contribution of explanatory factors to the Solow residual**

The results of the empirical estimates at the individual country level to explain the labour productivity development and private R&D expenditures were used to make a quantitative decomposition of the labour productivity growth and within that the Solow residual. The

15) The sector composition furthermore makes an important contribution to the private R&D shortfall in the Netherlands in comparison to the OECD average. Depending on the calculation method (the R&D intensity in the own country or abroad as the reference point), the contribution for 2006 can be quantified as 0.28 to 0.36 percent of the GDP. This result, indirectly derived from the regression analysis, tracks well with the results of the research conducted by Van Stel, Hartog, Timmermans and Verhoeven (2011) using a direct method. In that research, the contribution of the sector composition position to the private R&D shortfall in the Netherlands was directly calculated on the basis of R&D expenditure and value added data at the sector level for a large number of OECD countries.

contribution of the various factors to the actual labour productivity development was quantified as part of the decomposition. This was done over the full 1970–2006 estimation period and for sub-periods within this period. The analysis was conducted for four countries. The Netherlands and Finland were selected as relatively small countries and Germany and the United States as large countries. Direct as well as indirect influences via the R&D expenditures were taken into account. A long adjustment process via an accumulation function for R&D capital applies to the indirect influences via the R&D expenditures. The thesis contains elaborate tables with the results of the decomposition. The following deals with several main aspects, supported by a limited number of quantitative results.

In all four countries, the development of the capital to labour ratio and the development of the various categories of R&D capital (a distinction is made between domestic and foreign private R&D capital and domestic and foreign public R&D capital) made important contributions to labour productivity growth over the entire period 1970–2006. For the Netherlands and Finland this also applies to the development of the average years of education during the entire period. In Germany and the United States this contribution was limited in the nineties and in the most recent period 2000–2006. Furthermore, in all four countries, the increase in the openness of the economy has made a structural positive contribution of significance to labour productivity growth. Furthermore, the results show that catching up has made an important structural (positive) contribution to labour productivity growth in the Netherlands, Finland and Germany. In the United States the catching up effect is zero, because this country served as technology leader in the design of the catching up mechanism. Table 8.3.2 provides an overview of the results of the decomposition calculations for the Netherlands and Finland over the total period 1970–2006.[16)]

Sharp decreases in private and public R&D intensity in volume terms had a downward impact on the contributions of the development of private and public R&D capital to labour productivity growth in the Netherlands. The Netherlands negatively distinguishes itself from many other countries in terms of the development of private R&D intensity. In the total of the twenty OECD countries included in the empirical research, the private R&D intensity between 1970 and 2006 rose sharply in nominal terms and stayed roughly the same in volume terms. In the Netherlands, there was a slight decline over the period 1970–2006 in nominal terms, which on a volume basis implies a sharp decline of 33 percent as a result of the relative increase in the price of R&D. The level of the public R&D intensity between 1970 and 2006 stayed approximately the same for the Netherlands and the total of the twenty OECD countries in nominal terms, resulting in a decline of 25 percent in terms of volume.

16) The calculations were performed on the basis of the estimated results to explain labour productivity development and the private R&D intensity that on theoretical and empirical grounds can be considered preferable. Entrepreneurship does not occur as an explanatory factor for labour productivity development in this regard. While entrepreneurship was found to have a significant influence, this was paired with less plausible coefficients in a few other areas of the estimated equation. This is why it was decided to exclude entrepreneurship from consideration in the preferred equation for labour productivity development. Further research is required to be able to better embed entrepreneurship in the estimated equation.

### 8.3.2 Decomposition of labour productivity growth in the Netherlands and Finland in terms of the contribution of explanatory factors; 1970–2006, annual averages

| | Netherlands | Finland |
|---|---|---|
| Labour productivity growth, actual, % | 2.18 | 2.91 |
| Labour productivity growth, empirically explained, % | 2.21 | 2.74 |
| Contribution of (in percentages):[1] | | |
| – Growth in capital to labour ratio | 0.54 | 0.49 |
| – Growth in average years of education | 0.34 | 0.38 |
| – Increase in labour force participation rate (persons employed in relation to the population) | –0.24 | 0.00 |
| – Decrease in the number of hours worked per person employed | 0.40 | 0.23 |
| – Growth in domestic private R&D capital | 0.11 | 0.52 |
| – Growth in domestic public R&D capital | 0.09 | 0.21 |
| – Growth in foreign private R&D capital combined with an increase in the import ratio as an interaction term | 0.20 | 0.12 |
| – Growth in foreign public R&D capital combined with an increase in the import ratio as an interaction term | 0.08 | 0.06 |
| – Catching up on the basis of the stock of patents in relation to the United States as technological leader | 0.62 | 0.58 |
| – Development of sector composition, compared to the development of R&D capital intensity | –0.11 | –0.17 |
| – Growth in the openness of the economy | 0.12 | 0.13 |
| – Development of the net capital income share of the business sector | 0.01 | 0.07 |
| – Development of the state of the business cycle | –0.01 | –0.01 |

[1] The contributions in percentages are approximated using changes in natural logarithms due to the logarithmic character of the empirically estimated specifications (contribution expressed as percentage point ≈ 100 x the contribution expressed as change in natural logarithms).

Key explanatory factors for the sharp fall in the private R&D intensity in volume terms in the Netherlands are the decline in the share of the manufacturing industry in the value added of the total economy as part of the sector composition effect, a decline of the R&D capital intensity of research institutes and a deterioration of the Netherlands' position in relation to foreign countries regarding the stock of high-grade knowledge (to be considered as an R&D business location factor). In addition, the negative effect of the relative increase in the price of R&D clearly was of importance. This has a strong negative impact on the private R&D intensity in volume terms on the basis of the calculated –0.94 elasticity.

The explanatory factors in the decomposition analysis are, however, only able to explain 62 percent of the sharply decreased private R&D intensity in volume terms in the Netherlands at over 1 percent per year over the period 1970–2006. There are indications that the unexplained decline reflects a further increased gap between the amount of R&D that Dutch companies perform abroad and the volume of R&D that foreign companies perform in the Netherlands. Historical data about these R&D internationalisation flows are required to gain further insight. At the request of the Ministry of Economic Affairs, Agriculture and Innovation, Statistics Netherlands will conduct research into this aspect.

Finland experienced sharp increases in the private and public R&D intensities in volume terms. This has resulted in relatively high contributions of the growth of private and public R&D capital to labour productivity growth in Finland, amounting to an average of

0.5 percent and 0.2 percent per year over the period 1970–2006. In terms of the explanatory factors for the development of private R&D intensity, Finland in particular distinguishes itself from the other three countries on the basis of a highly positive impact of the development of the sector composition. In addition, Finland in comparison to the other three countries scores positively in terms of the influences of the development of its high-grade knowledge position in relation to foreign countries, the development of public R&D intensities, the development of the protection of intellectual property and the development of the net capital income share.

In addition to the development of the private and public R&D intensity, the growth in the volume of the gross domestic product is important to the development of the volume of private and public R&D expenditures in absolute terms. In terms of the ultimate impact of the explanatory factors for R&D expenditures on labour productivity growth via the stock of R&D capital, the growth in the volume of the gross domestic product appears to play a major role in the decomposition analysis. This has a strong relationship with the semi-endogenous growth theory of Jones (1995), in which productivity growth over the long term is determined by the growth in R&D efforts. In the Jones (1995) model, the R&D efforts are reflected by the number of R&D personnel as the variable. The growth in the number of R&D personnel is to a certain extent comparable to the growth in the volume of R&D expenditures, which in the R&D capital approach determines the growth in productivity that is attributable to R&D over the long term.

**Policy implications**

Finally, a few policy implications that follow from the thesis are described. A number of implications related to R&D are described first. Next, the human capital factor is discussed, partially in relation to R&D/innovation.

The elasticities found for domestic and foreign R&D capital in explaining labour productivity development at the individual country level point to sizeable domestic and foreign spillovers of knowledge developed through R&D. The catching up mechanism adds an additional effect of foreign spillovers as well. Spillovers of domestic R&D capital justify the financial stimulus of private R&D and the direct financing of public R&D by national governments in their own countries. The spillovers of foreign knowledge provide support for agreements in an international context designed to increase R&D intensity. After all, a country not only benefits from its own domestic R&D, but also from R&D conducted abroad.

In 2000, countries agreed at the EU level to jointly strive for an R&D intensity of 3 percent of the gross domestic product by 2010, with two thirds of R&D expenditures financed by the private sector ('Barcelona ambition' under the Lisbon Agenda). However, this has not resulted in a substantial increase in the average R&D intensity in the EU. In 2010, the objective to allocate 3 percent of the gross domestic product to the total R&D expenditure by 2020 was reaffirmed at the EU level, without making a distinction between the privately financed portion in this regard (objective in the context of the Europe 2020 Strategy).[17) More stringent agreements among countries in support of this newly formulated goal for 2020 are to be considered. These could be based on specific action plans that offer prospects of actually realising this goal.

The public R&D intensity can be directly influenced by government through means of the government financing of public R&D performed at higher educational institutions and research institutes. Public R&D expenditures subsequently also appear to have a positive influence on private R&D expenditure. Publicly developed knowledge enlarges the knowledge base available to companies to build on with their own private R&D efforts. Direct government stimulus of private R&D is feasible through means of financial instruments. The multipliers calculated for fiscal R&D incentives and 'other government financing' of private R&D, however, require very large amounts of money for achieving a much higher R&D intensity. A strong intensification of R&D incentives can nevertheless be justified due to the strong external effects of R&D. If the multipliers found for the impact of government financing of private R&D are linked to the multipliers derived from the empirical estimates for the impact of private R&D expenditures on the gross domestic product, it follows that 1 euro of additional government financing of private R&D over the long term would lead to approximately 10 euros of additional gross domestic product.

Finland is an interesting country to consider in greater depth because the private R&D intensity there rose sharply over time. From the decomposition analysis it is evident that this sharp rise in private R&D intensity can, among other things, be related to a sharp increase in the share of high-tech and medium high-tech sectors in the gross domestic product and an improvement in the high-grade knowledge stock position in relation to foreign countries (important as a business location factor for R&D). Both can be viewed as a result of the successful technology development in Finland. The Netherlands could achieve a sharp improvement in its private R&D position in a similar way. The top sector approach adopted by the Cabinet, focused on strengthening the position of a number of knowledge-intensive 'top sectors' in the Dutch economy, increases the opportunities for such a technological-economic success.[18)]

The growth of the amount of human capital per unit of labour is the second key factor underlying the Solow residual. A structural increase in the average years of education of the population has made a structurally important contribution to labour productivity growth in the Netherlands. One question is whether human capital also contributes to productivity growth via external effects. A distinction can be made in this respect between

17) The Netherlands in this regard has opted for an R&D objective of 2.5 percent of the GDP due to the Netherlands' sector composition position compared to other EU countries. This objective has been formulated in the context of the Netherlands National Reform Programme (Ministry of Economic Affairs, Agriculture and Innovation, 2011d). For an explanation of the correction made for the sector composition in support of this objective see: Minister of Economic Affairs, Agriculture and Innovation (2011).

18) For a description of the top sectors policy see: Minister of Economic Affairs, Agriculture and Innovation, State Secretary for Finance and State Secretary for Education, Culture and Science (2011).

the static externalities to human capital through means of knowledge transfer among individuals in the production process and dynamic externalities through means of the contribution of human capital to innovation. The thesis does not empirically confirm static externalities. Dynamic externalities to human capital are difficult to separate from the R&D contribution to productivity growth. Innovation is the work of humans; consequently, human capital as input for innovation generates dynamic externalities. Although dynamic externalities to human capital are difficult to detect directly on the basis of variables for human capital, they implicitly are clearly expressed through means of the R&D's impact on TFP development. The dynamic externalities of human capital justify government policy focused on strengthening the availability of scientists and engineers as input for R&D/innovation.

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# Glossary

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 price**

The selling price excluding third party trade and transport margins and excluding the balance of product-related taxes (including VAT) and product-related subsidies.

**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.

**Capital goods**

The total value of fixed assets. These are production resources that last longer than one year and represent a significant value. This includes tangible assets (such as buildings and machines) as well as intangible assets (such as software).

**Consumer spending**

Goods and services that are used to directly satisfy individual or collective needs. A distinction is made between government consumption and household consumption, and between actual individual and actual collective consumption.

**Durable consumer good**

A product that is designed to be used more than once and over a longer period of time. During use, the amount of the product remains virtually unchanged and the product is not ‘used up’, such as food, cigars or perfume.

**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.

**Employed labour force**

All individuals who work at least 12 hours per week (employees, independent workers and co-working family members). The figures generally concern individuals in the employed labour force aged 15 up to and including 64 years. The limit used internationally is at least one hour of work per week.

**EPO (European Patent Office)**

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.

**Export**

Export is defined as the goods and services that are sold abroad by residents. In terms of the export of goods, they must have been delivered abroad from the economic area of the Netherlands. If this includes the trade and transport margins up to the Dutch border, this is designated as free on board (FOB). Export also includes the expenditures of foreign tourists, border residents and diplomats in the Netherlands.

**External data communication**

The capability on the part of a company to communicate with computers of third parties through one or more of its own computers.

**Flexible employment relationship**

Employment relationship that deviates from normal employment contracts in terms of the number of working hours or the term of the contract. Well-known forms of flexible employment contracts are on-call contracts and temporary employment contracts.

**Globalisation**

The increasing interrelatedness of national economies.

**Government consumption**

Government spending on goods and services that are used to directly satisfy individual or collective needs of members of the community.

**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 value of the income generated in the Netherlands, or the GDP (at market prices). The transactions not allocated include the balance of product-related taxes and subsidies and the difference between the imputed and paid VAT. Gross in this context means that depreciation is 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/ITYhttp://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/pat_esms_an8.pdf.

**ICT (Information and communications technology)**

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.

**ICT capital**

ICT capital (goods) comprises ICT goods and services used to produce other goods and that form part of the production process for more than a year. Examples include computers and software.

**ICT expenditure**

Expenditure on ICT goods and services consisting of company and government investments in ICT capital, the intermediate consumption of ICT goods and services by companies and government and the consumption of ICT goods and services by households. ICT spendings consist of intermediate consumption and consumption.

**ICT market**

The total demand and supply of ICT goods and services. The size of this market can be expressed as the total sale of ICT goods and services over defined period. The total sales of the ICT sector provides an indication of the size of the ICT market.

**ICT sector**

See Section 2.2 for a definition of the scope of the ICT sector, including the applicable Standard Industrial Classification (SIC).

**ICT workers**

ICT workers comprise the following ISCO classifications: Programmers (514), Technical Systems Analysts (666), System Analysts (714) and Computer Scientists (914).

**Import**

Import is defined as the goods and services that are sold by the rest of the world to residents of one specific country (the Netherlands). The import of goods in this case concerns goods destined for residents that have been brought into the Netherlands economic area from abroad. If this includes the trade and transport margins up to the border of the exporting country, this is designated as free on board (FOB).
The import of services is related to the expenditure of Dutch companies abroad, such as transportation costs, banking fees and business trips. The payment for software produced by foreign companies is also considered as the import of services. In the case of the government, import includes the expenditure on embassies abroad among other things. Import by households includes things such as imported consumer goods and direct consumer spending abroad by Dutch tourists, border residents, diplomats and military personnel.

**Independent workers**

A person who acquires income by performing work for his/her own account or risk in his/her own company or independently exercised profession, or by working in the company of a family member. Co-working family members are counted as self-employed, unless they have specifically signed an employment contract.

**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 innovation.

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.

**Intermediate consumption**

Intermediate consumption includes all products that during the reporting period are used in the production process. This can include raw materials, semi-finished goods and fuels, as well as services such as communication services, cleaning services and external auditing services that may or may not have been purchased during the reporting period. Intermediate consumption is valued at purchase prices excluding deductible VAT.

**Internet users**

Individuals who use the internet. 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 years.

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 years.

**Job opening**

A job opening for which, within or outside a company or institution, personnel is sought that can be placed immediately or as soon as possible.

**Knowledge economy (or information society)**

A society in which the production factor knowledge takes on increasing importance in relation to labour, raw materials and capital. A significant portion of economic growth in an information society is engendered by (technological) knowledge.

**Labour force (national definition)**

All individuals who:

- Work at least 12 hours per week, or
- Have accepted work as a result of which they will start working at least 12 hours per week, or
- Declare that they want to work at least 12 hours per week, are available for this purpose and are engaging in activities designed to find work for at least 12 hours per week.

*Note:*

This is the standard labour force definition used in the Netherlands. The data presented for the situation in the Netherlands generally covers the labour force that is 15 to 65 years of age. In terms of the labour force, individuals who work at least 12 hours per week are considered part of the employed labour force and individuals who are not working or who work less than 12 hours per week are considered part of the unemployed labour force.

**Labour force (international definition)**

All individuals above a certain age who during a reference period make up the labour supply for the productive activities that fall within the production boundary as defined by the European System of National and Regional Accounts 1995 (ESA 1995). This includes everyone who meets the criteria for inclusion in the employed or unemployed class of individuals.

**Labour force participation rate (net)**

The proportion of the potential labour force that is employed.

**Labour productivity**

The gross value added in basic prices per unit of volume of labour.

**Multifactor productivity**

The share of production that cannot be attributed to separate production factors (labour, capital, energy, materials and services).

**National accounts**

Statistical system that provides a quantitative, systematic and full description of the economic process within a country and of the economic relationships with foreign countries.

**Production**

Production comprises the value of all goods destined for sale (including unsold goods) and the receipts for services provided. In addition, production comprises products with a market equivalent produced for own use, such as in-house investments, including in-house developed software for use within the company itself. Production is valued at basic prices.

**Production factor**

The resources required for the production process. The traditional production factors are: natural resources, labour and capital.

**Productivity**

See Labour productivity.

**Purchasing power parity**

A conversion factor for currency that eliminates the effects of price differences. This makes it possible to make volume comparisons for GDP components and to make price comparisons. Purchasing power parities identify geographical differences in price levels.

**Re-export**

Goods that are transported via the Netherlands and that in the process become the (temporary) property of a resident, without it being subjected to industrial processing.

Re-export, among other things, concerns goods that are cleared by Dutch distribution centres and that are delivered to other countries. Re-export, in contrast to transit, forms part of the import and export.

**R&D (Research & Development)**

An activity aimed at originality and innovation and consisting of the creative, systematic and planned search for solutions to practical problems. The activity also includes strategic and fundamental research in respect of which acquiring background knowledge and increasing (purely) 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.

**R&D expenditure**

Expenditure on R&D performed by in-house 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 WBSO grants is taken into account.[1)] This means that amounts spent by a company on subsidised R&D staff count as R&D expenditure even if the 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 (gross domestic product). This measure expresses the magnitude of R&D relative to the size of the total economy.

**Sales**

Sales represent the total revenue of goods and services sold.

**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

1) Promotion of Research and Development Act. This Act provides for a tax stimulus for (private) R&D by reducing the payroll tax owed for R&D staff.

Microsoft Outlook or Lotus Notes and/or connecting with business and other wireless networks.

**Solow residual**

The part of labour productivity growth that remains after the contribution of the growth in the amount of physical capital per unit of labour has been deducted from it.

**Tablet**

A tablet is a hand-held computer with a touch screen. It can be seen as a large smartphone or as a small laptop without a keyboard.

**Valorisation**

Valorisation is the process that converts knowledge into commercially feasible products, processes or services (money).

**Volume change**

The weighted average of the changes in the quantity and quality of the components of certain goods, services or balance transactions.

**Volume of labour**

The amount of labour used in the production process expressed in terms of working years or hours worked. A working year is calculated by converting all jobs (full-time and part-time) in any one year to full-time equivalents (FTEs).

**Working year**

A measure of the volume of labour calculated by converting all jobs (full-time and part-time) in any one year to full-time equivalents (FTEs).

# Contributors to the publication

**Authors**

M.M.P. Akkermans
P.J.G.M. Claessen
P. Donselaar (Ministry of Economic Affairs, Agriculture and Innovation)
N.M. Heerschap
H.N. de Heij
A.D. Kuipers
J.M.M.J. Nieuweboer
D. Pronk
G.P.E.A. Sleijpen
L. Wielenga-van der Pijl

**With the assistance of**

M. Andriessen MA (NL Kabel)
Th.B. Fielmich (Ministry of Economic Affairs, Agriculture and Innovation)
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)
C. Oosterlaken
C. van der Vlis
G.H. Wassink

**Final editing**

B. de Groot
L.E. Hoeksma