The digital economy 2009: Methodology

J.F.H. Hiethaar, L.E. Hoeksma, B. de Groot

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Explanation of symbols

.	= data not available
*	= provisional figure
**	= revised provisional figure
x	= publication prohibited (confidential figure)
0 (0,0)	= nil or less than half of unit concerned
–	= (between two figures) inclusive
blank	= not applicable
2008–2009	= 2008 to 2009 inclusive
2008/2009	= average of 2008 up to and including 2009
2008/'09	= crop year, financial year, school year etc. beginning in 2008 and ending in 2009
2006/'07–2008/'09	= crop year, financial year, etc. 2006/'07 to 2008/'09 inclusive

Due to rounding, some totals may not correspond with the sum of the separate figures.

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Information
Telephone +31 88 570 70 70
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I. Methodology

This methodological description of 'The digital economy 2009' discusses the following topics: ICT (information and communication technology), ICT goods and services, definition of the ICT sector, telecommunication infrastructure and the impact of ICT on society.

I.1 Information and communication technology

The abbreviation ICT stands for information and communication technology. The alternative term IT (information technology) is used less and less. Although today information technology and communication technology seem inseparable, this has not always been the case.

Information technology

Information technology is the technology for adequately providing people or machines with the information they require. Generally a computer is used to process data for the production of information. The way the data has to be processed, automation, is laid down in computer programs called software. A computer has four components: storage technology (memory), a calculation unit (processor), input (data and programs) and output (data or information). Although it is almost impossible to ascribe the invention of the computer to one single person, the Brit Charles Babbage is generally seen as the person who described the components of the modern computer for the first time in this way. He did so in 1834. Technology comprises more than the technical engineering processes required to design and construct. It also includes the skills and knowledge needed to apply these processes. Information technology applies the combined processes for collecting, recording, processing, storing, representing and transporting data.

Until the late 1970s only a small group of people working in computer centres physically worked with computers. Computer programmers had to supply their computer codes on punch cards and sometimes had to wait a long time for printed results that showed their progress. Most companies had only one or just a few computers, which in no way resembled the current personal computers. Increased chip capacity and the resulting smaller computer sizes changed all this. The influence of communication technology must also be mentioned in this respect.

Communication technology

The purpose of communication technology is to disseminate data (information). To do this it requires a source, a transmitter, a channel, a receiver and a destination. Communication technology has improved substantially in the last two decades, and new technologies continue to emerge. Alongside the 'old' forms of information exchange across large distances, such as radio, television and fixed telephone lines, a growing number of new forms are now commonplace, including the internet and mobile telephone.

The rapid developments in communication technology have made the old type of computer, entirely based on information technology, obsolete. The combination of information and communication technology has greatly simplified the use of computers. The use of keyboards has made it easy to operate computers, and the presentation of information on screen has also become common. This is all based on communication technology.

As the available technologies became smaller and smaller in size, and cheaper and cheaper to produce, computers showed up not only on office desks in the 1980s, but also increasingly at home. Initially, home computers were game computers that had to be connected to a television set, and which sometimes used a tape recorder as storage device. The development of faster chips made it possible to develop the personal computer. Since then, computer developments have led to the widespread availability of information and communication technology without too many financial or physical obstacles. Many new forms of ICT have been developed alongside the computer, such as mobile telephones, network tools and satellite systems. Computer technology is now also commonly 'embedded' in appliances such as washing machines and microwave ovens, making ICT even more widespread. These technologies are also applied in the industrial production processes.

I.2 ICT goods and services

Products that serve primarily to process data electronically and/or provide communication are defined as ICT product. Without ICT these products, which include tangible goods as well as services, would not exist. In *The digital economy* series there is a strict distinction between goods and services. 'ICT goods' are hardware or hardware components, while 'ICT services' are services exclusively aimed at electronic data processing (including the production of software) and/or communication.

Statistics Netherlands uses several goods and services classifications. They play a key role in the compilation of the National accounts (NA). The NA integrate all data on companies collected by Statistics Netherlands and make estimations for those parts of the economy that are not observed. This results in a complete and consistent description of the Dutch economy. The OECD has defined an international list of ICT goods based on the classification of goods used in the international trade statistics. There is no internationally accepted definition of ICT services yet.

The national accounts distinguish the following ICT goods: '*office machines, computers and peripherals, insulated wire and cable, integrated circuits, other electronic components, transmitters, TV cameras, telephones, components of telephones, radios, televisions, other audio and video equipment, components for radios and televisions, equipment for measuring, checking, testing, navigating and other purposes, components of that equipment, industrial process control equipment, watches and clocks*'.
The national accounts distinguish the following ICT services: '*post office counter services, postal services, courier services, telecommunication services, computer and related services, software consultancy and supply services, production of own software*'.

Listing the ICT goods and services is a necessary starting point for the description of the digitalisation of society. The ultimate aim of Statistics Netherlands' ICT study is to map out the use society makes of ICT and its social and economic impact.

I.3 Defining the ICT sector

In statistical surveys, companies are classified by their 'main activity'. Roughly speaking the ICT sector consists of companies whose main activity is the production of ICT goods and services. These companies may also engage in other major activities besides these ICT goods and services. On the other hand, not all ICT goods and services are produced by the ICT sector. Manufacturers, for example, may produce software for their own use as a secondary activity.

Standard Industrial Classification

Statistics Netherlands uses its own Standard Industrial Classification for a uniform classification of the economy. This classification was last revised in 2008 (SIC 2008). The classification covers all economic activities, i.e. activities leading to the production of goods or services. The design of the Standard Industrial Classification takes the EU regulations into account, as laid down in NACE (Nomenclature of economic activities in the European Community).
The Standard Industrial Classification (SIC) is used in all surveys conducted by Statistics Netherlands in which results are broken down by economic activity. In principle, the most detailed level of the classification was designed for statistics describing the production process. Because of the costs and the reduction of the administrative burden, Statistics Netherlands does not collect and publish data at the lowest level for all its statistics. Confidentiality constraints may also prevent more detailed publications.
Despite the introduction of SIC 2008, not many results under this new classification are available. Results for years before 2008, in particular, are mostly based on the 'old' SIC93 classification. For that reason results according SIC93 are presented in *The digital economy 2009*. Where possible results according SIC 2008 are used. In chapter 4 of the publication, which describes ICT use by companies, SIC 2008 is almost exclusively used. This is somewhat at the expense of comparability with previous years, but by using the most current SIC the descriptions reflect the current state of affairs better and are in line with the international standard.
Chapter 2 of *The digital economy 2009* discusses, among other things, the ICT sector. Because of the limited availability of (international) figures on the ICT sector under SIC 2008, figures according SIC93 are used. Table I.3.1 shows the SIC classes that are included in the ICT sector in this publication. The definition is based on the OECD guidelines. See section 2.2 of *The digital economy 2009* for the definition of the ICT sector, including SIC 2008.

Table I.3.1
Definition of the ICT sector (SIC93)

SIC93	Activity
ICT industry sector	
3000	Manufacture of office machinery and computers
3130	Manufacture of insulated wire and cable
3210	Manufacture of electronic components
3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
3230	Manufacture of audio and video equipment
3320	Manufacture of equipment for measuring, checking, testing, navigating and other purposes
3330	Manufacture of industrial process control equipment
ICT services sector	
6400	Post and telecommunication
7200	Computer service and related activities

Source: OECD / Statistics Netherlands

An activity classification based on main activities does not provide a perfect overview of all ICT-related activities. For example, an ICT department within a bank is not included in the ICT sector, whereas people working in the childcare centre of a major ICT consultancy are included.
In addition, the volume of the ICT market does not correspond with the turnover in the ICT sector. Here the ICT market is seen as the virtual place where supply and demand of ICT goods and services meet. The volume of this market can be quantified by the turnover realised in ICT goods and services. The domestic ICT sector - a provider of ICT goods and services - is of course a key market player; however, as mentioned before, ICT goods and

services may also be provided by non-ICT companies. Moreover, ICT goods are imported on a large scale and partly marketed through domestic wholesale.

Content sector

Opinions differ as to whether the content sector should be considered part of the ICT sector. Certain companies distribute content with the specific aim to provide services via digital networks, while they are still classified as companies that provide comparable services through traditional channels. One example is news provided on the internet. These activities will not be considered an ICT service because the product – news – is seen as the primary criterion, not the distribution channel.

I.4 Telecom infrastructure

New communication technologies have made it possible to use computers more easily in work processes and to sell them as consumer products. Initially changes to the actual machines resulted in innovations in computer use, but since the 1980s the introduction of internal and external networks has been responsible for revolutionary new computer use. These far-reaching developments have in turn led to new kinds of business management and consumer behaviour. This section deals with concepts and developments used in telecom infrastructure and the services they help to provide. Figures on telecom are included in chapters 2 and 3 of the publication.

Delineating telecom infrastructure

The word 'infrastructure' conjures up connotations of spatial matters and physical facilities that connect places. In this sense, in *The digital economy 2009* telecom infrastructure includes all facilities that use information and communication technology to link spatial points. This interpretation assumes that the facilities are characterised by a certain immobility. The definition is strict. Just as a car is not part of the road network, a computer is not part of the telecom infrastructure. Like the computer, the telecom infrastructure is an application of ICT, but the two serve different purposes. The telecom infrastructure is mainly for transmitting data, while a computer is for processing or collecting these data before they are sent. A computer is part of an infrastructure if it is an integrated part of the technology used to operate the infrastructure (servers).

The term telecom infrastructure as used in this publication is in fact the total collection of electronic communication networks: a modern version of the traditional rail and road networks. Data are sent electronically via the telecom infrastructure, but the impact is more far-reaching than the physical process alone. In fact the telecom infrastructure creates a growing virtual world in which time and distance lose some of their meaning. This can have major social consequences, just as the arrival of the railways did.

In the future, ad hoc or spontaneous networks will play an increasingly important role. Devices will discover their physical proximity to each other and will link up to form temporary unique networks without the intervention of an operator, while it may also be possible to contact wider electronic networks through one of the devices.

Electronic communication networks may have different physical layouts. Some cables transmit electrical signals, other cables transmit light signals. There are wireless techniques such as WiFi, WIMAX and UMTS. These all share the fact that they are wireless with older technologies like radio and television, but in terms of application they are an extension of

existing cable networks. The emergence of wireless technologies has vastly expanded the telecom infrastructure.

End of network devices

ICT goods using the telecom infrastructure are referred to by the somewhat outdated term 'peripherals'. These include (mobile) telephones, faxes, computers, printers, televisions and radios. In fact these goods are also seen as interchangeable intelligent access points to the infrastructure. Not all ICT goods belong to this category as they also include goods that cannot be connected directly to the telecom infrastructure, for example because they are not appliances that can be used in their own right (diodes, transistors, processors and ICs).
The chapter on telecom infrastructure addresses the penetration of peripherals in society in general. This shows the scale on which telecom infrastructure is used and by which peripherals. The more specific use of the telecom infrastructure and its peripherals by companies, households and in the public sector is discussed in chapters 4, 5 and 6.

Internet as leading technology

The internet is an abstract term for a worldwide network. Computers linked to the internet make use of the internet protocol. This standard protocol, developed in 1977 under the name TCP/IP (Transmission Control Protocol /Internet Protocol), enables networks to be linked to each other.
The first network, ARPANET (Advanced Research Projects Agency Network), was set up in the 1960s by the U.S. Department of Defence as a network that would continue to operate even if parts of it were damaged. Therefore it was designed as a web structure rather than a linear structure that would allow only one single route between two computers. The network expanded over the years as other networks were linked up. These networks are owned by 'network providers' or 'internet backbone' providers. These providers are not interested in individual internet users, but in companies to whom they delegate the operational management. Such companies are called 'access providers'. They provide access to the services made possible by the internet. They have a fixed number of IP addresses, which are assigned to a client at random, per session or permanently. Access providers providing services rather than just access to the internet are called 'service providers'. The most common extra services are email, news groups and hosting (through which users can create their own website).

The internet protocol, which - in spite of the different views of Europe and the Unites States about control of the internet - is still monitored by national and international bodies, has become the standard for data transmission across the world. Its success is mainly based on its being an open standard that everyone can use and for which everyone can develop applications. In addition, more information is becoming available in digital form, which means it can be disseminated via the internet. For example: digital cameras. Before digital cameras came on the market, photographs had to be developed and digitised by scanners before they could be transmitted on the internet.

Access to the internet is very low-threshold for potential users. They have only to buy the peripherals and sign a contract with an access provider. The transport method itself is relatively simple and new elements can be introduced by changes at the access point to the network, mainly through software. The intensity of use has increased as a result of faster connections. Files for which network transmission used to be inconceivable, can now be sent through the internet (e.g. music and video files). In recent years, a great deal of money and effort has been invested in the backbone infrastructure, which links various local networks with the internet over long distances. The current capacity of these backbones is expected to suffice for quite some time to process the ever-increasing data

flows. Several chapters of the book show that the capacity of these connections in the Netherlands is very high in international terms.

Services via the telecom infrastructure

In terms of scope, capacity, speed of transmission and (technical) reliability, the usability of an electronic communication network is partly determined by its quality. Without a network, telecom services would not be possible. Almost all telecom services fall in one of two categories:
– making an electronic communication network available;
– providing an electronic communication service.

A reliable network is one that transmits information without failures, errors etc. Users must be able to rely on the fact that the information is received by the person it is addressed to, and does not fall into the wrong hands. Adequate handling of information flows increases public trust in electronic networks and indirectly also the use of applications. By privatising the post and telecommunications services (PTT), the Dutch government opted to no longer play a role in the active quality management of electronic networks. However, the government body Radio Communications Agency Netherlands (Agentschap Telecom) does monitor the continuity and availability of networks.
Companies that own a functioning electronic communication network can earn money by also making it available to others. This is a relatively new service. Originally, the owner of a network was also the sole provider of services through that network. Government measures, particularly the liberalisation of the telecom market, have brought about substantial changes in the past ten years.

Once a company has access to an electronic communication network, either as its owner or through a contract with the owner, it can provide a wide range of electronic services. Examples are analogue or digital transmission of television broadcasts, mobile and other telephone services, and internet access. Making available one or more email addresses is a standard service provided by most access providers in their paid packages. Hosting paid access internet sites is another service. However, only generating the information (the 'content') itself is not considered to be a telecom activity. A television production company, therefore, is not a telecom company. A newspaper that can be read on the internet carries out or insources telecom activities, but the actual compilation of the news reports is not a telecom activity.

I.5 The influence of ICT on society

The various developments and concepts discussed below are important for the understanding of the impact of ICT on the economy and on society. Many of the concepts are addressed in a quantitative context in the various chapters of *The digital economy 2009*.

Innovation and ICT

Looking back at the last decades, scientists sometimes refer to an ICT-created 'Fordism' crisis; Fordism, in this respect being a metaphor for the large-scale production of standardised goods for mass consumption by using routine production methods. Flexibility is seen as a key characteristic of more recent production methods. Flexibility in both the production process itself and the organisation of the production within and outside the company. The introduction of automation to make production processes more efficient has made it possible to produce cheaper and better quality products on a smaller scale (Oerlemans, 1996).

Much has been written about the specific relationship between innovation and ICT. The original theories referred to the manufacturing industry, and used the life cycle of a product as a basis to describe product innovation. According to these theories, a product passes through several stages before it reaches a certain standardisation, and just how these stages develop is determined by competition with respect to quality differences, investment and (apparent) chance.
However, it is more difficult to apply this theory to the services industry, which has become increasingly important in recent decades, also in terms of ICT applications. Therefore a similar theory has been developed for the services sector. With the introduction of the 'reversed product cycle' concept, Barras was the main exponent of those arguing for an explicit services approach. He described the 'reversed product cycle' based on his studies of the developments in financial and business services (Barras, 1986 and 1990). In short, he argues that innovations in services, including ICT services, first take place in the processes and only afterwards in the products themselves. Barras saw technology as the determining factor in innovation. This led to criticism from others, who felt that non-technological aspects did not receive enough attention and that innovation did not always necessarily result in a product (Gallouj, 1998 and Uchupalanan, 2000). Barras, like Oerlemans before him, noted that the major companies play a key role in the first stages of the application of new technology. However, their lack of flexibility gets them into difficulties in the later stages. Barras' studies are mainly based on innovation initiated by suppliers. Other authors stress other sources of innovation, such as customers and company employees. Statistics Netherlands' *Kennis en economie* series contains detailed information about innovation.

Dutch authors, like Goedvolk, have also described the role of ICT in innovation (Goedvolk, 1995). Goedvolk states that ICT is going through an evolution similar to all other new technologies. The first two stages are denial ('No, it is not important') and exploration ('Maybe we should take a look at it'). In the third stage, that of replacement, a company looks at which current operations could use the new technology in the future. This is done with a view to increasing efficiency without essentially changing the process. In the fourth stage, integration, the various new technological applications are studied in context and combined to form a new joint infrastructure. The new technological applications must meet demands in terms of production processes and organisation. In the fifth stage, transformation, business processes are adjusted because the new technology makes some processes redundant or allows them to be carried out elsewhere. Goedvolk indicates that companies often look beyond their own four walls during transformation. They make decisions based on opportunities and risks, and are concerned with their own competitiveness and environment. At this stage, the technology results in new products or services, and may trigger a restructuring of customer and supplier networks. The sixth and last stage, transparency, is reached when the interaction between technology and processes has developed to a point where people understand how they can make even better use of the technology. They perceive it as normal and do not need to know exactly how the technology works to be able to use it. Examples of this are the telephone and the car.

E-business and e-commerce

The physical presence of computers does not say much about the degree of computerisation in a company. What counts is what the organisation actually does with these computers: the question is how ICT can best be used as an instrument. The idea that there is one best way of ICT management was abandoned some thirty years ago. The importance of appropriate non-technological innovations to complement technological ones is now generally acknowledged. In business process re-engineering (BPR), organisations are required to reorganise their structures radically with the aid of new technology in order to survive. Enterprise resource planning (ERP) systems are software tools ('enablers') that are only profitable if companies are prepared to invest in

BPR beforehand. In combination with workflow software, these ERP systems facilitate the numerous electronic business activities that are thus generated. E-business is discussed in detail and quantified in chapter 4 of the book. E-business seeks to create synergy between traditional and new business methods, and use the opportunities offered by ICT in the best way possible.

It took a long time to reach a consensus about the definitions of e-business and e-commerce. E-business was generally defined as doing business with the help of ICT and ICT applications. E-commerce is an element of e-business and consists of initiating or concluding transactions through electronic networks: the actual purchasing or selling of goods and services. A distinction can be made in e-business between companies (business-to-business or B2B) and between companies and consumers (business-to-consumer or B2C). Opinions on the definitions differed mainly with respect to whether e-commerce referred only to trade through the internet or also through other electronic networks such as EDI. Increasing political and media interest in e-commerce made it necessary to end the confusion. Therefore, in 1999 the OECD decided to set up an international working group to compile a definition of e-commerce that could be used in policymaking and that was statistically reliable and feasible (see Pattinson, 2000). The working group compiled two definitions of e-commerce with the following dimensions: the network used for e-commerce, and the business processes related to e-commerce. The 'broad' definition concerns the purchase and sale of goods or services via computer networks in which the activity relating to purchase and sale refers to the order, and not to payment or delivery. The 'narrow' definition only deviates in one aspect: the network used to order the goods and services is the internet. In 2009 an international OECD working group started work on a definition of e-commerce in which this distinction between a broad and a narrow definition may be revised.

Stages of e-business

In the literature, the intensity of e-business is often described as developing in stages. The stages described below are taken from the Agency for International Business and Cooperation (EVD), part of the Dutch Ministry of Economic Affairs.
The EVD facilitates and stimulates international business and international cooperation. The approach of classifying companies by stage of development is based on the sales perspective. Companies in stage 1 only make passive use of external data communication. These companies use facilities provided by others, but do not have any facilities themselves on the internet; for example companies that purchase via the internet. In stage 2, companies who have only a website, only provide information via the internet. Companies in stage 3, transaction, sell products online. In stage 4, companies offer after-sales support and communicate with third parties through the internet. And lastly, in stage 5, companies have linked their computer system to that of customers or suppliers, and computerised certain processes between the own company and third parties such as clients or suppliers. Each stage is more or less the next step in the support of business processes by external data communication. In spite of the supposed logic or sequencing in the automation process of companies, it is not true to say that a company can only reach stage 4 if it has successfully completed the three preceding stages. Some companies sell products electronically without having a website. The approach 'permits' this.

Motives, consequences and risks of e-business

E-business seems to be here to stay. The motives for doing business online are not the same for all companies, however. Cost reduction and better customer service are the main reasons for doing business electronically.

Retailers have a traditional interest in personal contacts (customers in their shops). However, if their customers are no longer bound to their local shops, retailers will have to compensate by attracting customers from elsewhere, for instance through the internet. The motives for consumers to shop online are mainly convenience and a better overview of what's for sale. Market forces are gradually shifting as a consequence of e-business. The position of consumers, the demand side, seems to become stronger, as it is easier to compare products and prices. The traditional distribution trade is having to rethink its position because manufacturers can now also sell directly to consumers or can use other intermediaries (such as e-markets). Naturally, new ways of doing business involve risks. A well-known pitfall is the confusion of technology with market demand (i.e. it is technically possible, but no one wants it). Management is also sometimes insufficiently involved in the innovations, so that projects proceed too slowly to be successful.

Offshore outsourcing

One - literally - far-reaching consequence of computerising business processes is that they can be easily transferred and managed at a distance. As mentioned above, the use of ICT can lead to changes in the distribution of labour in a production and distribution chain. This may involve offshore outsourcing. Outsourcing means that a company transfers services it can provide itself to another company. The term offshore originally comes from oil and gas exploration as an indication of activities at sea. In practice, offshore outsourcing of ICT entails ICT services being transferred to another country.

Consequences for the public sector

Outside the business sector, too, there is a wide interest in the role ICT can play in improving business processes and customer contacts. The arrival of the internet makes it possible for the public to access a wealth of information on, for instance, legal or health issues, and thus become a well-informed party. The government is expected to account for its actions through easily accessible information on internet sites. With the aid of ICT, a modern and efficient government is expected to communicate with its citizens and with companies not only through traditional physical contacts and paper forms, but also through the internet. Several of these aspects and government progress in these areas are discussed at various places in the book.

Digital society

At the end of this section on the effects of ICT on society, the conclusion is that there are noticeable changes in society that can be called a transition toward a 'digital economy' (OECD, 2008). Changes occur in ways of doing business, but also in the social interaction between individuals and between organisations and individuals. These changes therefore have a significant impact on the economy, and in a wider context on virtually all aspects of society.

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