I. Methodology

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 desire. Generally a computer is used for processing 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 there is not really a single inventor of the computer 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 is more than technique. It also involves the skills to apply the techniques. Information technology applies the combined techniques for gathering, 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 they had to wait a long time for the printed results that showed what progress they were making. Most companies only had one or just a few computers which did not resemble the current personal computers in any way. The increased capacity of chips and the resulting miniaturisation of computers 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 or information. The following aspects play a role: source, transmitter, channel, receiver and destination. Communication technology has greatly improved in the last decade, and new techniques continue to emerge. Old forms of exchanging information across great distances, such as radio, television and fixed telephone lines, have been complemented by a growing number of new forms of which the internet is best-known.

The rapid developments in communication technology also 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. Keyboards have been used for years to instruct computers in a simple way, and accessing information on screen has also become common. Communication technology is at the basis of this.

As a result of the continuous miniaturisation of technologies and cheaper production methods the computer turned up not only on the desks of employees in the eighties, but also increasingly in the home. Initially the latter were mainly game computers that had to be connected to the television and where the tape recorder sometimes served as the storage device. The development of faster chips made it possible to introduce 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. New forms of ICT have developed alongside the computer, such as mobile phones, network tools and satellite systems. There are also embedded applications of computer technology in washing machines or microwave ovens, where the number of computer components is kept to a bare minimum, which make ICT even more widespread. Such software is also applied in the industrial production process.

I.2 ICT goods and services

Products that serve primarily to process data electronically and/or provide communication are considered to be ICT products. Without ICT these products, which include tangible goods as well as services, would not have become available. In *The Digital Economy* series there is a strict distinction between goods and services. ICT goods refers to hardware or its components. Likewise, services exclusively aimed at electronic data processing (including the production of software) and/or communication are referred to as ICT services.

Statistics Netherlands uses several goods and services classifications. They play a key role in the compilation of the National accounts (NA) by Statistics Netherlands. In compiling the NA all data gathered by Statistics Netherlands on companies are incorporated and estimates for those parts of the economy that are not observed are made. In this way Statistics Netherlands arrives at a complete and consistent description of the Dutch economy.

Internationally the OECD has defined a 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, telecommunications 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 the ICT study by Statistics Netherlands 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 which have the production of ICT goods and services as their main activity. 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 sideline.

Standard Industrial Classification

Statistics Netherlands uses its own Standard Industrial Classification for a uniform classification of the economy. This classification was last revised in 1993 (SIC93). 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, laid down in NACE (Nomenclature of economic activities in the European Community).
The Standard Industrial Classification 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 the 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.

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. However, there is a slight difference between the definition of ICT services used in *The Digital Economy 2008* and the OECD guidelines. This is discussed further in the glossary.

An activity classification based on main activities does not provide a perfect view 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 child-care centre of a major ICT consultancy are included.

Table I.3.1
Definition of the ICT sector

SIC93	Characterisation of the 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 telecommunications
7200	Computer and related activities

Source: OECD/Statistics Netherlands.

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 as 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 and not the distribution channel.

I.4 Telecom infrastructure

As a result of new communication technologies computers can now be used more easily in work processes and as consumer electronics. Initially changes to the actual

machines resulted in innovations in computer use, but since the eighties the introduction of internal and external networks have 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 it provides. Figures on telecom are included in chapters 2 and 3.

Delineating telecom infrastructure

The word infrastructure conjures up associations with spatial matters and physical facilities that connect places. In that sense telecom infrastructure in *The Digital Economy 2008* includes all facilities that link points through information and communication technology. In addition 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. The telecom infrastructure is an application of ICT as is the computer, but the two serve different purposes. The telecom infrastructure is mainly for transmitting data while a computer is for processing or gathering that data before sending them. A computer is part of an infrastructure if it is an integral part of the technology used to operate the infrastructure (servers).

The telecom infrastructure as used in this publication is in fact the total collection of electronic communication networks, making them 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 Wi-Fi, WLL, 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 with the somewhat outdated term peripherals. These include telephones, mobile phones, 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, e.g. 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 at the global level. 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 the public sector are 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 onto the market, photographs had to be developed and digitalised by scanners before they could be transmitted on the internet.

Access to the internet is very low-threshold for potential users, who only have to buy the peripherals and sign an agreement with the access provider to go online. 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 transmission via a network used to be unimaginable, 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.

Services via the telecom infrastructure

The usability of an electronic communication network in terms of scope, capacity, speed of transmission and (technical) reliability is partly determined by its quality. Without a network, telecom services would not be possible. Almost all telecom services are covered by 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. The Dutch government privatised the post and telecommunications services (PTT), thus opting to no longer play a role in the hands-on quality management of electronic networks. However, the government body Radiocommunications Agency Netherlands (Agentschap Telecom) does monitor the continuity and availability of networks.

Companies that own a functioning electronic communication network can earn money by making it available to others as well. 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 communication services. Examples are analogue or digital transmission of television broadcasts, providing 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 (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 conducts 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

Below, various developments and concepts are discussed that are important for the understanding of the impact of ICT on the economy and on society. Many of the concepts are addressed in various chapters of *The Digital Economy 2008*, but in a more quantitative context.

Innovation and ICT

Looking back at the last decades, scientists sometimes refer to an ICT-created 'Fordism' crisis. Fordism 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 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 then 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 publishes a series *Kennis en economie* detailing 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 aid of the new technology in the future. This is done with a view of increasing efficiency without essentially changing the process. In the fourth stage, that of 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, that of 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 will result in new products or services, and may trigger a restructuring of customer and supplier networks.

The sixth and last stage, that of 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 therefore how ICT can best be used as an instrument. The idea that there is a best way of ICT management was abandoned some thirty years ago. The importance of appropriate non-technical innovations to complement technical innovations is now generally acknowledged. In business process re-engineering (BPR), organisations are required to radically reorganise their structures 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 before. In combination with workflow software, these ERP systems facilitate the numerous electronic business activities that are thus generated. E-business is discussed in detail in chapter 4 of the publication. E-business seeks to create synergy between traditional and new business methods, and best use the opportunities offered by ICT.

For a long time, there was no 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 on the question if e-commerce only referred 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.

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 entrepreneurship and international cooperation.

The approach of classifying companies by their stage of development is based on the sales perspective. There is a certain logic to this. 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. They can purchase via the internet, however. In stage 2, companies who have only a website only provide information via the internet. Companies reach stage 3, that of transaction, when they are in a position to 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, 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 the case that a company can only reach stage 4 if it has successfully completed stages 1, 2 and 3. Some companies sell products electronically without having a website. The approach 'permits' this.

Motivations, 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 has to rethink its position because manufacturers can now also sell directly to consumers or 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. 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 in section 6.1.

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 consumption: ordering products and services and gathering product information such as information on prices online.
Apart from e-commerce, teleworking is another example of advances in digitalisation. A third example is the social interaction between individuals, the public and the private sector. Individuals can more easily get in touch than before the introduction of ICT

by using Hyves, web logs and chatting. So this is a qualitative change (new options) as well as a quantitative change (saving time).
Households also spend their time differently, because in the last decade the population increased their computer time at the expense of watching television. The most evident example is of course the use of the mobile phone: in a relatively short time almost the entire population got mobile phones, reducing certain barriers in communication.
These examples show the impact of ICT on society, which now looks very different than ten years ago thanks to ICT. Perhaps a decade is too short to draw well-founded conclusions, because major technological changes take time to jell. The argument in this edition is that the impact of ICT is mainly in the C of ICT.
Prior to the financial internet hype (before the bubble burst) economists figured that the economic transactions in particular would change due to ICT, e.g. because information would no longer be scarce, because new markets would be created, and because production chains would be drastically changed. Such changes did take place, but with hindsight we see that the economic impact was overestimated. The social impact of ICT, though, has been greater than predicted.