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 are apparently inseparable, this has not always been the case.

Information technology

Information technology is technology aimed at providing people or machines adequately with the information they need to perform well. To produce information, data are usually processed by computers. The way in which they have to be processed – the 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 not possible to point to one single inventor of the computer, the Brit Charles Babbage is widely accepted to be 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 just the mechanics; it also incorporates the skills applying these mechanics. Information technology combines the mechanics of collecting, recording, processing, storing, representing and transporting data.

Until the late 1970s, only a few people – working in computing centres – physically worked with computers. Even computer programmers had to hand in their computer codes on punch cards and sometimes had to wait a long time for their printed results that showed what progress they were making. Most companies had only a single PC or a few computers, which did not resemble the current personal computer (PC) in any way. The increased capacity of microprocessors and the consequent smaller and smaller sized computers changed all that. 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 elements play a role in communication technology: source, transmitter, channel, receiver and destination. The technology used for communication has greatly improved in recent decades, and new technologies continue to emerge. Old forms of exchanging information across large 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 simplified the use of computers. For quite some time now users can give computers instructions via the keyboard, while on-screen access to information has also become common. Communication technology is at the basis of these options.

As a result of the continuous miniaturisation of technologies and cheaper production methods, computers started to appear not only on the desks of company and government employees by the early 1980s, but also more and more in the home. Initially, these were mainly game computers that had to be connected to a television set and which sometimes used a cassette recorder as the storage element. The development of faster microprocessors enabled the introduction of the personal computer (PC). Since then, the development of the PC has led to an almost universal availability of information and communication technology without too many financial or physical obstacles. Apart from PCs, there are now many new ICT forms, such as mobile telephones, network equipment and satellite systems. As a result of 'embedded' applications of computer technology in things like washing machines and microwave ovens – where the number of computer components is minimised to the bare necessities – ICT is becoming more widespread. This is even more the case for 'embedded' software in all kinds of machinery and equipment used in (industrial) production processes.

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 exist. In this publication, there is a strict distinction between goods and services: goods refer to equipment (hardware) or its components; services aimed exclusively at electronic data processing (including 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, which incorporates all data gathered by Statistics Netherlands on companies, and estimates for parts of the economy that are not observed. In this way, Statistics Netherlands arrives at a complete, 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 currently distinguishes 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 of radios and televisions etc., equipment for measuring, checking, testing, navigating and other purposes, components of that equipment, industrial process control equipment, watches and clocks.

The National Accounts currently distinguishes the following ICT services:
postal services, post office counter 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 only a starting point for the study of the phenomenon ICT. The ultimate aim of the ICT study is to map out the use society makes of ICT and the social and economic consequences of this; in short: the impact of ICT.

I.3 Defining the ICT sector

Once ICT goods and services have been defined, the next step is to determine exactly what an ICT company is. In statistical surveys, companies are classified by their main activity. Roughly speaking, companies whose main activity is producing ICT goods and/or services belong to the ICT sector. These companies may also produce other products besides ICT goods and services. On the other hand, not all ICT goods and services are necessarily produced by companies in the ICT sector. Companies in the manufacturing industry, for example, may produce software for their own use as a sideline.

Standard Industrial Classification

Statistics Netherlands uses its own Standard Industrial Classification (SBI) for a uniform classification of the economy. This classification, last revised in 1993 (SBI93), covers all economic activities, i.e. activities leading to the production of goods and services. The SBI design takes EU regulations into account, such as those laid down in the NACE (*Nomenclature générale des Activités économiques dans les Communautés Européennes*).

The SBI 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.

Table 1.3.1 shows the SBI classes that are included in the ICT sector in this publication. These are based on the OECD guidelines. However, there is a slight difference between this publication and the OECD guidelines in the case of ICT services. This is discussed further in the glossary.

As activity classifications based on main activities do not provide a perfect view of the total volume of a particular activity, not all ICT-related economic activities are included in this publication. For example, an ICT department within a bank is not included in the ICT sector, whereas staff of a child-care centre within a large ICT consultancy are included in this sector.

Table I.3.1
Definition of the ICT sector

SBI93	Description of activities
ICT industry	
3000	Manufacture of office machines 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 instruments and appliances for measuring, checking and testing
3330	Manufacture of industrial process control equipment
ICT services	
6400	Post and telecommunication
7200	Computer service bureaus, etc.

Source: OECD/Statistics Netherlands.

In addition, the volume of the ICT market does not correspond with 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 on ICT goods and services. Naturally, the domestic ICT sector is a key market player as a provider of ICT goods and services. However, as mentioned above, ICT goods and services may also be provided by non-ICT companies. Moreover, ICT goods in particular are imported on a large scale and partly marketed through domestic wholesalers.

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 in the sector of companies who provide comparable services through traditional channels. One example is

news provided on the internet. For the time being, these activities will not be considered as ICT services because the product – news – and not the distribution channel is seen as the primary criterion.

I.4 Telecom infrastructure

As a result of new communication technologies, computers have become easier to use in the work place and also affordable as consumer goods. Initially, changes to the actual machines resulted in innovations in computer use, but since the 1980s the introduction of internal and external networks have been the main revolutions. These far-reaching developments have in turn led to new kinds of business management and consumer behaviour.

This section looks at the concepts and developments used in telecom infrastructure and the services it provides. Quantitative research data are presented in chapter 3 of the book, which is entirely devoted to telecom infrastructure.

Delineating telecom infrastructure

The word 'infrastructure' produces associations with physical facilities that connect places in space. In this sense, telecom infrastructure in this publication includes all facilities linking points in space with the aid of information and communication technology. In addition, this interpretation assumes that the facilities are characterised by a certain immobility. The definition is a strict one: just as a car is not part of a road network, so a PC is not part of the telecom infrastructure. The telecom infrastructure is an application of ICT, just as the PC, but the two serve different purposes. The telecom infrastructure is now mainly aimed at transmitting data, while a PC is mostly used to process or gather the data before sending them. A computer is part of the telecom infrastructure if it is an integral part of the technology used to operate the infrastructure (servers for example).

The telecom infrastructure as seen 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. Via the telecom infrastructure, the data are sent electronically, 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 railway networks did.

In the future, ad hoc or spontaneous networks will play an increasingly important role. Computers will discover their physical proximity to each other and will link up to form temporary unique networks without the intervention of an operator, while there is still the possibility that one of the machines is in contact with wider electronic networks.

Electronic communication networks may have physically different layouts. Some cables transmit electrical signals, for example, others transmit light signals. The new wireless WiFi, WLL and WiMax technologies share the fact that they are wireless with older technologies such as radio and television, but in terms of application they are an extension of existing cable networks. The new wireless technologies have vastly expanded the telecom infrastructure.

Appliances to access the networks

Alongside the telecom infrastructure are the ICT goods that use the infrastructure. Denoted by the collective term peripherals, these include for example telephones, mobile telephones, faxes, personal computers, printers, television and radio. In fact, these goods are also seen as interchangeable intelligent access points to the infrastructure. Not all ICT goods belong in this category, as they also include items that cannot be connected directly to the telecom infrastructure, for instance because they are not appliances that can be used in their own right (e.g. diodes, transistors, processors and ICs).

The chapter on telecom infrastructure addresses the penetration of peripherals in society, showing the scale on which the telecom infrastructure is used, and by which peripherals. The more specific use of the telecom infrastructure and its peripherals by companies, the public sector and households is discussed in chapters 4, 5 and 6 respectively.

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 US Department of Defence as a network that would continue to operate even if parts of it were damaged. To realise this, it was designed as a web structure rather than a linear structure which 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 the network providers or internet-backbone providers. The providers are not interested in individual internet users, but in companies to whom they delegate the operational management. These companies are called access providers: they provide access to the services made possible by the internet. They have a vast number of fixed IP addresses, which are assigned to clients at random per session, or permanently. Access providers providing more services than just access to the World Wide Web are called service providers. The most commonly known services are e-mail, news groups and hosting (through which users can operate their own website).

The internet protocol, which - in spite of the different views of Europe and the USA about control of the internet - is still monitored by national and international bodies, has increasingly 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 therefore everyone can develop applications. In addition, more information is standardly 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 digitized 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 on-line'. 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 that previously could not have been transmitted via a network can now be sent through the internet (e.g. music and video files). In recent years, a lot of money and effort have been invested in 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

In part, the usability of an electronic communication network in terms of scope, capacity, speed of transmission and (technical) reliability is 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, a new government body (the Telecom Agency or AT) does monitor the continuity and availability of networks.

Companies which 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) telephone services and internet access. Making available one or more e-mail 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, 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 here being a metaphor for the large-scale production of standardised goods for mass consumption by using routinised 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 in this area 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, this theory is more difficult to apply to the services industry, which has become increasingly important in recent decades, also in terms of ICT application. 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 subsequently 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 in the first stages of the application of new technology such as ICT, it is the major companies who play the main roles. However, they get into difficulties in later stages because of their lack of flexibility. Barras' studies are mainly based on innovation initiated by suppliers. Other authors stress other sources of innovation, such as customers and company employees.

Dutch authors, like Goedvolk, have also described the role of ICT in innovation (Goedvolk, 1995). Goedvolk states that ICT is going through a similar evolution 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 operations could be done with the aid of the new technology in the future. The purpose then is to increase efficiency without essentially changing the process.
In the fourth stage – integration – the various new technological applications are studied in connection with each other and combined to form a new joint infrastructure. The new technological applications must meet demands in terms of connectibility and integration. Processes may be changed alongside these developments, but the processes are not directly related to the new technological infrastructure.
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 this transformation. They make decisions based on opportunities and risks, and are concerned with their own competitiveness and environment. In 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, 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 it 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 can ICT can best be used as an instrument. The idea that there is 'one best way of management' was abandoned some thirty years ago where technology is concerned. The importance of appropriate non-technical innovations to complement technical innovations is now

generally acknowledged. Under the notion of 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. 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 the opportunities offered by ICT in enterprises.

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 concluding or initiating a transaction through electronic networks: actual purchases and sales of goods and services. A distinction can be made between 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 point of exactly which ICT was referred to. 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 ordering, 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 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, transaction, when they are in a position to sell products online. In stage 4 companies offer after-sales support and communicate with third parties via 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.

Each stage is more or less a subsequent step in the support of business processes by external data communication. In spite of the supposed logic or sequence in the automation process of companies, it is not the case that a company can reach stage 4 only if it has successfully completed stages 1,2 and 3. Some companies sell products-on-line without having a website. The approach 'permits' this.

E-business seems to be here to stay. The motives for doing business-on-line are not the same for all parties in the process chain, however. For companies 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 (see also Adelaar, Bouwman and Steinfield, 2004). The motives for consumers to shop on-line 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 be becoming stronger, as it is easier to compare products and prices. The traditional distributive trades are having to rethink their position because manufacturers can now also sell directly to consumers or use other intermediaries (such as e-markets). It is too early to draw definite conclusions about the consequences of e-business, though. There are still a number of ongoing studies in this respect.

Naturally, new ways of doing business involve risks. A well-known pitfall is the confusion of technology with market demand (i.e. something that is technically possible, but which no one wants). Management is also sometimes insufficiently involved in innovation, with the result 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 - called offshoring in the publication – entails ICT services being transferred to another country. It has now become a serious subject, and is even on the political agenda.

Section 2.10 on 'globalisation' examines these issues in more detail.

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 via the internet. Several of these aspects and government progress in these areas are discussed in section 5.1.

The digital economy

At the end of this section on the effects of ICT on society, it can be concluded that there are noticeable changes in society that can be termed a transition toward a 'digital economy'. Changes occur in ways of conducting business, but also in the social relations between individuals and between organisations and individuals.