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KNOWLEDGE INDICATORS BASED ON SATELLITE ACCOUNTS
FINAL REPORT FOR NESIS – WORK PACKAGE 5.1

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Summary: Post-industrialised economies are often characterised as being more and more knowledge and information oriented. Most policy strategies aim at enhancing this knowledge orientation as a way to increase competitiveness and to provide better jobs. A good example in this context is the European Lisbon Strategy. This paper explores several modifications of the national accounts required to enhance the system's relation to indicators that are currently used to measure the role of knowledge in the economy. Strengthening this relationship is expected to increase the analytical strength of national accounting as well as that of indicators measuring the new economy.

Keywords: System of National Accounts, Knowledge-based economy, Satellite accounting and indicators

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Knowledge Indicators based on Satellite Accounts Final Report for NESIS – Work Package 5.1

1. Introduction

The System of National Accounts (SNA-1993, Commission of the European Communities et al., 1993) consists of an integrated set of macroeconomic accounts and balance sheets based on internationally agreed accounting conventions. The system contributes to the international comparability of a series of key macroeconomic aggregates or indicators such as Gross Domestic Product (GDP), net national income, consumption, fixed capital formation, and government deficit. Within the European Union, the European System of National Accounts (ESA-1995, Commission of the European Communities, 1996) has been given a solid legal basis in the form of a Council Regulation with greater accuracy put to definitions and accounting rules. This refinement was required to adapt the SNA to the needs within the European Community where the accounting principles of the ESA-1995 have served international economic policy purposes such as the European Growth and Stability Pact.

Defining and representing macroeconomic indicators in an accounting framework has several advantages. The SNA represents indicators in their macroeconomic context and the accounting wise definition and description of indicators contribute to their mutual coherence and comparability. Accounting helps to illustrate the significance of indicators in relation to the complete economy. Also, the accounting identities safeguard an exhaustive description of the entire economic system. They assure that each outlay corresponds to a receipt and that ultimately (ex post) total supply equals total demand.

An accounting system as the national accounts can be regarded as an information pyramid in which a detailed information system underlies the macroeconomic indicators on top. The national accounts provide and coordinate the information requirements of different kind of users. The key macroeconomic aggregates together provide the condensed set of indicators required for policy uses and quick (short-term) information transmissions. The underlying accounts are used for analytical purposes such as productivity analysis and macroeconomic modelling. Both user types are unified by one set of macroeconomic entities.

There is clearly one price to be paid: the SNA is revised only rarely. Since its origin in 1953, the SNA was updated only twice, in 1968 and in 1993. This infrequent updating has several reasons. First of all, the revision of a statistical manual with a size of approximately 700 pages is simply very costly and time-consuming. Secondly, one of the key applications of national accounting data is measuring and analysing economic growth by means of time-series analysis. The implementation of new accounting rules will inevitably cause unwanted discontinuities in time-series. The reconstruction of time-series according to new

accounting guidelines usually involves a substantial amount of work. This all implies that newly emerging phenomena are often difficult to instantaneously accommodate in the core national accounts framework.

Post-industrialised economies are often characterised as being more and more knowledge and information oriented. Most policy strategies aim at enhancing this knowledge orientation as a way to increase competitiveness and to provide better jobs. For example, at the 2000 Lisbon Summit, the European Union has formulated the ambition to transform itself into "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion".

The SNA-1993 clearly lags behind the information requirements of such policy strategies. For example, the system contains a rather obsolete classification of industries and products especially with respect to the wide range of newly emerging telecommunication and internet services. Also, the economic importance of knowledge remains underexposed. This underexposure is partly related to a rather restricted capital concept that does not take hold of human capital and research and development (R&D) as a way to create or produce knowledge capital.

One of the possibilities to overcome these shortcomings is to expand the analytical capacity of national accounting by way of so-called satellite accounting. In a specific chapter on this subject, the SNA 1993 explains how satellite accounting and analysis may increase the system's flexibility without overburdening the core framework. Satellite accounts expand the system by introducing additional monetary and non-monetary data on particular economic or social aspects, by using alternative or complementary concepts and classifications or by extending the coverage of costs and benefits of human activities. Examples of satellite accounts that have been put into practice at present are accounts for the environment, informal household production and tourism but also for R&D and human capital. Besides adding flexibility, satellite accounts are also helpful in exploring possible modifications that may be taken into consideration in future SNA revisions.

In the Netherlands, the basic principles of national accounting are systematically extended to a broader range of economic, social and environmental statistics. For this purpose, a so-called System of Economic and Social Accounting Matrices and Extensions (SESAME) is set out. SESAME is a modular statistical information system from which a set of core economic, social and environmental macroeconomic indicators can be derived. The most well known modules in SESAME are the Social Accounting Matrix (SAM) and the National Accounting Matrix including Environmental Accounts (NAMEA).[1] The reference of the SESAME information system to the set of Structural Indicators

[1] The terms 'satellite account' and 'national accounts module' (as part of SESAME) are used synonymously in this paper.

introduced to monitor policy progress in the context of the Lisbon Strategy was the main subject of a paper presented at the NESIS conference on statistical information systems for good governance within the new economy (de Haan et al., 2002). The paper explains that especially those Structural Indicators aiming at measuring economic performance in a wide sense are preferably embedded in an underlying accounting system. Such a 'systems approach' provides a solid statistical basis for policy evaluation. In this context, national accounts conventions play an important role. Most of the General Economic Background Indicators (GDP, labour productivity, public balance) are already directly derived from the national accounts.

The current paper reviews some of the possible features of a satellite accounting system for the knowledge-based economy. The wide range of indicators that has recently been introduced to measure the knowledge-based economy indicates the directions in which such an accounting system could be developed. In fact, several satellite accounts, earlier developed (in concept) at Statistics Netherlands such as a R&D module (Bos et al., 1994), a human capital module (Bos, 1996) and a knowledge module (van de Berg, 2000), provide some of the basic features of the module proposed here.

Goals of the research presented in the current paper are twofold. Firstly, to explore several changes in the SNA required to keep up with current developments in the new economy. Secondly, to illustrate the benefits of integrating knowledge-based economy related indicators in one accounting module. The following section raises a number of conceptual issues. Section 3 presents the proposed module, the underlying methods and results. Section 4 provides an overview of the indicators that may be derived from the module. The last section winds up with conclusions and suggestions for future work.

2. Conceptual issues

The production account represents a fundamental part of national accounting. This account explains how inputs, or the means of production, are allocated to outputs. Obviously, it is necessary to specify what is meant by inputs and outputs to make a production account operational. Therefore, demarcating the output of goods and services, i.e. the production boundary, is given extensive thought in the SNA. The inputs of production include both goods and services and labour. The use of goods and services in production is split-up in intermediate consumption and consumption of fixed capital. The latter represents the losses in value, due to their productive use, of those goods with a service life longer than one year. The SNA marks the latter category of goods as produced or fixed assets and their acquisition is recorded as investment.

The production and use of knowledge are rather implicitly, if at all, shown in the production account. This is a serious shortcoming since knowledge is usually considered one of the key determinants of economic growth and productivity

gains, i.e. the increase in output per unit of input. Without information on knowledge obtained by processes of learning and discovery, the national accounts are unable to sufficiently explain the behaviour of enterprises in general and more specifically the economy wide significance of technological and non-technological progress.

Obviously, it is important to start with a notion of how to define and to depict knowledge in economic accounting. In this context it is relevant to distinguish human skills, often referred to as human capital, from codified knowledge such as scientific and artistic originals. Human capital results from human capabilities, education and working experience. Although dissemination of knowledge via education and training may increase the value of human capital, its total value is equally determined by non-exchangeable virtues such as intelligence and imaginative powers. Human capital is inseparable from human beings and therefore principally not exchangeable. Codified and human embodied knowledge are usually considered complementary in nature.[2] In other words, the productive use of codified knowledge depends on the availability of human capital.

Hill (2002) argues that the increasing role of knowledge and information flows in post-industrialised economies necessitates reconsidering the classical goods and services dichotomy underlying the output classification in the 1993 SNA. The distinction between physical or material products on the hand, and immaterial services on the other, conceals the significance of what he calls intangible products in the new economy. Instead, he advocates a threefold categorisation of output: tangible products, intangible products and services.

Intangibles exist independently of its owner, can be exchanged, and have therefore much more in common with (tangible) goods than with services. Most services cannot be considered as independent entities and cannot be produced without the direct involvement of persons or objects subject to the service provided. Production and consumption of services usually take place at the same time. Also services cannot be stored while intangibles certainly can. In other words, the production of services is bound by clear time and spatial constraints. This means that the 'death of distance', often considered one of the key benefits of ICT in the 'new' economy, mainly applies to intangibles or services exclusively existing of information exchanges and to a much lesser extent to services in any other sense.

A revision of industry and product classifications interferes with all steps in the statistical production process: from the co-ordinated observation of entities to the integration of different kinds of statistics in the national accounts. Satellite accounting can help to separate the output of a restricted number of intangible goods from services. However, a full-scale reorientation of classifications, as recommended by Hill, cannot be accomplished independently from statistical

[2] See also CPB (2002) for a more detailed discussion.

surveying. Certainly, there seems to be a need for such a reorientation. Recent problems with measuring gross fixed capital formation in software show that the current product classification does not univocally divide software production from pure computer services (*e.g.* computer education, system's support).[3] Similar problems may occur when separately identifying the output of other intangibles such as those created by R&D.

2.1 Research and development

Codified knowledge results from activities such as research, designing and art creation. Contrary to human capital, codified knowledge can be stored and transferred. Several characteristics of codified knowledge coincide with the SNA criteria stated in the definition of fixed assets. It can be considered as a produced asset that is repeatedly or continuously used in processes of production often for longer time periods. Furthermore, it is likely to represent an economic value otherwise it would not have been produced. Indeed, the 1993 SNA considers the creation of books, recordings, films and software as the production of intangible fixed assets. Often, their productive use coincides with the reproduction and sales of copies that are subsequently used for production or consumption.

A rather remarkable exception is made for scientific originals such as inventions of new products and processes. As scientific originals often yield benefits for more than one year, most economists will consider R&D as investment. After all, it is likely that entrepreneurs will invest in R&D to safeguard profitability of the enterprise for longer periods of time. However, the SNA 1993 does not consider R&D as investment since in many cases it is unclear how the assets resulting from R&D and their subsequent use in production should be defined and valued. Instead, R&D expenditure is recorded as intermediate consumption. A disturbing consequence of the current SNA recording is that patented *entities* (and not just the costs of patenting) are considered as non-produced assets similar to typically non-produced assets such as land and subsoil assets.[4] The current SNA recording of R&D is therefore unsatisfactory and the search for an improved treatment of R&D continues.

In the module described here, all R&D expenditure will be recorded as gross fixed capital formation (GFCF). This is mainly motivated by the desire to show R&D as part of total gross fixed capital formation. As a consequence, GDP and gross fixed capital formation in the module are higher than the corresponding

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[3] Recently, reports from the Eurostat/OECD (2002) task force on software measurement were finalised.

[4] As explained by Hill (1997) this inconsistency is even more profound due to the 1993 SNA's recommendation to record royalties to the owner of patented entities as payments of services rendered as if they were rentals received from the lease of fixed assets (cf. SNA 1993, §7.92).

officially published figures. No initiatives have yet been taken to measure an R&D capital stock.

2.2 Human capital

Human capital less easily meets the general SNA definition of an asset. Human capital is inseparable from individuals and therefore not exchangeable, although exclusive rights of use coincide with the individual endowed with human capital. An often-applied approach to value the total human capital stock is the estimation of the net present value of current and future earnings of labour (cf. Australian Bureau of Statistics, 2001, Jorgenson & Fraumeni, 1989). Although these calculations are useful to indicate the amount of wealth the labour force (potentially) represents at a certain point in time, this approach is not useful to analyse how human capital contributes to economic growth. In fact, the assumptions on which these calculations are founded completely determine the outcome value of human capital.

In order to facilitate the analysis of human capital without these presuppositions, a more descriptive approach is followed to account for human capital in the module. The part of the (potential) labour force that is specifically endowed with knowledge is separately identified to indicate the importance of knowledge embodied in human capital. The OECD (1995) "Canberra manual" on the measurement of Human Resources devoted to Science and Technology (HRST) provides a useful starting point for this purpose.

The consideration of human capital as a *produced* or fixed asset is even more problematic. Clearly, formal education, training and working experience substantially contribute to the formation of human capital. Yet, human capital also depends on a range of non-producible features such as personal character and talent. This does not alter the fact that education expenditure is clearly forward looking. It reinforces the knowledge endowments of the labour force for longer periods of time. Education is generally considered a key source of economic growth. This is why most economists will consider education as investment.

Bos (1996) shows by way of a satellite account the various consequences of recording education as gross fixed capital formation in human capital. In his approach, all expenditure on education, either by households, government or enterprises, is recorded as capital formation. Formal education, provided by the government or non-profit institutions serving households, is recorded as capital formation by households while company education is considered as capital formation by enterprises. Education expenditure is recorded as work-in-progress when it pertains to people that have not yet entered the labour force. Fixed capital formation takes place at the moment a student finalises his or her education and enters the labour force. This accumulated value of education expenditure is counterbalanced by a concomitant 'work-in-progress' inventory withdrawal.

The recording of education and training expenditure as gross fixed capital formation entails that compensation of employees must now be regarded as a payment of labour services produced by households. In other words, the employee has become an entrepreneur selling the services derived from the exploitation of his human capital. He can decide to increase the quality and value of his labour services by additional investments in education. Also, part of the income generated from labour services output consists of the depreciation of human capital. The value of the output of labour services includes the full compensation of employees: wages and social contributions paid by employers.

One could argue that this way of recording reflects the more flexible and dynamic relationship between employers and employees experienced in post-industrialised economies. Yet, the implications of this manner of recording are rather rigorous. For example, value added at the industry level will no longer include the compensation of employees. Instead, a corresponding amount of value added is generated in newly introduced production activities, which output mainly consists of labour services. In the Netherlands, these newly introduced labour services industries would together generate more than 50% of GDP at market prices. GDP itself is also likely to change since work related consumption expenditure such as commuter traffic expenses must now be regarded as intermediate consumption. GDP will also increase because education expenditure by enterprises is no longer part of intermediate consumption but is instead included in gross fixed capital formation. Furthermore, this approach widens the production boundary. If the process of learning leads to capital formation, it seems necessary to include in this capital formation also the labour costs, or the opportunity costs of time spent on education, of those receiving education or training.

The described implications of recording education expenditure as gross fixed capital formation will in fact rigorously change the system of national accounts. The aim of the module described in this paper is to enhance the system's relation to indicators that are used to measure the knowledge-based economy while at the same time keeping (as much as possible) the connection with the regular national accounts and its main outcome variables such as GDP, value added, fixed capital formation etc. Therefore, a less radical approach is followed in the module. In addition to purchases of education and public education which are already shown in the regular national accounts, expenses on internal training within enterprises are separately identified and shown at the industry-level. Furthermore, public education is subdivided into primary, secondary and third level education.

This approach is in accordance with what is denominated "functional classifications" in the SNA-1993. In paragraphs 18.1-18.14 "functional" classifications are proposed for individual consumption, total outlays of non-profit institutions serving households, total outlays of government and selected outlays of producers. They are described as "functional" classifications because they identify the "functions" in the sense of "purposes" or "objectives" for

which these groups of transactors engage in certain transactions. Reasons of using functional classifications are for instance to provide statistics which experience has shown to be of general interest for a wide variety of analytic uses or to identify more fully those functions that are of special policy concern. Education services and outlays on employee training are specifically addressed as a separate function in various functional classifications proposed in the SNA.

Another drawback of recording education expenditure as gross fixed capital formation is that, as already mentioned, formal education and training are not the only determinants of human capital. Since, human capital carries in many ways the characteristics of a non-produced asset, the asset created by education could at the very most be regarded as 'improvements in human capital by education and training'.[5] Such a recording is only meaningful after solid methods have been established first to estimate the principle asset: human capital. In other words, capitalisation of education itself will not lead to a human capital measure.

One of the reasons to separate gross fixed capital formation from current expenditure is to specify how fixed assets contribute to production over longer periods of time. The OECD handbook (2001) on capital stock pays a lot of attention to the definition and measurement of the so-called capital services, i.e. the capital inputs into production. In the case of human capital, such an indirect measurement of related services is not necessary. By the recording of wages, the generation of income account in the SNA 1993 already provides a clear picture of the value of human capital in production. Nevertheless, it may be desirable to add more detail to labour inputs and wages, for example by means of a subdivision by educational attainment or occupation. This allows for a further differentiation between various human capital categories. For this purpose, the module makes use of the Human Resources in Science and Technology (HRST) concept derived from the OECD (1995) Canberra manual. This is further illustrated in subsection 3.2

2.3 Information and communication infrastructure

Information and Communication Technology (ICT) enhances the accessibility, dissemination and storage of codified knowledge. ICT should therefore be regarded as an important part of the total knowledge infrastructure in an economy. In addition, ICT itself has been considered an important driving factor of economic growth in recent years. This is why ICT is taken into consideration in the satellite account described here. Most ICT related expenditure is

[5] Such a treatment would have similarities with improvements in land e.g. dykes, walls and irrigation systems. Although such improvements do not lead to the creation of new assets, the SNA recommends improvements to land, to be shown on their own in a classification of gross fixed capital formation (Commission of the European Communities et al., 1993, §10.54).

(implicitly) included in the national accounts. It merely needs to be determined which expenditure is ICT related and which is not. In measuring the productivity spill-over effects of ICT, Schreyer (2000) distinguishes three categories of gross fixed capital formation in ICT:

- Software
- Hardware
- Network equipment

The 1993 SNA requires expenditure on software, i.e. development costs of original software and purchases of copies, to be recorded as gross fixed capital formation. This requirement represents one of the major changes compared to the former 1968 SNA. In the last few years, countries have included gross fixed capital formation of software estimates in their national accounts, adding directly to GDP. There is evidence though, that the applied methodologies differ substantially, along with the estimates. Recently, a Eurostat-OECD task force finalised their recommendations to improve comparability (Eurostat, 2002). In line with the Task Force's recommendations the production of own account software is recalculated in the module described here.

ICT hardware comprises servers, personal computers, workstations and peripherals. All but household consumption expenditure on ICT hardware qualifies as gross fixed capital formation in hardware and thus as part of the ICT capital stock. Expenditure on e.g. semiconductors and related components is not separately included since these components usually serve as inputs into hardware manufacturing. Including the expenditure on these components would result in double counting. Also, the application of microchips and the corresponding software in general machinery and equipment are not considered part of ICT capital. The latter mainly refers to the information and communication infrastructure and not to the automation of production systems.

Investment in network equipment principally includes the complete ICT network infrastructure such as cable and mobile telecommunication networks. The module only includes fixed capital related to telecommunication infrastructure managed by the telecommunication industry. Theoretically, non-produced assets such as mobile phone licenses should be taken into consideration as well. Also, telecommunication equipment in other industries should be included. These latter two components are subject to future investigation.

At present, Statistics Netherlands carries out a research project on how the ICT industry should be explicitly represented in the official industry classification. However, the co-ordinated European wide revision of the industry (NACE) and product (CPA) classifications is not planned until 2007. In anticipation of this revision, three ICT related industry branches are being represented in the proposed module: the ICT industry, telecommunication and a 'content' industry,

representing activities such as press and media (cf. Statistics Netherlands, 2001, p.178).

3. Overview of the accounts: methods and results

The module is compiled for five successive years, covering the period 1995-1999. The main structure of the module consists of national accounts supply and use tables but in this paper a selection of the data will be shown.[6] In this section the applied methods and results are discussed.

3.1 Education

Most expenditure on education is already recorded in the regular national accounts. To improve the availability of information on education expenditure and its presentation, the following three aims were formulated:

1. The identification of internal training within enterprises;
2. The explicit presentation of purchases of (market) education at the industry level;
3. The presentation of the production and consumption of public education subdivided by primary, secondary and third level education.

The required adjustments needed for such a presentation of education related expenditure are discussed in detail below.

3.1.1 Internal training within enterprises

The SNA considers internal training of personnel within enterprises as a so-called 'ancillary activity'. Ancillary activities are supporting activities undertaken within enterprises to create the conditions under which production can be carried out. The output of an ancillary activity is not explicitly recognised and separately recorded in the SNA. Equally, expenses on internal education and training are not separately identified in the national accounts. Contrary to regular national accounting practice, in the module all internal training is registered separately. This implies that as compared to the regular national accounts' supply and use tables, output and intermediate consumption are simultaneously increased by the supply and use of internal education and training while value added and all other balancing items in the accounts remain unchanged.

The most suitable source for the identification of expenditure on internal training within enterprises in the Netherlands is the 'Continuing Vocational Training Survey' (CVTS). This is a survey carried out by Statistics Netherlands under the authority of the statistical office of the European Communities

[6] A complete set of results is available from the authors on request.

(Eurostat). It is held every five years and data are currently available for the years 1993 and 1999. Because of differences in the questionnaires and in the populations observed, the datasets of the two years are reconciled for the purpose of the module, resulting in two comparable datasets with information on various components of education expenditure at the industry level (see columns of table A3.1.1 for a description of the components). It should be mentioned that the surveys only include costs of so-called external and internal courses/education, comprising expenditure on courses that are attended by several participants at a time and that are held outside the direct working environment. Expenditure on other forms of training or education like "training on the job", "job rotation" and "attending conferences" is not included.

Furthermore, the industries "education", "public administration and social security" and "health and social work activities" are not included in the surveys mentioned above. For the industry "public administration and social security" the only available source of information on expenditure on internal and external education is a survey of education within the central government carried out in 1990.[7] With the help of data on education expenditure components from this survey as a percentage of compensation of employees, expenditure on internal and external education for the industry "public administration and social security" is estimated for the year 1993.[8] The same procedure is repeated to produce estimations for the year 1999 except that for this year growth percentages from 1993 to 1999, as observed among the enterprises in the CVTS data, are added. Because only one relatively old source of information about expenditure on internal and external education in the industry "public administration and social security" is available, the figures for this industry in tables A3.1.1 and A3.1.2 should be considered tentative.

Because the aim of the module is to describe the period 1995-1999, figures on education expenditure components by industry for the year 1995 are produced based on the average annual growth-percentages of the education expenditures components as a percentage of value added per industry between 1993 and 1999.

As already mentioned, the "education industry" is not included in the CVTS data either. For this industry the only available source of information on education expenditure is a survey of continuing education within the "education industry" carried out in school year 1994-1995.[9] Data from this survey are used to estimate figures for the year 1995. Universities and higher professional

[7] This survey is only held in the Netherlands and is not internationally coordinated.

[8] The industry "defence activities" is excluded because it seems not very plausible that education expenditure as a percentage of compensation of employees in this industry would be comparable to that within the central government. Therefore no figures on education expenditure are estimated for the industry "defence activities" in the module.

[9] This survey is only held in the Netherlands and is not internationally coordinated.

education institutes are not included in this survey. Therefore, education expenditure for universities and higher professional education institutes is estimated with the help of education expenditure data from the survey as a percentage of compensation of employees, assuming such expenditures as percentages of compensation of employees are equal in universities and professional education institutes as compared to institutes for primary and secondary education. Another problem with the continuing education survey within the "education industry" is the fact that the education expenditure components measured with this survey are very different from those measured with the CVTS.[10] To obtain expenditure components similar to those measured with the CVTS in 1999, it is further assumed that the distribution of expenditure components within the "education" industry is equal to that among the enterprises observed with the CVTS. Finally, education expenditure within the "education industry" for the year 1999 is estimated using the same procedure as applied to obtain estimations for the industry "public administration and social security" as described above.

Because only one relatively old source of information about expenditure on internal and external education in the "education industry" is available and expenditure components are very different from those in the CVTS 1999, the figures for the "education industry" in table A3.1.1 and A3.1.2 should be considered tentative.

Finally, for the industry "health and social work activities" no source of information is available. Therefore no figures on education expenditure are estimated for the industry "health and social work activities" in the module.

The final product then consists of data on education expenditure components by industry (except for the industries "health and social work activities" and "defence activities") for the years 1995 and 1999. Tables A3.1.1 and A3.1.2 summarise the results.

3.1.2 Purchases of market education

Although not explicitly mentioned in either the SNA 1993 or the ESA 1995, (market) education expenditure by employers is recorded as intermediate consumption in the regular national accounts. The general rule is that expenditure by employers, which is to their own benefit as well as to that of their employees but which is necessary for the employers' production process, should be regarded as intermediate consumption. The module explicitly shows these purchases of education at the industry level (table A3.1.1, column 1). The purchases of market education shown in table A3.1.1 (and table A3.1.4) are based on data from the CVTS as described in paragraph 3.1.1.

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[10] To a lesser degree, this is also true for the industry "public administration and social security".

In the regular national accounts different sources of information are used for different industries to measure purchases of market education and the CVTS is not one of these sources. For the sake of consistency the CVTS is used as the main source of information for the measurement of both purchases of market education as well as expenditure on internal training within enterprises in the module described here. Therefore, figures on purchases of market education in the module do not coincide with the corresponding figures in the regular Dutch national accounts.

3.1.3 Public education

In the national accounts, most public education is provided by the general government sector and characterised as non-market production. As such it is simultaneously produced and consumed by the government. Tuition and fees paid by households are an exception in this respect. These are recorded as final consumption expenditure of households. In the module, the production and consumption of public education are subsequently subdivided into primary and secondary level versus third level education. In the Netherlands, third level education includes university education and higher professional education. In order to show third level education separately, higher professional education needs to be separated from primary and secondary education.

For this purpose wage proportions resulting from a reconciliation of the Structure of Earnings Survey and the labour accounts, as described in paragraph 3.2 and table A3.2.2, are applied to the public education produced by primary, secondary and higher professional education together. Tuition and fees can be allocated directly to primary and secondary level education on the one hand and higher professional education or university education on the other hand. Table 3.1.3 shows final consumption of public education as well as "market" education ("Other education" in the various tables) covering 1995-1999. Table A3.1.4 shows supply and use of education in 1999, including public, "market" and own-account education.

Table 3.1.3
Education expenditure, final consumption[1)] in the Netherlands, 1995-1999 (mln euro)

	1995	1996	1997	1998	1999
Public education	12763	12916	13392	14212	15169
Level 1-2 (primary and secondary)	9860	10061	10484	11055	11736
Level 3	2903	2855	2908	3157	3433
Higher education	1512	1580	1601	1699	1814
University education	1391	1275	1307	1458	1619
Other education	558	595	623	663	706
Total	13321	13511	14015	14875	15875

[1)] including non-deductable VAT

3.2 Human capital-HRST

In the module, the total stock of human capital is at first instance represented by the potential labour force. One way to indicate the importance of knowledge embodied in human capital in an economy is to identify that part of the potential labour force specifically endowed with knowledge. The OECD (1995) manual on the measurement of Human Resources devoted to Science and Technology (HRST) defines HRST as those members of the labour force with a third (university) level[11] education or employed in a specific HRST occupation, defined as:

- *Managers*, comprising production and operations department managers (ISCO-88: 122), other department managers (123) and general managers (131)
- *Professionals*, comprising physical, mathematical, and engineering science professionals (21), life science and health professionals (22), teaching professionals (23) and other professionals (24)
- *Technicians and associate professionals*, comprising physical and engineering science associate professionals (31), life science and health associate professionals (32), teaching associate professionals (33) and other associate professionals (34)

Information on the availability of HRST, as illustrated in table 3.2.1, can be derived from the Dutch labour force surveys and is frequently shown in a annual publication on the knowledge-based economy (*cf.* Statistics Netherlands, 2001). Results presented in table 3.2.1 have been revised and differ from those that have been officially published so-far. These officially published HRST figures are compiled on the basis of a classification of occupations that diverges from the ISCO-88. The final two rows of the table present two groups of HRST. The first group (I) represents all labour force members with education level three *and* a HRST profession; the second group (II) includes those with third level education *or* a HRST profession. While the first group comprises 16% of the total population with an age between 18 and 64 year in 1999, the second group comprises 40%.

[11] In the Netherlands (and in the module presented here) third level education includes university education as well as higher professional education.

Table 3.2.1
Total stock of Human Resources in Science and Technology (HRST) in the Netherlands

	1995	1996	1997	1998	1999
	× 1000				
Total population 18 - 64 year	9 954	9 976	10 008	10 046	10 110
Total working labour force[1)]	6 641	6 751	6 953	7 137	7 328
Education level 3	1 619	1 674	1 747	1 900	1 985
Managers	177	180	188	221	235
Professionals	902	914	949	1 020	1 044
Technicians	289	286	304	330	347
Other	251	294	306	329	359
Education level 1-2	4 878	4 928	5 066	5 099	5 223
Managers	558	518	520	526	542
Professionals	187	188	220	217	237
Technicians	921	853	901	939	943
Other	3 212	3 369	3 425	3 417	3 501
Unknown	144	149	140	138	120
Other	3 313	3 225	3 055	2 909	2 782
Education level 3	393	392	375	359	361
Education level 1-2	2 913	2 829	2 673	2 545	2 414
Unknown	7	4	7	5	7
HRST I: level 3 education *and* HRST profession	1 368	1 380	1 441	1 571	1 626
HRST II: level 3 education *o* HRST profession	3 678	3 625	3 763	3 941	4 068

[1)] The working labour force is here defined according to the internation definition of all individuals working at least 1 hour.

In addition to measuring the HRST stock as presented in table 3.2.1, the module also illustrates how the economy depends on HRST. For this purpose, a breakdown of labour inputs and wages by HRST and non-HRST is established. It is particularly interesting to present information on HRST at the industry branch level in order to clarify in what direction an economy's industry composition (i.e. economic structure) influences the knowledge orientation of the national economy. As shown by de Haan (2002), the structural composition of the economy may strongly influence the outcome of indicators at the national economy level and is therefore rather important in country-by-country indicator comparisons.

In the Netherlands, the most suitable source for setting up such a differentiation of labour input and wages is the 'Structure of Earnings Survey'. This is not an independent survey but a micro integration of three independent sources: the labour survey, employment and wages survey and the social insurance administration of employees. The Structure of Earnings Survey contains detailed information on wages and paid hours by level of education, occupation and industry branch.

In a subsequent step, the results from the Structure of Earnings Survey are made consistent with the Dutch integrated system of labour accounts and national

accounts. The labour accounts include a subdivision of labour volume data (in paid hours and full-time equivalents) by employees, self-employed, industry branch, gender, and level of education, but not by occupation. Data from the Structure of Earnings Survey and the labour accounts are reconciled in order to arrive at a complete representation of HRST wages and labour input at the industry branch level.

Results with respect to HRST wages by industry branch are shown in table A3.2.2 for the years 1995 and 1999. Table A3.2.3 shows the estimates of the labour input by industry for the years 1995 and 1999. These labour input data include both employees and self-employed workers and are expressed in full time equivalents. The most recent Structure of Earnings Survey available at the time of compilation of these accounts was for 1997. Therefore, it must be acknowledged that the Structure of Earnings Survey for 1997 is used to subdivide the 1999 national accounts wages and labour volume data.

3.3 Research and development

As already mentioned above, all R&D expenditure is recorded as gross fixed capital formation in the module described here. An elementary step in the capitalisation of R&D is first of all a sound recording of R&D according to current national accounts conventions.[12] De Haan and Van Rooijen –Horsten (2003) provide an overview of how R&D statistics, as compiled according to Frascati guidelines, are reconciled with SNA conventions for the purpose of the module described here. This overview is summarised below.

Most countries use the Frascati system of R&D statistics (OECD, 1993) as an internationally standardised way to collect and compile data on R&D. Although, originally the Frascati system was inspired by the SNA, a number of different recording principles evolved as a logical consequence of the diverging purposes of both systems.

The translation of R&D statistics, as compiled according to Frascati guidelines, to SNA guidelines comprises several steps i.e.:

- the re-classification of economic units;
- the translation from R&D expenditure to R&D output;
- eliminating overlaps with software.

The case of the Netherlands is perhaps somewhat more complicated compared to other countries. The Dutch R&D survey is largely functional in scope and therefore not always coordinated with the Dutch business register. This implies that the reclassification of production units becomes an important part of the translation process. A production survey concerning the R&D industry (NACE-73) has recently been initiated but has not yet provided satisfying results. The

[12] Bos et al. (1994) earlier compiled an R&D account for the Netherlands.

final result of the translation process as applied in the module is an R&D supply and use table including entries for the own-account R&D output and use. As a result of this translation process, the R&D estimates differ at present from the recording of R&D in the Dutch national accounts. It is expected that the upcoming national accounts revision in the Netherlands, planned in 2004, will include an improved recording of R&D.

The different translation steps from Frascati guidelines to SNA guidelines are described in more detail in the following paragraphs. The transition steps presented here roughly follow those suggested by Mantler & Peleg (2003). The method description is illustrated with data from the year 1999.

3.3.1 Point of departure

The Dutch R&D statistics are compiled annually according to three major separately surveyed R&D performing groups: enterprises, research institutes (government and other; approximately NACE-73) and universities. The annual survey includes questions on the following R&D related outlays:

- compensation of employees and labour input in full time equivalents, both subdivided by scientists, assistants and other personnel;
- other operating costs (excluding consumption of fixed assets);
- capital expenditure (buildings, land, machines etc.).

Gross Expenditure on Research and Development (GERD) according to Frascati guidelines is subsequently calculated as the sum of these three R&D related expenditure categories.

In addition, the survey provides data on R&D purchases (by type of provider) and sales (by type of purchaser). These data are straightforwardly used to determine the supply and use of market R&D. However, these sales and purchases do not yet include all intra-enterprise R&D (own account R&D) produced by separate entities on behalf of affiliated producers (see also paragraph 3.3.2)[13]. A first balanced presentation of sales and purchases, as directly derived from the R&D surveys, including imports and exports, is shown in table 3.3.1.

[13] In table 3.3.1 only the sales and purchases to and from affiliated enterprises that are observed within the survey are included. The survey includes questions about sales and purchases to and from affiliated enterprises but it was determined that the necessary reclassification of R&D performers as described in paragraph 3.3.2 was not completely covered by the inclusion of these questions.

Table 3.3.1
The initial grossed-up R&D statistics according to Frascati guidelines in the Netherlands, 1999 (million €)

	Research institutes	Universi-ties	(other) Enterprises	Rest of the the World	Total
Gross expenditure on Research and Development (GERD)	1 317	1 983	4 264		7 564
R&D Sales	609	415	1 099 [1)]	441	2 564
R&D Purchases	608	12	1 249 [2)]	694	2 564

Source: Statistics Netherlands (2001)

[1)] Including data from the R&D survey questionnaire on sales to affiliated enterprises (78 million €)

[2)] Including data from the R&D survey questionnaire on purchases from affiliated enterprises (78 million €)

3.3.2 Reclassification of R&D performers

The SNA considers own-account production of R&D not as an ancillary activity and recommends that separate units should be distinguished for it when possible. In contrast, the Dutch R&D survey of industries observes R&D in connection to those enterprises that directly benefit from it. This recording follows Frascati recommendations.

In order to reconcile these data with national accounting principles, private research units that can be separately distinguished are presented as part of the R&D industry (NACE-73). The beneficiary enterprises (or one or more of its individual domestic divisions) are in a subsequent stage identified as the purchasers of their R&D output. In this way, an institutional classification is logically combined with the identification of those industries that benefit from the R&D of these separate private research units. These imputed intra-enterprise sales and purchases must be valued according to representative market prices (see paragraph 3.3.3).

For the year 1999 an estimated amount of GERD of 1014-million € of separately identifiable establishments, mainly occupied with R&D production, is transferred from the enterprises in those industries to which these establishments are affiliated to the R&D industry (NACE-73). Since such a reallocation can only be based on grossed up survey results, it is assumed that the composition of GERD being transferred to NACE-73 represents the average composition with respect to compensation of employees, other operating expenses and capital expenses in the originating industry. Labour input figures to be transferred to NACE-73 are calculated in correspondence with the proportion of compensation of R&D that is being transferred. The corresponding sales reallocated from these industries to the R&D industry amounts to 265-million €. It is assumed that all R&D purchases have been made by the affiliated enterprise. In other words, no purchases are being transferred to the R&D industry.

In addition, the surveyed population of R&D research institutes includes several institutes that are at present recorded as part of public administration (NACE-75) in the Dutch national accounts. Additional research is still needed to determine which of these units truly belong to public administration and which should instead be identified as main R&D performers to be included as part of the R&D industry. For 1999 the corresponding amount of GERD is tentatively estimated to equal 283-million €. This amount is therefore moved from the GERD of research-institutes (approximately NACE-73) to public administration (NACE 75). Again, the resulting decrease in output of research-institutes implies a proportional decrease of compensation of R&D employees, other R&D operating costs and R&D related capital outlays. Labour-inputs (in full time equivalents) are being diminished in correspondence to the decrease in compensation of R&D personal. These estimated decreases of compensation of R&D employees, other R&D operating costs, R&D related capital outlays and labour-inputs in NACE-73 are moved to NACE-75.

The two reallocations discussed in this section are summarised in table 3.3.2.

Table 3.3.2
The reclassification of R&D expenditure and sales, the Netherlands, 1999 (million €)

	Research institutes (NACE-73)	Public administration and social security (NACE-75)	Universities (NACE-8030.2)	(other) Industries
Gross expenditure on Research and Development (GERD)	731	283		- 1 014
R&D Sales	265	-		- 265
R&D Purchases	-	-		-

3.3.3 Determination of R&D output

R&D expenditure (*i.e.* GERD) as measured according to Frascati guidelines comprises compensation of R&D employees, other R&D operating costs (excluding consumption of fixed assets) and R&D capital outlays (buildings, land, machines etc.). This implies that several additional calculations are needed to arrive at a R&D production total in accordance with national accounts conventions.

Three product groups are introduced to translate GERD into the national accounts oriented supply and use of R&D services:

- Market R&D
- Non-market R&D
- Own-account R&D

Market R&D is supposed to coincide with the sales and purchases as directly observed in the R&D surveys. Its value is consistently determined by the price at which it is exchanged. In addition, market R&D also includes the intra-enterprise supply and use of R&D discussed in the former section. Since, the intra-enterprise transfer of R&D is rarely observed either as a sale or a purchase, a representative market price must be imputed in order to determine its value. This valuation is discussed in more detail below.

In the national accounts, *non-market output* is by convention valued by the sum of production costs. However, the sum of outlays as reflected by GERD does not fully coincide with the sum of production costs in accordance with national accounts principles. This problem is further discussed below. All non-market output is by convention consumed by the general government sector.

The SNA considers *own-account* production of R&D not as an ancillary activity and recommends that separate units should be distinguished for it when possible (cf. §6.142). The European System of Accounts (ESA-1995, §3.64) recommends that in case separate units cannot be distinguished, all R&D of significant size should be recorded as a secondary activity. Following these guidelines, a product group is introduced to explicitly identify the own-account R&D output. In current practice, own-account production is only separately recorded when used either as final consumption (in case of unincorporated enterprises) or as gross fixed capital formation. In this respect, the explicit representation of own-account R&D output anticipates a future SNA directive to record (at least part of) own-account R&D production as gross fixed capital formation.

The standard SNA rule to value own-account production is using a representative market price (SNA-1993, §6.84). When a reliable market price cannot be obtained, a second best option is to determine own-account production as the sum of production costs. Since, in the Dutch national accounts, all own-account gross fixed capital formation (including software) is presently being valued at production costs, valuation at production costs is also applied to the recording of own-account production of R&D for the purpose of the present paper.

Establishing a (cost-based) value for the non-market and own-account output of R&D is not straightforward. Several production units observed in the R&D survey are expected to produce market as well as own-account output of R&D. For these production units, the own-account production of R&D can only be determined after production costs related to R&D sales (market output) have been identified first. As already mentioned, the sum of outlays as reflected by GERD does not fully coincide with the sum of production costs in accordance with national accounting principles. The figures on capital expenditure (buildings, land, machines etc. used to generate R&D) included in GERD should therefore be replaced by an estimation of the consumption of fixed assets as far as non-market and own-account output is concerned and by an estimation of gross operating surplus as far as market-R&D is concerned.

To determine a value for non-market R&D output in the R&D industry (NACE-73) a subdivision between intra-enterprise R&D [14], (other) market output and non-market output is first established in this industry. The omission of a well-established production survey for the R&D industry complicates the identification of market and non-market producers and their output. Therefore, the non-market output is identified after the corresponding production costs connected to sales have been determined. In other words, non-market output is determined as the residual sum of production costs that is not attributable to market output.

Table 3.3.3 summarises the results. The bold figures in this table are the points of departure. They represent R&D survey data as summarised in table 3.3.1 and reclassified as described in paragraph 3.3.2. Clearly, this information is not sufficient to determine total R&D output. For the time being, it is therefore assumed that the gross operating surplus of market R&D encompasses a 19% share of sales. This share is derived from the "Other business services industry" (NACE-74). This results in a gross operating surplus of 213-million € connected to intra-enterprise R&D and 116-million € connected to other market output. This assumption enables the subsequent allocation of production costs, including a substantial sum of R&D purchases[15], to other market output and non-market output. After adding an estimated sum of 83-million € for the consumption of fixed capital (7, 5% share of total non-market output; derived from the "universities" industry), total non-market production amounts to 1.1-billion €. The total output of the R&D industry then approximates 2.8-billion €.

[14] This intra-enterprise R&D that was moved to the R&D industry (NACE-73) as described in paragraph 3.3.3, is considered market R&D (sales) and should therefore be valued accordingly.

[15] In the R&D industry (NACE-73) and the universities industry (NACE-8030.2) purchases of R&D are included in the production costs because they are costs in the production of R&D and are explicitly excluded from the Frascati variable "other operating costs". In all other industries purchases of R&D are not considered part of the production costs of R&D.

Table 3.3.3
Estimating the output of the R&D industry (NACE-73), the Netherlands, 1999 (million €)

	Compensation of employees	Purchases of R&D	Other operating costs	Gross operating surplus	Total output
R&D	1 150	608	663	412	2 833
Intra-enterprise	**512**	**-**	**398**	213	1 123 [1]
Other market output	208	198	87	116	**609**
Non-market	430	410	179	83	1 101
Total, costs	**1150**	**608**	**663**	412	2 833

[1] This output includes the directly observed sales of 265-million € (*cf*. table 3.3.2)

The total output of the intra-enterprise R&D now comprises 1123 mln € of which 265 million € are directly observed sales. The remaining 858 million € of the intra-enterprise output is then purchased by the industries of origin (data not shown).

A similar procedure is followed to determine the (cost-based) own-account output of R&D in the other industries. In industries with R&D sales, the production costs related to sales (market R&D) must be identified first before the own-account production can be determined. In the other industries (when R&D sales equal zero), the own-account output is calculated directly by adding the consumption of fixed capital (7,5% of total own-account output) to labour costs and other operating costs as derived from the R&D survey.

3.3.4 Overlaps with software

The ESA-1995 explicitly excludes the expenditures on R&D incurred in the production of software from R&D activities: "Expenditure on R&D does not include the costs of developing software as a principal or secondary activity. However, their accounting treatment is nearly the same; the only difference is that software is regarded as a produced intangible asset… " (§3.64).

In the Frascati Manual, R&D related to software development is explicitly, included (cf. OECD, 1993, §135-142). To avoid duplications in the national accounts, the expenditure on R&D incurred in the production of software must be subtracted from the R&D survey data. Starting in 1997, every other year, both the enterprise survey and the research institute (approximately NACE-73) survey, include a question on the percentage of total R&D labour input in full time equivalents that is devoted to ICT.

This information is used to estimate the amount of R&D output that should be subtracted in order to avoid overlap with software output. Firstly, the average ICT percentage of full time equivalents is calculated per industry for the year

1999. This is subsequently used to diminish the own-account R&D production of industries, assuming a corresponding decrease in all production cost categories. For the NACE-73 industry, non-market R&D output is diminished with the corresponding ICT percentage. This equally holds for the non-market R&D output of research institutes that is transferred to the general government (cf. table 3.3.2). Furthermore, the own-account R&D of the intra enterprise R&D that was moved to the NACE-73 industry (estimated to equal 858 million € in total in the previous paragraphs) where it was recorded (after revaluation) as market R&D is also corrected for overlap with software output. The amount of market-R&D of NACE-73 that should be subtracted for this purpose is calculated by multiplying the moved own-account R&D (intra enterprise R&D) with the average ICT percentage of full time equivalents applying to the original industry. The sum of these is then subtracted from the market-R&D of the NACE-73 industry and the individual decreases determined per industry are subtracted from the R&D purchases of these industries of origin. For universities, no duplication with own-account software production is expected. In the Dutch national accounts, a sound delineation of output has already been established between education services, R&D and the own-account gross fixed capital formation in software.

In summary, only non-market and own-account production are corrected for software overlaps. Data on R&D sales and purchases have not been adjusted. The total effect of eliminating software-R&D overlaps amounts to a total reduction of 484-million € (cf. table A3.3.4, column 5). At this time, possible overlaps of R&D with other fixed intangible assets such as mineral exploration and entertainment, literary or artistic originals have not yet been investigated.

3.3.5 Other taxes less subsidies on production

Additional attention must be paid to other taxes less other subsidies on production. Although in the case of the Netherlands other taxes related to R&D are quite insignificant, the other subsidies are substantial (e.g. 234-mln € in 1999), comprising a general subsidy on the labour costs of all R&D performing personnel with the exception of general government and universities. This subsidy must be subtracted from own-account output of R&D in order to consistently determine output at production costs. In case, of market output, the subsidy becomes straightforwardly a separate entry in the generation of income account without any effect on output.[16] The ultimate reduction of R&D output, resulting from the subtraction of other subsidies on own-account production, amounts to 119-million € (cf. table A3.3.4, column 6).

[16] The 234 mln € other subsidies are allocated to the different industries and to market versus own-account R&D within those industries on the basis of wage-distributions. The general government, universities and the non-market production of the NACE-73 industry are excluded because the subsidy on R&D production cannot be applied for by the public sector.

3.3.6 An overview of adjustments

Table A3.3.4 represents a bridge table showing step by step all differences between GERD presented in column 1 and R&D output according to national accounts definitions presented in column 7. The results show that total R&D output according to national accounts definitions as calculated for the purpose of the module is only 3% higher than GERD in 1999. The largest overall adjustment in both absolute and relative terms is found within the R&D industry.

The second column shows the reclassification of economic units, earlier summarised in table 3.3.2. Column three eliminates the capital component in GERD as observed in the R&D surveys. Column four adds the gross operating surplus to the R&D related compensation of employees and intermediate consumption as measured by GERD. In addition, the R&D output of the R&D industry and universities explicitly includes R&D purchases and these adjustments are also reflected in the figures in this column. This implies that R&D output according to national accounts definitions inevitably contains double counting which is carefully avoided in GERD. Column five eliminates overlaps with gross fixed capital formation in software while column six excludes the other subsidies on own-account production.

3.3.7 The module: R&D results

Applying the adjustments described in the previous paragraphs results in data on R&D supply and use (market, non-market and own-account) as well as R&D related labour input and compensation of employees, by industry branch for the years 1995-1999. A summary of these results is presented in tables A3.3.5-A3.3.7. Table A3.3.5 shows total use of R&D, including market R&D, non-market R&D and own-account R&D at the industry branch level. Table A3.3.6a and A3.3.6b present R&D labour input of employees by industry branch.

Supply and use tables concerning R&D for the years 1995-1999 are presented in the Annex (A3.3.7a-3.3.7e). While in the module R&D is included as gross fixed capital formation, the supply and use tables A3.3.7a to A3.3.7e follow current national accounting practice by recording R&D as current expenditure. The R&D estimates shown in these tables differ at present from the current recording of R&D in the national accounts. The upcoming national accounts revision, planned in 2004, will include an improved recording of R&D. One unfortunate consequence of this modified recording is that the R&D related labour inputs data presented in table A3.3.6a and A3.3.6b have not yet been reconciled with the labour input data as presented in table A3.2.3 of this paper.

3.4 Information and communication infrastructure

The ICT capital stock consists of three types of assets i.e. computers and related equipment, software and telecommunication infrastructure. Principally, all these related assets are already regarded as fixed capital in the national accounts. However, they are not necessarily classified as ICT related. This is especially the case for the telecommunication infrastructure, which is usually made up by traditional fixed assets such as equipment and structures.

Computers and related equipment are separately identified in the regular Dutch estimates on gross fixed capital formation by type of asset. The recording of software as fixed capital was newly introduced in the SNA-1993. So far, in the Dutch national accounts, only the labour costs of software developers have been capitalised, ignoring possible other cost involved in software development.

For the purpose of the module described here, the production of own account software is re-valued by including estimates for intermediate consumption and consumption of fixed capital. The required information to do so is obtained from the production cost structure of the computer services industry (NACE-72). This revaluation is in line with the Eurostat-OECD Task Force's recommendations (Eurostat, 2002), with the exception that this Task Force recommends in addition the inclusion of a mark up. In other words, the Task Force recommends the valuation of own-account software at a representative market price. In the module described here, such a mark up has not been added. In the Dutch national accounts, own-account capital formation is generally valued on the basis of production costs. For the sake of comparability, own account software is therefore equally valued by summing up the costs of their production.

Table 3.4.1
ICT related gross fixed capital formation in the Netherlands, 1995-1999 (million €)

	1995	1996	1997	1998	1999
	million-€				
Total gross fixed capital formation [1)]	67965	73285	79305	84504	93352
ICT capital	6761	7849	9864	12134	15221
Computers	2714	3156	3489	3704	4180
Software	2860	3314	4565	6240	7161
Telecommunication infrastructure	1187	1378	1810	2190	3880
	%-shares in total gross fixed capital formation [1)]				
ICT capital	9,9	10,7	12,4	14,4	16,3
Computers	4,0	4,3	4,4	4,4	4,5
Software	4,2	4,5	5,8	7,4	7,7
Telecommunication infrastructure	1,7	1,9	2,3	2,6	4,2

[1)] Extended total gross fixed capital formation, including R&D and software revision.

In addition, an attempt is made to identify gross fixed capital formation related to telecommunication infrastructure (cf. Van den Bergen, 2003). Although, it is likely that most of this gross fixed capital formation is found in the telecommunication industry, investment in telecommunication equipment by other industries still needs further investigation. Gross fixed capital formation in telecommunication infrastructure by the telecommunication industries mainly consists of "Other structures" (NA.11122) *e.g.* cable networks and "Other machinery and equipment" (NA.11132) *e.g.* transmission equipment and the like. An overview of ICT related gross fixed capital formation between 1995 and 1999 in current prices is presented in table 3.4.1. In this table, total gross fixed capital formation is "extended" to include R&D and the revision of software. Data on total ICT gross fixed capital formation by industry of destination are shown in table A3.4.2.

4. Overview of indicators: results

As already mentioned, the basic framework of the module consists of an extended supply and use table. The classification of industries and product groups applied in the module separates those industries and product groups that are conceived as relevant from a knowledge-based economy perspective.

ICT related industries are separately identified:
- Manufacture of ICT hardware;
- Telecommunications and post;
- Content: publishing, press and broadcasting;
- Content: entertainment and art;
- Computer and related services.

Knowledge related business services are shown in detail:
- Research and development;
- Legal and economic activities;
- Architectural and engineering activities;
- Advertising.

The following educational institutes are being distinguished:
- Primary education;
- Secondary education[17];
- Third level higher education;
- Third level university education;
- Other education.

[17] Primary and secondary education are shown separately whenever this is feasible with the available sources of information.

In summary, the module generates a series of aggregated figures covering various aspects of the knowledge-based economy. Indicators that are included on the industry level are:

- Internal (own-account) and external company education;
- HRST utilisation in full time equivalents and in terms of money (*i.e.* HRST wages)
- Expenditure on R&D;
- Expenditure on ICT.

A selection of the results is discussed in more detail below.

4.1 Aggregated indicators: results

An 'augmented investment matrix', as presented in table 4.1, indicates the extent to which the asset portfolio of the economy is moving towards knowledge related assets in recent years. A comprehensive overview of all capital formation, conventional assets as well as those associated with the knowledge-based economy, enhances the significance of indicators dealing with 'knowledge investment'.

Table 4.1
Knowledge related final expenditure in the Netherlands, 1995-1999 (million €)

	1995	1996	1997	1998	1999
	%-shares in (extended) GDP [2)]				
Gross fixed capital formation[1)]	22,1	22,9	23,4	23,4	24,5
ICT capital	2,2	2,5	2,9	3,4	4,0
Computers	0,9	1,0	1,0	1,0	1,1
Software	0,9	1,0	1,3	1,7	1,9
Telecommunication infrastructure	0,4	0,4	0,5	0,6	1,0
R&D	2,0	2,0	1,9	1,9	2,0
Enterprise	1,1	1,1	1,1	1,1	1,2
Government [3)]	0,9	0,9	0,8	0,8	0,8
Other intangible assets	0,1	0,2	0,2	0,2	0,1
Other assets	17,8	18,3	18,3	18,0	18,4
Total education (final consumption)	4,3	4,2	4,1	4,1	4,2
Public education	4,2	4,0	3,9	3,9	4,0
Level 1-2	3,2	3,1	3,1	3,1	3,1
Level 3	0,9	0,9	0,9	0,9	0,9
Other education	0,2	0,2	0,2	0,2	0,2
Total knowledge related expenditure [4)]	8,7	8,8	9,2	9,5	10,2

[1)] Extended total gross fixed capital formation, including R&D and software revision.

[2)] Extended GDP (market prices), including R&D and software revision.

[3)] This concerns all enterprises in the general government sector.

[4)] Includes gross fixed capital formation in ICT, R&D and other intangible assets and final consumption expenditure on education.

Compared to loose sets of indicators, important advantages of indicators embedded in an integrated accounting structure are the consistency and mutual comparability of these indicators. Embedding indicators in an integrated framework implies that data are statistically integrated, meaning e.g. that data are made consistent between sources and over time and that differences in definitions have been eliminated. In addition to improvements in reliability and stability of the data, this also implies that the various relationships between the indicators can be shown and investigated. This enhances the policy relevance of indicators because it enables quantification of the way in which a specific government policy (measured by one indicator) affects other aspects of the economy (measured by other indicators). Consistency, mutual comparability and consequently policy relevance is much less present in indicators that simply enumerate or even add up weakly linked knowledge related expenditure categories that are likely to show overlap cf.:

- Investment in knowledge, being the sum of expenditure on R&D, software and higher education as a percentage of GDP (STI scoreboard, OECD, 2001)
- Structural indicators (Lisbon Strategy) – theme: Innovation and research: spending on human resources (*i.e.*, public expenditure on education), R&D expenditure (*i.e.* GERD), ICT expenditure as percentage of GDP, (Eurostat, 1999)
- Knowledge Investment including computers, education, R&D, expenditure on royalties and licences, software and advertising (Kennis en economie 2001, Statistics Netherlands, 2001)

In table 4.1, several knowledge-related expenditure categories are shown as a percentage of (extended) GDP. GDP is not only used as a scaling factor: all expenditure categories shown in the table are actually part of GDP. There is however one major exception: R&D expenditure. As shown in table A3.3.7a to A3.3.7e, a large share of R&D is currently recorded as intermediate consumption. The alternative recording of R&D as gross fixed capital formation enables the inclusion of (all) R&D as part of knowledge related final expenditure and the determination of its direct share in GDP. As a consequence, the GDP figures, serving as the denominators in table 4.1, are slightly higher than those officially published, i.e. on average an increase of one percent over the whole period. In addition, these GDP figures are further adjusted, compared to the officially published figures, as a result of two statistical improvements made in the module presented here, namely the revision of the valuation of software and the revision of R&D estimates, leading on average to an increase of 0.5 percent over the whole period. Table A4.1(a) is a bridge table showing the differences between the official GDP and GFCF in the Netherlands on the one hand and the extended GDP and GFCF applied in the module on the other hand.

Another important advantage of an accounting wise description of indicators is that overlaps between different knowledge related expenditure categories are eliminated. This is particularly relevant for overlaps between education and R&D and between R&D and software.

Although, education expenditure is for reasons explained in paragraph 2.2 not considered as gross fixed capital formation, most education expenditure is recorded as final consumption in the national accounts and the module described here. Since final consumption is included in GDP, this part of education expenditure as a percentage of GDP is directly comparable to data on gross fixed capital formation as a percentage of GDP. Unfortunately, business related expenditure on education and training is considered as intermediate consumption and therefore this part of education is not included in GDP, nor presented in table 4.1.

The results in table 4.1 show that the share of knowledge related final expenditure in GDP has increased between 1995 and 1999. The aggregate "knowledge related expenditure" is defined as the sum of gross fixed capital formation of ICT, R&D and other intangible assets together with all final consumption expenditure on education. The gross fixed capital formation of other intangible assets includes mineral exploration and entertainment, literary and artistic originals.

The increased share of knowledge expenditure in GDP is entirely due to the rapidly expanding investment in ICT in the final years of the last century. Other knowledge related expenditure such as R&D and education show rather stable shares in GDP between 1995 and 1999. These results do not give the impression that the Netherlands are rapidly moving towards a knowledge-based economy.

4.2 Indicators at the industry branch level: results

In the module, the knowledge indicators presented in table 4.1, as well as those related to HRST (utilisation), are equally compiled at the industry level (*e.g.* tables A3.1.1, A3.1.2, A3.2.2, A3.2.3, A3.3.5 and A3.4.2). In table A4.2a and A4.2b, knowledge indicators in relation to value added are shown by industry for the years 1999 and 1995. In these tables, several knowledge-related expenditure categories are presented per money unit of value added. For HRST-I wages, the percentages reflect the actual shares in value added. For the other three indicators, value added is merely used as a scaling factor. The main results are reviewed below.

The share of HRST in the total labour input by industry branch gives a first indication of its knowledge intensity. Perhaps not surprisingly, when the industries presented in table A3.2.3 are ranked according to the HRST-I share in their total labour input, education services show the highest HRST-I shares and R&D and computer services are also on top of the list. In general, knowledge related business services, medical services, ICT hardware manufacturing and public administration have above average shares while agriculture, construction,

transport, traditional manufacturing industries and trade services are below average (in 1995 as well as 1999). A similar pattern can be observed when HRST-I wages are shown as a share of value added (table A4.2a and A4.2b). The specific knowledge related industries addressed in the module, and presented in the lower part of the table, generally show above average shares of HRST-I wages in value added. Between 1995 and 1999, these shares increased rather modestly.

The third column in the tables A4.2a and A4.2b contains the sum of three expenditure categories: education, R&D and ICT. Education expenditure is in the module recorded as intermediate consumption while R&D and ICT expenditure are recorded as gross fixed capital formation. All these expenditures are shown per money unit of value added in order to get a notion of the knowledge intensity of individual industries. Although, some of the industries, that have been a priori identified as knowledge related, show extremely high knowledge intensities, *e.g.* ICT hardware, telecommunication, university education, several other manufacturing industries equally show above average intensities. Between 1995 and 1999, the total knowledge intensity increased from 5.7 to 7.9 percent. This increase is almost entirely due to the increase of ICT. R&D expenditure remained constant in relation to value added.

Company education in relation to value added is rather equally distributed over the industries presented in the module. There seems to be a moderate concentration of company education in those industries that are in the module presented as knowledge intensive.

Not surprisingly, the R&D industry shows the highest R&D investment related to value added (114,6% in 1999 and 124,0% in 1995, table A4.2a and A4.2b). The larger part of this (73,6% and 81,8% respectively) concerns public or non-market R&D. The second place is taken by the university education industry where R&D investment related to value added is 64,2% in 1999 and 67,8% in 1995. Here too, this mainly concerns non-market R&D (63,7% and 67,4% respectively).

As far as private R&D investment is concerned, the industries “manufacture of ICT hardware”, “manufacture of chemical products” and “manufacture of basic chemicals and man-made fibers” follow closely after the R&D industry (25.7%, 24.8% and 9,0% respectively in 1999 and a similar pattern in 1995). More than 50% of all R&D investment in the Netherlands is concentrated in these four industry branches. This is also true for private (non-public) R&D. Quite remarkably, these industries make up together only 4% of total value added in 1999 and 5% in 1995. This indicates a very high concentration of R&D investment in only a few and rather small industry branches.

Table A3.4.2 shows that in 1999 more than 64% of total ICT investment is concentrated in four industry branches (59% in 1995): “Trade, hotels, restaurants and repair”, “Banking, insurance and pension funding”, “Public administration and social security” and “Telecommunications and post”.

However, these industries together represent a major part of the services industry in the Dutch economy, with a share of almost 32% of total value added in the Netherlands in 1999 (31% in 1995). This implies that ICT capital is much wider disseminated than R&D capital. Also, ICT capital is highly represented in the services industries while R&D is typically concentrated in the manufacturing industries. Table A4.2b shows that, in relation to value added, the telecommunication industry (including postal services) shows the highest ICT investment percentage (57%). ”Banking, insurance and pension funding” and “manufacture of ICT hardware” follow with 13% and 9% respectively. Between 1995 and 1999, investment in ICT, also in relation to GDP, has been rapidly expanding (tables 3.4.1 and 4.1). ICT is the only expenditure component that contributed to the increasing knowledge intensity of industries in the Netherlands.

5. Recommendations and future work

The module presented in this paper is a first attempt to strengthen the representation of knowledge-related indicators in the system of national accounts. At the same time, the application of a uniform set of accounting conventions improves the mutual consistency and comparability of these indicators. Also, their relationships to other national accounts indicators become visible. This puts these indicators into perspective and allows for further analysis.

This is very well illustrated by table 4.1 in this paper. This table embodies three Structural Indicators, as defined in the context of the Lisbon Strategy, that have been utilised in connection with the pillar “Innovation and Research”: “Spending on human resources” (public expenditure on education), “R&D expenditure” (GERD) and “ICT expenditure”. The sources currently applied for each of these indicators are divers and their mutual comparability is not guaranteed. The underlying concepts may differ considerably. As shown in this paper, one may expect a considerable overlap in what each of these indicators measure. A national accounts based representation of these indicators helps to eliminate differences in concepts as well as possible overlaps. Also, the direct relation of these indicators to GDP and other national accounts indicators such as fixed capital formation and consumption becomes visible.

The module illustrates that the national accounts provide a solid statistical basis for estimating these indicators. Most of the adjustments presented in the modules are the consequence of improvements that are currently being implemented in most countries (software measurement - ICT capital) or are expected as a result of the upcoming SNA revision (R&D). This implies that, in the near future, most EU countries will be able to regularly compile these indicators in connection to their annual (and quarterly) national accounts with restricted additional efforts.

Although the module provides an extended presentation of knowledge compared to standard national accounting, some topics have not yet been investigated within the context of the module.

With regard to telecommunication infrastructure related gross fixed capital formation, only the capital formation in the telecommunication industry has so far been investigated. Although it is expected that a larger part of gross fixed capital formation in telecommunication infrastructure is found within this industry, investment in telecommunication equipment by other industries is expectedly not ignorable. This needs further investigation.

As far as public education is concerned, it is expected that additional sources of information will become available in 2004 to improve the subdivision of primary, secondary and third level education. On the other hand, it is doubtful whether more sources of information on internal company education and training expenditure will become available at Statistics Netherlands in the near future.

In the Netherlands, the following problem complicates the translation of gross expenditure on R&D in accordance with Frascati guidelines to R&D output in accordance with national accounts practice. The R&D statistics is a functional statistics and therefore not entirely co-ordinated by the business register. This complicates reconciliation with the national accounts, which is an institutional statistics. An alternative for the R&D statistics is the business survey of the R&D industry (NACE-73) which is initiated recently. It is expected that this new statistics will improve the reconciliation of R&D statistics with the Dutch national accounts. However, additional research is still needed to obtain a satisfactory demarcation of the R&D industry in this production survey. From a national accounting point of view, it would be very beneficial to fully co-ordinate or perhaps even integrate both statistics. Obviously, a production survey is also useful as a supplementary source in the translation of GERD to R&D output in industries other than the NACE-73 industry.

Frascati statistics allow for the compilation of R&D related capital stock based on a perpetual inventory method. This capital stock, required in the production of R&D, has not been estimated in the course of this project. Also, the consumption of fixed capital component in non-market and own-account R&D output, as presented in the current paper is provisional, and not (yet) based on such perpetual inventory calculations.

So far attention has only been paid to R&D-software overlaps. However, it is imaginable that overlaps with other intangible fixed assets may occur as well. More research is needed on this topic.

A sound national accounts based delineation of R&D output is obviously an elementary step in the capitalisation of R&D expenditure. However, before such additional steps can be taken in a meaningful way, several conceptual issues need to be solved such as a clear understanding of the assets created by R&D and their subsequent use in production. The more practical issues, *e.g.* proper

valuation principles, double counting, do not seem to differ substantially from those related to the capitalisation of software. In fact, it is likely that most countries will use the Frascati-based R&D statistics as the main source of information. Therefore, the measurement of R&D investment and related capital will probably lead to much better internationally comparable results, than the first estimates that were made for software after the latest SNA-1993 implementation.

The module proposed here is a first step in adding knowledge related indicators to productivity measurement. An isolated description of knowledge intensive capital such as ICT capital, R&D, other intangibles and labour (*e.g.* HRST) facilitates the measurement of economy-wide spill-over effects that are generally expected from the creation and use of these knowledge-related assets. However, this is clearly a subsequent step in measuring the importance of knowledge in the economy.

References

Australian Bureau of Statistics (2001) Experimental estimates of human capital for Australia. Paper presented at the OECD meeting of national accounts experts, OECD (9-12 October 2001, Paris).

Berg, A., van den (2000) Knowledge: expenditures, output and growth; provisional results of a knowledge module supplementing the Dutch national accounts. *Netherlands Official Statistics* 15(3), 4-7.

Bergen, D., van (2003) ICT investeringen en ICT kapitaalgoederenvoorraad, internal report, Statistics Netherlands (Voorburg/Heerlen).

Bos, F. (1996) Human capital and economic growth; a national accounting approach. Paper presented at the 24th General Conference of the International Society of Research in Income and Wealth (Lillehammer, 18-24 August).

Bos. F., H. Hollanders & S.J. Keuning (1994) A research and development module supplementing the national accounts, *Review of income and wealth*, 40(3): 273-286.

CPB (2002) De pijlers onder de kenniseconomie, CPB (The Hague).

Commission of the European Communities (1996) *European System of Accounts 1995,* Commission of the European Communities (Luxembourg).

Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank (1993) *System of National Accounts 1993*, Series F, No. 2, Rev. 4, United Nations (New York).

Eurostat (2003) Structural indicators – short methodological overview, Eurostat (Luxembourg).

Eurostat (2002) Report of the Eurostat task force on software measurement, Eurostat (Luxembourg).

Haan M., de (2002) Indicatoren EU strijdig met specialisatie. Economische Statistische Berichten, 12 April: 290-291.

Haan, de M., W.P. Leunis & M. Verbruggen (2002) European Structural Indicators, a way forward. Paper presented at the NESIS conference on statistical information systems for good governance within the new economy (Olympia, 9-14 June).

Haan, M., de & M. van Rooijen-Horsten (2003) The translation of R&D statistics from Frascati to National Accounts guidelines in the Netherlands. Statistics Netherlands (Voorburg/Heerlen), BPA number 0561-03-MOO.

Hill, P. (2002) Tangibles, intangibles and services; a new taxonomy for the classification of output (http://www.euintangibles.net/publications/localfiles/Newtaxonomyofintangiblegoods-CSLS.PDF)

Hill, P. (1997) Intangible assets, patents and copyrights in the 1993 SNA. SNA news and notes, issue 6, United Nations (New York).

Jorgenson, D.W. & B.M. Fraumeni (1989) The accumulation of human and non-human capital, 1948-1984. In: R. Lipsey & H. Stone Tice (eds.), The measurement of saving, investment and wealth, 227-285, National Bureau of Economic Research (Washington D.C.).

Mantler P. & S. Peleg (2003) Background and issues paper for the R&D-SNA Task Force, 1st meeting on 14 April 2003 at Statistics Netherlands (Voorburg).

OECD (2001) *Measuring capital*, OECD (Paris).

OECD (2002) Software task force report OECD (Paris).

OECD (2001) *STI scoreboard; creation and diffusion of knowledge*, OECD (Paris).

OECD (1995) *Manual on the measurement of human resources devoted to science and technology; "Canberra manual"*, OECD (Paris).

OECD (1993) *Frascati manual 1993*, OECD (Paris).

Schreyer, P. (2000) The contribution of information and communication technology to output growth: a study of the G7 countries. Paper presented at the 26th General Conference of the International Association on Research in Income and Wealth (Krakow, 27 August – 2 September).

Statistics Netherlands (2001) *Kennis en economie 2001*, Statistics Netherlands (Voorburg/Heerlen).

Statistics Netherlands (2001) *De digitale economie 2001*, Statistics Netherlands (Voorburg/Heerlen).

Annex

Table A3.1.1
Education expenditure components by industry branch, 1999 (million €)

	Purchases of "market" education	Own-account education expenditure					Total
		Intermediate consumption		Compensation of employees		Total	
		Travelling expenses and accomodation in connection with education	Material expenses in connection with education [5]	Costs of forgone working hours [4]	Costs of (internal) teachers/ training-personal [4]		
Agriculture, forestry and fishing	4	0	0	3	1	4	8
Mining and quarrying	9	1	0	5	1	7	16
Manufacture of food products, beverages and tobacco	39	2	2	39	12	55	95
Manufacture of textile and leather products	5	0	0	4	1	6	11
Manufacture of building material	11	0	0	9	2	12	24
Manufacture of paper and paper products	11	1	0	8	3	12	23
Printing	9	0	0	8	1	10	19
Manufacture of petroleum products	3	0	0	1	1	3	6
Manufacture of basic chemicals and man-made fibres	19	1	1	17	3	22	41
Manufacture of chemical products	24	1	2	23	5	30	55
Manufacture of rubber and plastic products	9	0	0	9	2	12	20
Manufacture of basic metals	15	1	1	17	5	24	39
Manufacture of fabricated metal products	25	1	1	20	3	25	50
Manufacture of machinery and equipment n.e.c.	24	1	1	24	3	29	54
Manufacture of (other) electronic equipment	6	0	1	11	1	14	20
Manufacture of transport equipment	19	1	1	13	4	19	38
Other manufacturing	17	1	1	22	4	28	45
Construction	107	4	3	117	11	134	241
Trade, hotels, restaurants and repair	183	12	15	223	53	303	486
Transport and storage	101	7	5	78	26	116	218
Banking, insurance & pension funding	234	15	9	145	42	211	446
Other business activities	128	17	6	112	50	185	313
Electricity, gas and water supply	14	1	1	18	5	25	39
Public administration and social security [2) 3)]	469	37	30	582	117	767	1236
Health and social work activities [1)]	-	-	-	-	-	-	-
Other service activities n.e.c.	38	5	3	30	11	49	87
Manufacture of ICT Hardware	36	3	3	40	9	56	92
Telecommunications and post	67	4	6	26	40	76	143
Content: publishing, press and broadcasting	14	1	1	11	3	15	29
Content: entertainment and art	6	0	0	5	1	6	12
Computer and related activities	123	14	7	63	34	118	242
Research and development	13	1	1	6	3	11	23
Legal and economic activities	90	12	2	102	18	134	224
Architectural and engineering activities	16	3	3	13	2	21	37
Advertising	2	0	0	1	0	2	4
Primary education [2)]	20	0	0	9	4	13	33
Secondary education [2)]	24	1	0	10	4	16	40
Higher education [2)]	6	0	0	2	1	4	9
University education [2)]	11	0	0	5	2	7	18
Other education [2)]	2	0	0	1	0	2	4
Total (= column sum)	1955	152	107	1836	488	2583	4538

[1)] The industry "Health and social work activities" is not included in these figures because of lacking data.

[2)] Tentative estimations: see text.

[3)] The industry "Defence activities" is not included here because of lacking data.

[4)] Compensation of employees.

[5)] Including buildings, rooms, equipment and teaching aids.

Table A3.1.2
Education expenditure by industry branch, 1995-1999 (million €)

	1995			1999		
	Purchases of "market" education	Own-account education expenditure	Total	Purchases of "market" education	Own-account education expenditure	Total
Agriculture, forestry and fishing	2	3	6	4	4	8
Mining and quarrying	12	11	23	9	7	16
Manufacture of food products, beverages and tobacco	28	38	66	39	55	95
Manufacture of textile and leather products	3	4	8	5	6	11
Manufacture of building material	11	17	28	11	12	24
Manufacture of paper and paper products	8	10	18	11	12	23
Printing	6	8	14	9	10	19
Manufacture of petroleum products	2	3	5	3	3	6
Manufacture of basic chemicals and man-made fibres	20	34	54	19	22	41
Manufacture of chemical products	22	40	61	24	30	55
Manufacture of rubber and plastic products	6	12	18	9	12	20
Manufacture of basic metals	14	26	41	15	24	39
Manufacture of fabricated metal products	19	20	38	25	25	50
Manufacture of machinery and equipment n.e.c.	18	22	40	24	29	54
Manufacture of (other) electronic equipment	4	10	14	6	14	20
Manufacture of transport equipment	12	19	31	19	19	38
Other manufacturing	15	30	45	17	28	45
Construction	46	56	102	107	134	241
Trade, hotels, restaurants and repair	100	154	254	183	303	486
Transport and storage	47	158	205	101	116	218
Banking, insurance & pension funding	150	172	322	234	211	446
Other business activities	49	78	127	128	185	313
Electricity, gas and water supply	18	22	40	14	25	39
Public administration and social security [2) 3)]	332	666	998	469	767	1236
Health and social work activities[1)]	-	-	-	-	-	-
Other service activities n.e.c.	16	22	37	38	49	87
Manufacture of ICT Hardware	27	44	71	36	56	92
Telecommunications and post	50	64	114	67	76	143
Content: publishing, press and broadcasting	8	11	19	14	15	29
Content: entertainment and art	2	3	5	6	6	12
Computer and related activities	43	44	87	123	118	242
Research and development	5	4	9	13	11	23
Legal and economic activities	34	54	89	90	134	224
Architectural and engineering activities	5	8	13	16	21	37
Advertising	1	1	2	2	2	4
Primary education [2)]	10	10	19	20	13	33
Secondary education [2)]	16	11	28	24	16	40
Higher education [2)]	3	3	6	6	4	9
University education [2)]	7	5	12	11	7	18
Other education [2)]	1	1	3	2	2	4
Total (= column sum)	1174	1900	3074	1955	2583	4538

[1)] The industry "Health and social work activities" is not included in these figures because of lacking data.

[2)] Tentative estimations: see text.

[3)] The industry "Defence activities" is not included here because of lacking data.

Table A3.1.4
Supply and use of education in the Netherlands, 1999 (mln euro)

	Primary & secondary education	Higher education	University education	Other education[1)]	Health and social work	Public administration and social security	Other industries	Rest of the world	Non-deductable VAT	Total supply
Primary & secondary education	11393					343				11736
Higher education		1814								1814
University education			1241		378					1619
Other education[2)]				1991			573		96	2661
Own account education expenditures[3)]	29	4	7	2	-	767	1775			2583
Total	11422	1818	1248	1993	378	1110	2349	0	96	20413

[1)] This includes education at private schools (primary, secondary, higher and university level).
[2)] Figures on other education are based on the official national accounts figures plus a mark-up in order to equal the total amount of purchases of market education as reported in Table A3.1.1 first column.
[3)] Figures on own-account education come from Table A3.1.1 last column but one.

	Primary & secondary education	Higher education	University education	Other education[1)]	Health and social work[3)]	Public administration and social security [3)]	Other industries	Rest of the world	Final consumption expenditure	Total use
Primary & secondary education									11736	11736
Higher education									1814	1814
University education									1619	1619
Other education[2)]	43	6	11	2	-	469	1424		706	2661
Own account education expenditures[2)]	29	4	7	2	-	767	1775		0	2583
Total	72	9	18	4	0	1236	3199	0	15875	20413

[1)] This includes education at private schools (primary, secondary, higher and university level).
[2)] Figures on intermediate consumption of "Other education" come from Table A3.1.1 first column, and figures on own-account education expenditures come from Table A3.1.1 last column but one.
[3)] For the industries "Health and social work activities" and "Defence activities" no figures are identified concerning purchases of "Other education" and own-account education because of lacking data.

Table A3.2.2
HRST wages, 1995-1999 (million €)

	1995			1999		
	Total	HRST-I	HRST-II	Total	HRST-I	HRST-II
Agriculture, forestry and fishing	1598	62	347	1833	70	383
Mining and quarrying	408	164	242	413	151	272
Manufacture of food products, beverages and tobacco	3822	525	1435	3933	611	1565
Manufacture of textile and leather products	738	51	215	678	72	235
Manufacture of building material	1372	127	430	1463	138	481
Manufacture of paper and paper products	770	99	288	813	118	317
Printing	1334	110	503	1402	100	510
Manufacture of petroleum products	325	81	190	324	75	183
Manufacture of basic chemicals and man-made fibres	1495	405	843	1418	360	742
Manufacture of chemical products	1284	374	762	1374	374	781
Manufacture of rubber and plastic products	871	113	366	973	139	379
Manufacture of basic metals	900	156	389	898	142	409
Manufacture of fabricated metal products	2423	202	791	2708	239	954
Manufacture of machinery and equipment n.e.c.	2288	366	988	2616	496	1201
Manufacture of (other) electronic equipment	749	111	320	848	204	431
Manufacture of transport equipment	1590	268	627	1703	303	691
Other manufacturing	2462	97	677	2663	201	810
Construction	8947	630	2578	10620	655	2947
Trade, hotels, restaurants and repair	21320	2330	9011	25214	2869	11075
Transport and storage	7147	905	2221	8322	1039	2629
Banking, insurance and pension funding	7024	1959	5332	9286	3048	7530
Other business activities	7629	1109	3010	11073	1877	4612
Electricity, gas and water supply	1389	352	839	1334	347	842
Public administration and social security	12645	4663	8948	13962	4761	9509
Health and social work activities	12818	4752	9590	14812	5827	11331
Other service activities n.e.c.	3047	776	1520	3719	1099	2071
Manufacture of ICT Hardware	2166	771	1294	2196	841	1404
Telecommunications and post	2278	337	901	2859	576	1326
Content: publishing, press and broadcasting	1353	582	1054	1651	647	1295
Content: entertainment and art	955	469	731	1050	492	817
Computer and related activities	1703	1024	1563	3633	2196	3320
Research and development	880	543	757	1080	761	970
Legal and economic activities	4532	1973	3421	5782	2678	4521
Architectural and engineering activities	2003	1042	1762	2501	1281	2202
Advertising	495	151	376	690	220	521
Primary education	2731	2312	2531	3184	2758	2985
Secondary education	3321	2561	2988	3842	3013	3490
Higher education	795	626	717	906	695	828
University education	1529	1206	1414	1710	1388	1595
Other education	336	194	299	371	209	333
Total (= column sum)	131472	34578	72266	155857	43069	88500

Table A3.2.3
HRST labour input (including self-employed), 1995-1999 (x 1000 full time equivalents)

	1995			1999		
	Total	HRST-I	HRST-II	Total	HRST-I	HRST-II
Agriculture, forestry and fishing	237	7	45	238	10	47
Mining and quarrying	9	3	4	9	2	5
Manufacture of food products, beverages and tobacco	143	13	39	136	14	40
Manufacture of textile and leather products	35	2	8	30	2	8
Manufacture of building material	53	3	13	55	4	14
Manufacture of paper and paper products	26	2	7	25	3	8
Printing	53	4	17	51	3	16
Manufacture of petroleum products	8	2	4	7	1	4
Manufacture of basic chemicals and man-made fibres	38	8	18	33	7	15
Manufacture of chemical products	39	8	20	40	8	21
Manufacture of rubber and plastic products	32	3	11	32	3	10
Manufacture of basic metals	27	3	10	26	3	10
Manufacture of fabricated metal products	97	6	26	104	6	29
Manufacture of machinery and equipment n.e.c.	79	9	28	89	12	33
Manufacture of (other) electronic equipment	30	3	11	31	5	12
Manufacture of transport equipment	61	7	18	62	7	19
Other manufacturing	131	4	26	138	7	33
Construction	416	23	98	467	24	107
Trade, hotels, restaurants and repair	1097	83	360	1208	92	407
Transport and storage	275	23	69	289	22	73
Banking, insurance and pension funding	211	47	143	255	70	189
Other business activities	418	49	140	572	68	188
Electricity, gas and water supply	41	8	22	36	8	20
Public administration and social security	430	128	277	425	115	256
Health and social work activities	569	177	394	661	222	469
Other service activities n.e.c.	219	55	99	245	64	118
Manufacture of ICT Hardware	68	18	33	69	20	36
Telecommunications and post	80	9	28	98	15	40
Content: publishing, press and broadcasting	80	34	59	88	35	66
Content: entertainment and art	34	13	23	38	16	27
Computer and related activities	52	30	46	106	59	92
Research and development	24	13	20	29	19	25
Legal and economic activities	155	59	106	180	73	130
Architectural and engineering activities	67	31	56	83	37	70
Advertising	28	7	18	34	9	21
Primary education	102	83	92	111	92	101
Secondary education	107	77	91	118	85	100
Higher education	22	16	19	25	17	21
University education	44	31	38	44	32	39
Other education	27	14	22	25	13	21
Total (= column sum)	5663	1113	2557	6309	1302	2939

Table A3.3.4
A Bridge table summarizing all differences between gross expenditure on R&D and the R&D output measured in accordance with national accounts guidelines, the Netherlands, 1999 (million €)

	Gross expenditure on R&D	Re-classification	Capital expenditure	Gross operating surplus [1]	Overlaps with software	Subsidies on production	R&D output (SNA/ESA) = row sum
	1	2	3	4	5	6	7
Agriculture, forestry and fishing	87	-21	-26	6	-	-1	46
Mining and quarrying	86	-74	-2	2	-	-	13
Manufacture of food products, beverages and tobacco	250	-112	-17	13	-2	-7	125
Manufacture of textile and leather products	17	-	-3	2	-	-1	14
Manufacture of building material	17	-	-2	2	-	-1	15
Manufacture of paper and paper products	16	-	-1	1	-	-1	14
Printing	11	-	-3	1	-3	-1	6
Manufacture of petroleum products	37	-	-	5	-	-1	40
Manufacture of basic chemicals and man-made fibres	354	-220	-12	14	-	-6	129
Manufacture of chemical products	564	-513	-4	5	-	-2	49
Manufacture of rubber and plastic products	42	-	-5	4	-	-2	38
Manufacture of basic metals	60	-44	-2	2	-	-	16
Manufacture of fabricated metal products	54	-	-6	5	-1	-4	49
Manufacture of machinery and equipment n.e.c.	339	-29	-40	26	-31	-13	252
Manufacture of (other) electronic equipment	101	-	-7	9	-15	-5	83
Manufacture of transport equipment	155	-	-11	18	-1	-6	154
Other manufacturing	17	-	-3	1	-	-1	14
Construction	61	-	-6	9	-18	-1	44
Trade, hotels, restaurants and repair	206	-	-20	24	-24	-7	179
Transport and storage	99	-	-4	15	-23	-2	85
Banking, insurance & pension funding	100	-	-14	9	-63	-2	29
Other business activities	56	-	-6	5	-3	-3	49
Electricity, gas and water supply	21	-	-2	3	-1	-1	21
Public administration and social security	-	283	-36	20	-3	-	264
Health and social work activities	-	-	-	-	-	-	-
Other service activities n.e.c.	12	-	-5	2	-	-	8
Manufacture of ICT Hardware	1206	-	-91	118	-195	-42	996
Telecommunications and post	5	-	-4	1	-	-	2
Content: publishing, press and broadcasting	3	-	-	-	-1	-	2
Content: entertainment and art	-	-	-	-	-	-	-
Computer and related activities	107	-	-6	10	-69	-3	40
Research and development [2]	1317	731	-235	1020	-20	-	2813
Legal and economic activities	22	-	-3	4	-1	-	22
Architectural and engineering activities	158	-	-10	25	-6	-4	163
Advertising	-	-	-	-	-	-	-
Primary education	-	-	-	-	-	-	-
Secondary education	-	-	-	-	-	-	-
Higher education	-	-	-	-	-	-	-
University education	1983	-	-127	139	-	-	1995
Other education	-	-	-	-	-	-	-
Total (=column sum)	7564	-	-711	1521	-484	-119	7771

[1] This adjustment also includes 608 million € of R&D purchases in the Research and development industry (*cf.* table 3.3.1 and 3.3.3), and 12 million € of purchases of R&D in the University education industry (cf. table 3.3.1).

[2] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.5
R&D use by industry branch, 1995-1999 (million €)

	1995	1996	1997	1998	1999
Agriculture, forestry and fishing	46	32	37	55	43
Mining and quarrying	63	22	53	92	46
Manufacture of food products, beverages and tobacco	262	241	253	251	288
Manufacture of textile and leather products	12	9	9	8	14
Manufacture of building material	20	16	11	9	19
Manufacture of paper and paper products	16	13	10	15	16
Printing	3	3	2	3	9
Manufacture of petroleum products	0	21	19	38	45
Manufacture of basic chemicals and man-made fibres	566	204	132	163	368
Manufacture of chemical products	324	625	657	718	808
Manufacture of rubber and plastic products	24	37	39	30	39
Manufacture of basic metals	33	30	19	24	38
Manufacture of fabricated metal products	57	34	43	33	55
Manufacture of machinery and equipment n.e.c.	153	181	204	247	329
Manufacture of (other) electronic equipment	58	69	71	73	95
Manufacture of transport equipment	131	82	106	91	139
Other manufacturing	11	13	30	19	13
Construction	18	18	16	25	19
Trade, hotels, restaurants and repair	118	127	131	157	188
Transport and storage	25	23	26	25	31
Banking, insurance & pension funding	20	76	104	113	79
Other business activities	33	34	28	9	51
Electricity, gas and water supply	49	51	77	84	64
Public administration and social security	238 [2)]	241 [2)]	248 [2)]	259 [2)]	264 [2)]
Health and social work activities	-	-	-	-	-
Other service activities n.e.c.	-	16	17	16	10
Manufacture of ICT Hardware	734	849	845	864	997
Telecommunications and post	45	45	43	37	1
Content: publishing, press and broadcasting	2	3	2	3	5
Content: entertainment and art	-	-	-	-	-
Computer and related activities	6	33	44	40	58
Research and development [1)]	1567 [3)]	1545 [3)]	1595 [3)]	1699 [3)]	1697 [3)]
Legal and economic activities	2	5	13	8	17
Architectural and engineering activities	17	109	157	133	80
Advertising	-	-	-	-	-
Primary education	-	-	-	-	-
Secondary education	-	-	-	-	-
Higher education	-	-	-	-	-
University education	1444 [4)]	1515 [4)]	1548 [4)]	1501 [4)]	1592 [4)]
Other education	-	-	-	-	-
Total (=column sum)	6094	6321	6590	6840	7518

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

[2)] This is public (non-market) R&D.

[3)] Of which 1033, 1036, 1057, 1115 and 1089 mln euro concerns public (non-market) R&D for the years 1995-1999 respectively, the rest being purchases of private (market) R&D.

[4)] Of which 1434, 1511, 1536, 1490 and 1580 mln euro concerns public (non-market) R&D for the years 1995-1999 respectively, the rest being purchases of private (market) R&D.

Table A3.3.6a
Total R&D related labour input of employees by industry branch, 1995-1999 (x 1000 full time equivalents)

	1995	1996	1997	1998	1999
Agriculture, forestry and fishing	0,5	0,4	0,5	1,0	0,8
Mining and quarrying	0,1	0,1	0,1	0,1	0,1
Manufacture of food products, beverages and tobacco	1,4	1,4	1,4	1,4	1,7
Manufacture of textile and leather products	0,2	0,2	0,2	0,2	0,2
Manufacture of building material	0,3	0,3	0,2	0,1	0,2
Manufacture of paper and paper products	0,2	0,2	0,2	0,3	0,3
Printing	0,0	0,1	0,0	0,1	0,1
Manufacture of petroleum products	0,0	0,3	0,2	0,5	0,2
Manufacture of basic chemicals and man-made fibres	2,0	1,0	0,9	0,9	1,2
Manufacture of chemical products	0,3	0,5	0,5	0,5	0,5
Manufacture of rubber and plastic products	0,5	0,6	0,7	0,6	0,7
Manufacture of basic metals	0,1	0,1	0,1	0,2	0,2
Manufacture of fabricated metal products	0,7	0,8	0,8	0,7	1,0
Manufacture of machinery and equipment n.e.c.	2,3	2,3	2,5	2,5	3,1
Manufacture of (other) electronic equipment	0,9	0,9	1,0	1,0	1,2
Manufacture of transport equipment	2,2	1,4	1,9	1,6	1,9
Other manufacturing	0,2	0,2	0,4	0,3	0,2
Construction	0,3	0,5	0,4	0,6	0,6
Trade, hotels, restaurants and repair	1,4	1,6	2,4	2,6	2,5
Transport and storage	0,3	0,3	0,3	0,2	0,7
Banking, insurance & pension funding	0,0	0,3	0,3	0,2	0,3
Other business activities	1,0	0,9	1,0	0,8	0,8
Electricity, gas and water supply	0,1	0,1	0,3	0,3	0,3
Public administration and social security	3,7	3,6	3,6	3,7	3,7
Health and social work activities	-	-	-	-	-
Other service activities n.e.c.	0,0	0,1	0,1	0,1	0,1
Manufacture of ICT Hardware	8,0	8,0	8,6	9,1	9,1
Telecommunications and post	0,6	0,6	0,6	0,5	0,0
Content: publishing, press and broadcasting	0,0	0,1	0,0	0,1	0,0
Content: entertainment and art	-	-	-	-	-
Computer and related activities	0,4	0,4	0,4	0,5	0,8
Research and development [1)]	22,3	22,4	22,7	23,4	22,9
Legal and economic activities	0,1	0,1	0,1	0,1	0,2
Architectural and engineering activities	0,7	1,4	2,1	1,5	1,8
Advertising	-	-	-	-	-
Primary education	-	-	-	-	-
Secondary education	-	-	-	-	-
Higher education	-	-	-	-	-
University education	24,9	24,4	24,4	24,2	24,3
Other education	-	-	-	-	-
Total (=column sum)	75,8	75,5	78,9	79,9	81,5

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.6b
R&D related labour input of employees by industry branch: scientific staff, 1995-1999 (x 1000 full time equivalents)

	1995	1996	1997	1998	1999
Agriculture, forestry and fishing	0,1	0,1	0,1	0,2	0,2
Mining and quarrying	0,0	0,1	0,1	0,1	0,0
Manufacture of food products, beverages and tobacco	0,4	0,5	0,5	0,6	0,8
Manufacture of textile and leather products	0,1	0,1	0,1	0,1	0,1
Manufacture of building material	0,1	0,1	0,1	0,1	0,1
Manufacture of paper and paper products	0,1	0,1	0,1	0,1	0,1
Printing	0,0	0,0	0,0	0,0	0,1
Manufacture of petroleum products	0,0	0,1	0,1	0,1	0,0
Manufacture of basic chemicals and man-made fibres	0,7	0,4	0,4	0,3	0,4
Manufacture of chemical products	0,1	0,2	0,2	0,2	0,2
Manufacture of rubber and plastic products	0,2	0,2	0,3	0,3	0,3
Manufacture of basic metals	0,1	0,1	0,1	0,1	0,1
Manufacture of fabricated metal products	0,3	0,3	0,4	0,4	0,5
Manufacture of machinery and equipment n.e.c.	0,9	0,9	1,0	1,1	1,1
Manufacture of (other) electronic equipment	0,5	0,4	0,5	0,5	0,4
Manufacture of transport equipment	0,7	0,4	0,8	0,5	0,6
Other manufacturing	0,1	0,2	0,2	0,2	0,1
Construction	0,1	0,2	0,2	0,4	0,4
Trade, hotels, restaurants and repair	0,5	0,9	1,0	0,9	1,0
Transport and storage	0,1	0,1	0,1	0,1	0,5
Banking, insurance & pension funding	0,0	0,1	0,1	0,2	0,2
Other business activities	0,4	0,4	0,5	0,5	0,4
Electricity, gas and water supply	0,0	0,1	0,1	0,1	0,1
Public administration and social security	1,8	1,8	1,8	1,8	1,8
Health and social work activities	-	-	-	-	-
Other service activities n.e.c.	0,0	0,1	0,1	0,1	0,1
Manufacture of ICT Hardware	2,7	2,2	2,8	2,7	3,6
Telecommunications and post	0,2	0,2	0,2	0,3	0,0
Content: publishing, press and broadcasting	0,0	0,1	0,0	0,0	0,0
Content: entertainment and art	-	-	-	-	-
Computer and related activities	0,1	0,3	0,3	0,3	0,4
Research and development [1)]	9,6	9,8	10,1	10,4	10,1
Legal and economic activities	0,0	0,0	0,1	0,0	0,1
Architectural and engineering activities	0,3	0,7	1,3	1,3	1,3
Advertising	-	-	-	-	-
Primary education	-	-	-	-	-
Secondary education	-	-	-	-	-
Higher education	-	-	-	-	-
University education	12,5	12,4	12,4	12,4	12,7
Other education	-	-	-	-	-
Total (=column sum)	32,8	33,2	35,8	36,4	37,9

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.7a
Supply and use table R&D, 1999 (million €)

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[2)]	University education	Public admini-stration & social security	Other industries	Rest of the the World		Total supply
Market R&D[1)]	40	220	16	1724	415	-	558	441		3413
Non-market R&D	-	-	-	1089	1580	264	-			2933
Own-account R&D	138	776	24	-	-	-	928			1866
Total supply	178	996	40	2813	1995	264	1486	441		8212

[1)] including 'intra-enterprise R&D'.

[2)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[1)]	University education	Public admini-stration & social security	Other industries	Rest of the the World	Government consumption	Total use
Market R&D	1 038	221	34	608	12	-	806	694		3 413
Non-market R&D	-	-	-	-	-	-	-		2 933	2 933
Own-account R&D	138	776	24	-	-	-	928			1 866
Total use	1 176	997	58	608	12	-	1 735	694	2 933	8 212

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.7b
Supply and use table R&D, 1998 (million €)

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[2)]	University education	Public admini-stration & social security	Other industries	Rest of the the World		Total supply
Market R&D[1)]	68	232	6	1 623	385	-	374	352		3 040
Non-market R&D	-	-	-	1115	1490	259	-			2 864
Own-account R&D	84	634	23	-	-	-	785			1 526
Total supply	152	866	29	2 737	1 875	259	1 159	352		7 430

[1)] including 'intra-enterprise R&D'.

[2)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[1)]	University education	Public admini-stration & social security	Other industries	Rest of the the World	Government consumption	Total use
Market R&D	796	230	17	584	11	-	812	590		3 040
Non-market R&D	-	-	-	-	-	-	-		2 864	2 864
Own-account R&D	84	634	23	-	-	-	785			1 526
Total use	880	864	40	584	11	-	1 596	590	2 864	7 430

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.7c
Supply and use table R&D, 1997 (million €)

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[2)]	University education	Public admini-stration & social security	Other industries	Rest of the the World		Total supply
Market R&D[1)]	77	269	6	1 516	337	-	415	345		2 966
Non-market R&D	-	-	-	1057	1536	248	-			2 841
Own-account R&D	71	629	27	-	-	-	791			1 518
Total supply	148	898	34	2 573	1 873	248	1 206	345		7 325

[1)] including 'intra-enterprise R&D'.

[2)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[1)]	University education	Public admini-stration & social security	Other industries	Rest of the the World	Government consumption	Total use
Market R&D	718	216	16	538	12	-	730	735		2 966
Non-market R&D	-	-	-	-	-	-	-		2 841	2 841
Own-account R&D	71	629	27	-	-	-	791			1 518
Total use	789	845	44	538	12	-	1 521	735	2 841	7 325

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.7d
Supply and use table R&D, 1996 (million €)

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[2)]	University education	Public admini-stration & social security	Other industries	Rest of the the World		Total supply
Market R&D[1)]	44	110	3	1 382	309	-	246	230		2 324
Non-market R&D	-	-	-	1036	1511	241	-			2 788
Own-account R&D	99	694	22	-	-	-	755			1 570
Total supply	143	804	25	2 418	1 820	241	1 000	230		6 682

[1)] including 'intra-enterprise R&D'.

[2)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[1)]	University education	Public admini-stration & social security	Other industries	Rest of the the World	Government consumption	Total use
Market R&D	730	155	12	509	4	-	554	362		2 324
Non-market R&D	-	-	-	-	-	-	-		2 788	2 788
Own-account R&D	99	694	22	-	-	-	755			1 570
Total use	829	849	33	509	4	-	1 309	362	2 788	6 682

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.3.7e
Supply and use table R&D, 1995 (million €)

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[2)]	University education	Public admini-stration & social security	Other industries	Rest of the the World		Total supply
Market R&D[1)]	8	161	20	1 362	307	-	294	190		2 343
Non-market R&D	-	-	-	1033	1434	238	-			2 705
Own-account R&D	197	609	2	-	-	-	661			1 469
Total supply	206	770	23	2 394	1 741	238	955	190		6 517

[1)] including 'intra-enterprise R&D'.

[2)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

	Manufacture of chemicals, chemical products and man-made fibres	Manufacture of ICT hardware	Computer and related activities	R&D industry[1)]	University education	Public admini-stration & social security	Other industries	Rest of the the World	Government consumption	Total use
Market R&D	693	125	3	534	10	-	555	423		2 343
Non-market R&D	-	-	-	-	-	-	-		2 705	2 705
Own-account R&D	197	609	2	-	-	-	661			1 469
Total use	890	734	6	534	10	-	1 216	423	2 705	6 517

[1)] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A3.4.2
ICT related gross fixed capital formation by industry branch of destination, 1995-1999 (million €)

	1995	1996	1997	1998	1999
Agriculture, forestry and fishing	39	48	48	59	85
Mining and quarrying	31	47	73	81	104
Manufacture of food products, beverages and tobacco	135	168	169	194	245
Manufacture of textile and leather products	19	16	15	29	32
Manufacture of building material	28	29	32	45	51
Manufacture of paper and paper products	28	24	30	68	69
Printing	49	50	72	85	81
Manufacture of petroleum products	52	41	18	27	8
Manufacture of basic chemicals and man-made fibres	62	46	38	49	68
Manufacture of chemical products	140	102	74	89	120
Manufacture of rubber and plastic products	24	23	24	29	36
Manufacture of basic metals	37	46	70	90	96
Manufacture of fabricated metal products	43	44	46	87	105
Manufacture of machinery and equipment n.e.c.	77	84	99	181	139
Manufacture of (other) electronic equipment	72	83	147	115	124
Manufacture of transport equipment	52	48	51	93	121
Other manufacturing	23	26	26	42	52
Construction	108	132	142	220	229
Trade, hotels, restaurants and repair	633	761	668	929	1179
Transport and storage	221	263	281	406	451
Banking, insurance and pension funding	1154	1403	2151	2586	2757
Other business activities	156	203	290	328	358
Electricity, gas and water supply	106	113	166	157	149
Public administration and social security	790	918	1026	1131	1314
Health and social work activities	145	208	196	246	327
Other service activities n.e.c.	96	80	100	125	145
Manufacture of ICT Hardware	197	249	238	307	351
Telecommunications and post	1382	1558	2233	2642	4531
Content: publishing, press and broadcasting	91	98	130	156	164
Content: entertainment and art	54	65	46	72	78
Computer and related activities	215	296	319	366	450
Research and development	50	47	61	82	80
Legal and economic activities	262	312	440	614	687
Architectural and engineering activities	79	90	112	152	167
Advertising	19	23	29	41	44
Primary education	7	7	15	16	17
Secondary education	41	42	90	91	98
Higher education	23	23	51	52	56
University education	13	19	26	30	33
Other education	10	15	22	24	19
Total (=column sum)	6761	7849	9864	12134	15221

Table A4.1a
Bridge table explaining differences in GFCF and GDP as a result of modified R&D and software estimates, 1995-1999 (million €)

	1995	1996	1997	1998	1999
GDP National Accounts Netherlands (market prices)	302233	315059	333725	354194	374070
Statistical adjustments					
R&D revision	719	633	775	922	728
Software revision	524	584	1035	1434	1648
Adjustment in accounting concept					
Reclassification of R&D intermediate consumption as gross fixed capital formation	3389	3532	3749	3976	4585
Extended GDP (market prices)	306865	319808	339284	360526	381031
Gross fixed capital formation National Accounts Netherlands	61347	66381	71680	76230	84186
Statistical adjustment					
Software revision	524	584	1035	1434	1648
Adjustment in accounting concept					
Reclassification of R&D [1)] as gross fixed capital formation	6094	6320	6590	6840	7518
Extended gross fixed capital formation	67965	73285	79305	84504	93352

[1)] Including intermediate consumption and revised government consumption.

Table A4.2a
Industrial profile in relation to value added, 1999

	Value added [1]	HRST-I wages	Total knowledge expenditure [2]	Education expenditure [3]	R&D expenditure [4]	ICT expenditure
	%	% of value added	% of value added	% of value added	% of value added	% of value added
Agriculture, forestry and fishing	2,8	0,7	1,4	0,1	0,4	0,9
Mining and quarrying	1,9	2,3	2,5	0,2	0,7	1,6
Manufacture of food products, beverages and tobacco	3,1	5,7	5,8	0,9	2,7	2,3
Manufacture of textile and leather products	0,4	5,3	4,2	0,8	1,0	2,3
Manufacture of building material	0,9	4,4	3,0	0,8	0,6	1,6
Manufacture of paper and paper products	0,5	7,2	6,6	1,4	1,0	4,2
Printing	0,8	3,7	4,0	0,7	0,3	3,0
Manufacture of petroleum products	0,3	6,9	5,5	0,6	4,2	0,7
Manufacture of basic chemicals and man-made fibres	1,2	8,8	11,6	1,0	9,0	1,6
Manufacture of chemical products	0,9	11,5	30,1	1,7	24,8	3,7
Manufacture of rubber and plastic products	0,6	7,2	5,0	1,1	2,1	1,9
Manufacture of basic metals	0,4	9,5	11,7	2,6	2,6	6,5
Manufacture of fabricated metal products	1,4	5,2	4,5	1,1	1,2	2,3
Manufacture of machinery and equipment n.e.c.	1,3	11,2	11,8	1,2	7,4	3,1
Manufacture of (other) electronic equipment	0,4	14,3	16,8	1,4	6,7	8,7
Manufacture of transport equipment	0,9	9,8	9,6	1,2	4,5	3,9
Other manufacturing	1,2	4,8	2,7	1,1	0,3	1,3
Construction	5,6	3,4	2,5	1,2	0,1	1,2
Trade, hotels, restaurants and repair	15,5	5,4	3,5	0,9	0,4	2,2
Transport and storage	4,9	6,1	4,1	1,3	0,2	2,6
Banking, insurance and pension funding	6,2	14,4	15,5	2,1	0,4	13,0
Other business activities	13,2	4,1	1,6	0,7	0,1	0,8
Electricity, gas and water supply	1,7	6,1	4,4	0,7	1,1	2,6
Public administration and social security	7,6	18,3	10,8	4,7	1,0	5,0
Health and social work activities	7,3	23,3	1,3	-	-	1,3
Other service activities n.e.c.	2,7	11,7	2,6	0,9	0,1	1,5
Manufacture of ICT Hardware	1,1	21,7	37,1	2,4	25,7	9,0
Telecommunications and post	2,3	7,2	58,8	1,8	0,0	57,0
Content: publishing, press and broadcasting	1,0	18,9	5,8	0,8	0,1	4,8
Content: entertainment and art	0,8	18,1	3,3	0,4	-	2,9
Computer and related activities	1,9	34,2	11,7	3,8	0,9	7,0
Research and development	0,4	51,4	121,6	1,6	114,6	5,4
Legal and economic activities	3,0	25,7	8,9	2,2	0,2	6,6
Architectural and engineering activities	1,1	33,3	7,4	1,0	2,1	4,3
Advertising	0,5	13,6	3,0	0,3	-	2,7
Primary and secondary education	2,8	58,9	1,9	0,7	-	1,2
Higher education	0,4	55,1	5,2	0,7	-	4,5
University education	0,7	56,0	66,2	0,7	64,2	1,3
Other education	0,3	20,6	2,3	0,4	-	1,9
Total	100	12,5	7,9	1,3	2,2	4,4

[1] Value added (basic prices) as reported in the Dutch national accounts, without any extensions.

[2] Sum of Education expenditure, R&D expenditure and ICT expenditure (last three columns).

[3] The industry "Health and social work activities" is not included in these figures because of lacking data. For the same reason the industry "Defence activities" is not included in the industry "Public administration and social security".

[4] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .

Table A4.2b
Industrial profile in relation to value added, 1995

	Value added [1]	HRST-I wages	Total knowledge expenditure [2]	Education expenditure [3]	R&D expenditure [4]	ICT expenditure
	%	% of value added	% of value added	% of value added	% of value added	% of value added
Agriculture, forestry and fishing	3,5	0,6	0,9	0,1	0,5	0,4
Mining and quarrying	2,6	2,2	1,6	0,3	0,9	0,4
Manufacture of food products, beverages and tobacco	3,4	5,5	4,9	0,7	2,8	1,4
Manufacture of textile and leather products	0,4	4,1	3,1	0,6	1,0	1,5
Manufacture of building material	1,0	4,7	2,9	1,1	0,8	1,1
Manufacture of paper and paper products	0,5	6,6	4,0	1,2	1,0	1,8
Printing	0,9	4,4	2,7	0,6	0,1	2,0
Manufacture of petroleum products	0,4	7,6	5,3	0,5	0,0	4,9
Manufacture of basic chemicals and man-made fibres	1,9	7,7	13,0	1,0	10,8	1,2
Manufacture of chemical products	1,1	12,4	17,4	2,0	10,7	4,6
Manufacture of rubber and plastic products	0,6	7,2	4,2	1,2	1,5	1,5
Manufacture of basic metals	0,7	8,2	5,8	2,1	1,7	1,9
Manufacture of fabricated metal products	1,4	5,2	3,5	1,0	1,4	1,1
Manufacture of machinery and equipment n.e.c.	1,3	10,0	7,4	1,1	4,2	2,1
Manufacture of (other) electronic equipment	0,5	8,3	10,8	1,1	4,3	5,4
Manufacture of transport equipment	0,7	13,3	10,6	1,5	6,5	2,6
Other manufacturing	1,2	2,8	2,3	1,3	0,3	0,7
Construction	5,4	4,1	1,5	0,7	0,1	0,7
Trade, hotels, restaurants and repair	15,0	5,5	2,4	0,6	0,3	1,5
Transport and storage	4,9	6,5	3,2	1,5	0,2	1,6
Banking, insurance and pension funding	5,7	12,1	9,2	2,0	0,1	7,1
Other business activities	11,7	3,4	1,0	0,4	0,1	0,5
Electricity, gas and water supply	1,9	6,4	3,6	0,7	0,9	1,9
Public administration and social security	8,2	20,2	8,8	4,3	1,0	3,4
Health and social work activities	7,3	23,1	0,7	-	-	0,7
Other service activities n.e.c.	2,5	11,0	1,9	0,5	-	1,4
Manufacture of ICT Hardware	1,3	21,4	27,8	2,0	20,3	5,5
Telecommunications and post	2,3	5,3	24,1	1,8	0,7	21,6
Content: publishing, press and broadcasting	0,9	22,2	4,3	0,7	0,1	3,5
Content: entertainment and art	0,8	21,1	2,7	0,2	-	2,4
Computer and related activities	0,9	38,5	11,5	3,3	0,2	8,1
Research and development	0,4	43,0	128,7	0,7	124,0	4,0
Legal and economic activities	2,7	26,0	4,6	1,2	0,0	3,5
Architectural and engineering activities	1,1	34,6	3,6	0,4	0,6	2,6
Advertising	0,5	11,9	1,6	0,1	-	1,5
Primary and secondary education	2,9	58,9	1,1	0,6	-	0,6
Higher education	0,4	57,6	2,7	0,6	-	2,1
University education	0,8	56,7	69,0	0,6	67,8	0,6
Other education	0,3	22,1	1,4	0,3	-	1,1
Total	100	12,3	5,7	1,1	2,2	2,4

[1] Value added (basic prices) as reported in the Dutch national accounts, without any extensions.

[2] Sum of Education expenditure, R&D expenditure and ICT expenditure (last three columns).

[3] The industry "Health and social work activities" is not included in these figures because of lacking data. For the same reason the industry "Defence activities" is not included in the industry "Public administration and social security".

[4] A totally satisfying demarcation of the R&D industry is currently not possible. The current figures presumably include units that are genuinely part of the industries "Health and social work activities" or "Content: entertainment and art" .