IWT-Observatory

Institute for the Promotion of Innovation
by Science and Technology in Flanders

Innovation Science Technology

46

R&D Activities of the Business Sector in Flanders: Results of the R&D Surveys in the Context of the 3% Target

MICHELE CINCERA
ROGER KALENGA-MPALA
REINHILDE VEUGELERS
DONALD CARCHON
JAN LAROSSE

COLOFON

IWT-Studies is published by IWT-Vlaanderen as part of the work programme of the IWT- Observatory. However, the authors are personally responsible for the opinions adopted in the development of these studies.

Editors
Ann Van den Bremt (secretariat)
Jan Larosse (co-ordination)

Production
N'lil

IWT-Observatory
Jan Larosse, Co-ordinator
Donald Carchon, Information system
Marc Van Gastel, Knowledge Management
Ann Van den Bremt, Secretariat

Bischoffsheimlaan 25
1000 Brussels

Phone: 02/209 09 00
Fax: 02/223 11 81
E-mail: iwt-observatorium@iwt.be
Web-site: http://www.iwt.be
Registration number: D/2004/7037/1
Published in March 2004

CONTENTS

SUMMARY 4

VOORWOORD 7

CHAPTER 1: METHODOLOGY FOR THE MEASUREMENT OF R&D DATA OF THE BUSINESS SECTOR IN FLANDERS 11

1.1 Introduction 11
1.2 R&D statistics reference framework 11
1.3 R&D survey of the business sector 11
1.4 Boundaries and problems encountered when measuring R&D in business enterprise sector 14
REFERENCES 16
ANNEX 17

CHAPTER 2: R&D ACTIVITIES OF FLEMISH COMPANIES IN THE PRIVATE SECTOR: AN ANALYSIS FOR THE PERIOD 1998-2002 19

2.1 Introduction 19
2.2 Intra-mural R&D expenditures 21
2.3 R&D personnel 24
2.4 R&D by type of activity 29
2.5 R&D by source of funding 32
2.6 Internationalization of R&D 36
2.7 R&D collaborations 37
2.8 Innovation activities 39
2.9 Conclusion 40
REFERENCES 41
ANNEX 42

CHAPTER 3: TOTAL R&D INTENSITY IN FLANDERS 1993-2001 47

3.1 Introduction 47
3.2 The R&D indicators used 47
3.3 GERD per activity sector for Flanders 1993-2001 49
3.4 R&D intensity: GERD as % of GDPR for Flanders 1993-2001 49
3.5 Total R&D expenditures per sector of funding 50
3.6 Conclusion 50

QUESTIONARY 53

NOTES 75

SUMMARY

This Study on Business R&D in Flanders is divided in three chapters.
The **methodological** section explains how the official R&D statistics are calculated. The different Belgian authorities work together in establishing a common methodological framework but each authority is responsible for data collection from the entities under its jurisdiction. The target population is identified in a 'repertory', but a statistical correction has been applied for unobserved R&D activities by means of a sample on the rest of the business population. The latter accounted for about 10% of calculated R&D. The **repertory** consists of about 1000 enterprises that are considered as 'permanent' R&D actors in the main part, and a varying number of enterprises that are 'occasional' R&D actors or not well known yet in an additional part. The estimates of total intra-mural business expenditures on R&D (BERD) and total R&D-personnel in the business sector in Flanders are presented in tables 1 (**2.818 billion euros** in 2001) and 2 (**23,726 full time equivalents** in 2001) in the annex of this chapter.
The composition of R&D statistical data has improved notably during the last decade but still suffers from insufficient **response rates**. On top of that the main challenge is to harmonize the interpretation of respondents of what can be accounted for as 'R&D' according to the official 'Frascati' **definition**, since R&D activities are not uniformly defined in accounting practices.

The second chapter of this Study analyses the results of the **last two surveys** (2000 and 2002). These surveys cover a period of rapid expansion of R&D-activities in the Flemish economy. The BERD has grown on average with nearly 13% yearly between 1998 and 2001. The most important characteristic of Flemish business R&D is the very **strong concentration** of R&D-expenditures in a few big firms (the top 5 stands for 63% of the expenditures of all permanent R&D players) and in a few sectors (66% in the chemical ICT sector).
This concentration has been increasing even further during this period of expansion and re-inforced tendencies of outsourcing (up to 23%), the capital intensity of research, as well as in a shift from research to development (the latter from 70 tot 77%).
Another characteristic is the predominance of **foreign** decision power: nearly 90% of R&D expenditures are performed in foreign controlled enterprises. But those firms are well integrated in the Flemish innovation system. R&D **cooperations** have been executed for the larger part (45%) with Flemish partners, and they receive the larger majority of R&D outsourcing.
R&D is mostly **product oriented** (62%, vs. 24% process oriented); 56% of R&D actors have introduced new or technologically improved products and 40% new or technologically improved processes during 2000-2001.

The last chapter of this Study compares the R&D-activities of the business sector with the gross expenditures for R&D in Flanders (GERD) and the **3% target** that the Flemish Government has adopted as a consequence of the Lisbon strategy.
In 2001 the ratio of BERD to GDP has reached a level of **1.93 %** in relation to the regional GDP. This calculation is subject to an institutional particularity in the Belgian federal state since the Flemish government is not only responsible for territory-related affairs – as economy and innovation - in the Flemish Region on the regional level but also for person-related affairs – such as education and research- of Flemish citizens and institutions in the Brussels Region (called the Flemish Community). Therefore a distinction is made between a GERD on community level (**2.53%** GDP in 2001) and a GERD on regional level (**2.49%** GDP in 2001). The difference can be mainly attributed to research activities of Flemish university departments in Brussels.
BERD constitutes the main part of GERD (76%) and was also the **main driver** in catching-up to join the top performers between 1995 and 2002 (from 1.75 % to 2.53%). The business sector is also the most important source of funding of R&D in Flanders , accounting for around 7.6% or 1.92% GDP. Despite the important efforts that have been made by the Flemish government to increase the budget for science and innovation, the private sector has kept its relative dominance because of this strong evolution. With 0.6% GDP there is still a way to go in order to reach the 1% target for government funding.

In view of reaching the 3% objective Flanders has made enormous progress in the recent period. The most important contribution came from the business sector. The statistical previsions for 2002 of a marked **slowdown** (and even a downright slump in the ICT sector) of business R&D and an emergent trend of **delocalisation** of R&D-intensive activities constitute a new situation for R&D policy. The Flemish innovation system is **vulnerable** because of the heavy concentration of R&D-expenditures in a small number of enterprises in the chemical and ICT sector, largely dependent on headquarters abroad. But the human capital basis of R&D personnel that accounts for nearly 24.000 FTE's is an important asset. Innovation policy in Flanders is steeping-up budgets and enlarging its scope to improve the **anchoring** of the strategic players and promote the emergence of **new knowledge-based value chains**.

VOORWOORD

In het 'Innovatiepact' engageren alle actoren van het Vlaamse innovatiesysteem zich voor het **3% objectief** dat op Europees niveau als beleidsdoelstelling naar voor is geschoven in het kader van de zogenaamde 'Lissabon-strategie' om de meest competitieve kenniseconomie te worden tegen 2010. Uit recente statistieken blijkt dat de O&O-bestedingen in Vlaanderen in 2001 ca 2,5% van het BBP bedroegen. Dit wijst op een **snelle inhaalbeweging** sinds de periode van het ontstaan van het IWT in 1995, toen dit percentage nog op 1,75% stond. De groei van deze totale O&O-bestedingen (GERD) is vooral toe te schrijven aan de O&O-activiteiten van de ondernemingen (BERD) die 78% van dit totaal uitmaken. Het IWT was verantwoordelijk in de voorbije periode voor de dataverzameling en het samenstellen van de statistieken over de BERD, zodat we in deze publicatie enkele **achtergronden** kunnen belichten over de betekenis van deze statistieken. De publicatie in het Engels gebeurt om praktische redenen.

In een eerste bijdrage van Roger Kalenga (expert van het Federale Wetenschapsbeleid) wordt de **methodologie** toegelicht die in samenspraak met de verschillende Belgische overheden in de Overleggroep Statistiek van de Commissie Federale Samenwerking (CFS-STAT) is ontwikkeld om de O&O-inspanningen van de ondernemingen in te schatten. Het is immers niet onbelangrijk om de **onzekerheden** te duiden die meespelen in het tot stand komen van dergelijke cijfers die richtinggevend zijn voor het beleid. Ondanks grote inspanningen is het nog zeer moeilijk om betrouwbare cijfers te verkrijgen. Ten eerste omwille van de aanzienlijke **non-respons** bij de dataverzameling waardoor enkel op partiële gegevens kan worden voortgegaan. Maar ten tweede ook omwille van wat onder 'Onderzoek' en 'Ontwikkeling' verstaan wordt bij de respondenten, ondanks het bestaan van een internationaal gehanteerde referentie, de zogenaamde Frascati-definitie. Het betreft immers geen formele, boekhoudkundig duidelijk omschreven categorie maar een **levende** praktijk zodat er nogal wat **verschillen** optreden in rapportering tussen bedrijven en sectoren in een zelfde periode, maar ook tussen periodes bij dezelfde bedrijven en sectoren. Om deze en andere problemen in de toekomst beter op te lossen heeft de Vlaamse overheid beslist om een 'Steunpunt O&O-Statistieken' op te richten bij de KU Leuven die deze methodologische problemen meer systematisch zal aanpakken.

De best beschikbare schattingsmethodes werden aangewend voor de berekening van de huidige statistieken die aan internationale statistische diensten als Eurostat en Oeso worden doorgegeven door CFS-STAT, en waarvan de resultaten voor Vlaanderen wat betreft de ondernemingen in dit hoofdstuk worden hernomen. Op basis van deze berekeningen komen we o.m. tot een reële inschatting van het menselijk potentieel dat door de Vlaamse bedrijven in 2001 voor O&O werd ingezet: bijna 24.000 voltijds equivalenten O&O-personeel, waarvan 43% toch bij KMO'S zijn tewerkgesteld.

Uit de tweede bijdrage van Professor Michele Cincera, die vanuit zijn ervaring met de behandeling van dergelijke O&O-data gevraagd is een analyse te geven van de **resultaten** van de **laatste enquêtes**, zijn er een aantal markante inhoudelijke vaststellingen te maken over de aard en evolutie van de O&O-activiteiten van de Vlaamse ondernemingen met een bijzondere betekenis voor de opvolging van de O&O-norm van 3%. De ontplooiing van de kenniseconomie in Vlaanderen is een feit wanneer we constateren dat de O&O-intensiteit van de O&O-actieve ondernemingen is toegenomen van ca 6,75% van hun omzet in 1998 tot ca 7,52% in 2001. In die periode groeien de O&O-budgetten met bijna 13% op jaarbasis. Met als resultaat dat de BERD is gestegen van 1,61 tot 1,93 % BBP.

Opvallend is dat het fenomeen O&O **zeer geconcentreerd** is in een aantal sectoren en in een aantal grote ondernemingen, en dat deze concentratie zich doorzet. De top-10 grote besteders verhoogt zijn aandeel tussen 1999 en 2001 van ca 72% naar ca 77% van de totale BERD. Ook de sectorale specialisatie versterkt: ICT en chemie (waaronder vooral farmacie) gaan van bijna 55% in 1999 naar 61,6%van de totale interne bestedingen in 2001. Dit maakt het Vlaams innovatiesysteem

zeer gevoelig voor ontwikkelingen in deze sectoren en bedrijven, en daarmee ook de O&O-norm. Vooral de ICT en farmacie waren de drijvende krachten in de groei van de BERD, met een jaarlijkse toename van ca 22% tussen 1998 en 2001: dit is de weerspiegeling van de technologieboom eind vorige eeuw. Het eventuele einde van die boom legt dus ook een hypotheek op een verdere vooruitgang in de O&O-norm. De voorlopige cijfers voor 2002 wijzen op een ernstige **vertraging** in de O&O-bestedingen in het algemeen en een terugval in de ICT-sector in het bijzonder. De groeiversnelling in O&O is dus niet noodzakelijk duurzaam.

Dit conjunctuureffect versterkt de **structurele evoluties** in de O&O-activiteiten in Vlaanderen. De toename in de O&O-bestedingen wordt niet helemaal gevolgd door de toename in personeel: vooral management, doctoraten en universitairen blijken een flessenhals te vormen, want hun aandeel in het totaal O&O-personeel vermindert (al geeft dit tegelijkertijd ook uitdrukking aan een significante verschuiving van 'onderzoek' naar meer 'ontwikkeling'). Het aandeel van de kapitaalinvesteringen verdubbelt tot ca 15% in een paar jaar. Maar ook de uitbestedingen verdubbelen nagenoeg, vergeleken met midden jaren negentig, tot een niveau van ca 23 % van de interne bestedingen. Het is waarschijnlijk dat met het einde van de technologieboom ook de O&O-cijfers tot meer 'normale' proporties terugvallen, maar tendensen zoals groeiende kapitaalintensivering, toenemende uitbesteding, de grotere nadruk op ontwikkeling, gaan door. Een herneming van de expansie zal zeker rekening moeten houden met de beschikbaarheid van geschikt personeel. Maar op dit ogenblik is de nieuwe tendens naar delocalisatie van O&O-activiteiten eerder een bedreiging voor de bestaande werkgelegenheid in O&O.

Ondanks de versterking van de O&O-intensiteit in de periode tot 2001 zijn er immers een aantal bedreigingen die samenhangen met de **afhankelijkheid** van een handvol grote spelers en de bestaande sectorale **specialisaties**. Voegen we daarbij de vaststelling dat bijna 90% van de O&O-bestedingen in filialen van buitenlandse bedrijven plaats vinden dan lijkt deze structurele positie nog meer precair. Maar het beleid kan zich ook steunen op een aantal andere karakteristieken van het Vlaamse O&O-systeem. Zo blijkt 30% van de ondernemingen in het 'repertorium' van O&O-actieve bedrijven opgericht na 1990, wat op een sterke **vernieuwing** wijst. Ook is bij de toename van de uitbestedingen en samenwerkingen te noteren dat 45% hiervan met partners in Vlaanderen gebeurt, wat duidt op een zekere **verankering**. Op dit elan moet dan ook de kennisintensivering van de Vlaamse economie doorgaan.

In de laatste bijdrage van Professor Reinhilde Veugelers – die als nota van het Steunpunt O&O-Statistieken aan de Vlaamse Regering is overgemaakt – worden de beschikbare gegevens volgens de gangbare methodologie gevalideerd als de 'officiële' Vlaamse O&O-statistieken. Opmerkelijk is dat in Vlaanderen **twee statistieken** naast elkaar worden gehanteerd die rekening houden met twee politieke realiteiten. In de context van de internationale statistiek, volgens de definities van Eurostat, geldt de zogenaamde 'gewestelijke' definitie van de GERD die enkel rekening houdt met de territoriale dimensie van een regio. Refererend naar de institutionele context in België met zijn unieke omschrijving van 'gemeenschappen' is er tevens een 'gemeenschaps' definitie van de GERD die ook de O&O-activiteiten meeneemt van de onderwijsinstellingen die onder de bevoegdheid vallen van de Vlaamse Gemeenschap in België. Beide statistieken hebben een **eigen betekenis** (alhoewel ze niet sterk verschillen). Maar voor de bedrijfsstatistieken stelt zich dit probleem niet omdat de economische materies puur op gewestelijke basis zijn toegewezen. De BERD is in 2001 tot 1,93 % van het BBP gestegen. Bovendien wordt meer dan 90% door de bedrijven zelf gefinancierd terwijl ze ook bijdragen tot de financiering van de andere onderzoekssectoren. Dit heeft als gevolg dat van de totale GERD 76% wordt gefinancierd door de **private sector**, wat ruimschoots de 'verdelingsnorm' van twee derden overschrijdt.

Daarmee lijkt vooral de **overheidssector** de uitdaging te moeten opnemen om de financiering van de bijkomende inspanningen

voor het bereiken van de 3%-doelstelling waar te maken. Ondanks de sterke toename van de budgetten van het IWT (een stijging met 50% in drie jaar) en andere onderzoeksfinancieringen is het aandeel van de overheid in de financiering van de totale O&O-bestedingen nog geen 0,65% van het BBP. Maar in het voorgaande blijkt echter dat ook bij de inspanningen van de ondernemingen enkele kanttekeningen kunnen gemaakt worden. De vooruitgang van de BERD berust immers op een smalle basis (een beperkt aantal topactoren in enkele sectoren). Daarnaast zijn neerwaartse correcties van de statistiek wellicht mogelijk door de nog onzekere kwaliteit van de data en de ruime interpretatie van de O&O-definitie. Bovendien lijkt de snelle opgang van de O&O-bestedingen abrupt tot een einde te zijn gekomen in de recente periode. Daarom blijft een **stimulerend** beleid ten opzichte van de inspanningen van de ondernemingen meer dan ooit noodzakelijk. Daarbij is overheidsfinanciering voor O&O a rato van 1% van het BBP geen doelstelling op zich maar in de eerste plaats een hefboom voor de versterking van de **performantie** van het Vlaams innovatiesysteem in termen van nieuwe toegevoegde waardecreatie. Omzetting van kennis in innovatieresultaten, verbreden van de absorptiecapaciteit van de Vlaamse bedrijven, stimulering van innovatie in sectoren die minder O&O doen (b.v. de voeding, sinds kort de grootste industriële sector in Vlaanderen) of op andersoortige wijze aan kennisontwikkeling doen (vele dienstensectoren), sector-overstijgende stimulansen zijn daarbij complementaire actieterreinen, naast de aandacht voor de verankering van onze grote O&O-bedrijven en de verdere doorgroei van nieuwe hightech groeibedrijven. Conform zijn missie ontvouwt IWT een reeks instrumenten om aan deze ambitie van een geïntegreerd innovatiebeleid vorm te geven, waarin de stimulering van O&O een centrale plaats blijft innemen.

Paul Zeeuwts
Directievoorzitter

Chapter 1

METHODOLOGY FOR THE MEASUREMENT OF R&D DATA OF THE BUSINESS SECTOR IN FLANDERS[1]

Roger Kalenga-Mpala

> 1.1 INTRODUCTION

Several reports and publications, at regional, national as well as international level, prove that the statistics and indicators of science, technology and innovation (STI), and in particular those for research and development (R&D), are essential in order to appreciate and evaluate many scientific programmes and policies, in the context of the knowledge-based economy. These statistics are now a source of interest for researchers as well as policy advisors. The administrations and university institutions interested in economic growth and productivity consider these R&D statistics as one of the key factors that can explain technological progress. In many countries, R&D statistics are regarded as a part of general economic statistics. The political decision-makers in science policy, but also in industrial policy and even general socio-economic policies extensively use these statistics. The realisation of the European Research Area with the goal of increasing the Gross domestic expenditures on R&D (GERD) to reach the level of 3% of the Gross Domestic Product (GDP) by 2010 prove that it is important to use the right indicators and methodology in this field.

In this context, the different Belgian authorities at federal, regional and community level are working together in the framework of a cooperation agreement[2] for some years now, so that more reliable R&D statistics could be produced. This introductory chapter will focus on the methodological aspects of R&D statistics of the Business enterprise sector. It will consist of three main parts, namely the reference framework, the R&D survey and problems encountered when measuring R&D.

> 1.2 R&D STATISTICS REFERENCE FRAMEWORK

R&D data in Flanders and Belgium are collected and processed according to the cooperation agreement. While each authority is responsible for data collection from the entities under its jurisdiction, the methodological and technical aspects of the statistical work are coordinated in the Concertation Group for Statistics in the Commission for Federal Cooperation (CFS-STAT). In this framework two biannual retrospective R&D surveys are held for business enterprise sector and for non-profit institutions. R&D data of business enterprise sector and non-profit sectors is collected and presented in accordance with the norms of OECD methodology publicised *in the Measurement of Scientific and Technological Activities: the Proposed Standard Practice for Surveys of Research and Experimental Development – Frascati Manual 2002* (OECD)[3].

The Frascati Manual defines R&D as: *research and experimental development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of mankind, culture and society, and the use of this stock of knowledge to devise new applications.*

R&D consists of the activities of basic research, applied research and experimental development. R&D also covers one of the innovation activities[4] and can be realised during the different stages of the innovation process. The R&D activities are not only used as a source of inventive ideas, but also to solve problems that may occur during any step of the innovation process.

The methodological framework for R&D has substantially evolved in the past decade. Since the defederalisation of the policy for science, technology and innovation in Belgium, IWT has been in charge of organising the surveys on R&D for firms based on the Flemish territory. As such, IWT has been making efforts in contributing to improve the collection, processing and diffusion of R&D data.

> 1.3. R&D SURVEY OF THE BUSINESS SECTOR

Business enterprise is one of five identified institutional sectors of R&D[5]. It is the principal sector in the field of performing and financing of R&D, as it performs about 73%

of the intramural expenditures of R&D and finances 64% of those expenses in Belgium. The Flemish enterprises represent 69% of the intramural R&D expenditures and 67% of the total R&D personnel for the entire Belgian business enterprise sector[6].

The Business sector consists of all companies, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price, as well as the private non-profit institutions mainly serving them. This sector therefore principally consists of *private enterprises* (corporations and quasi-corporations), which may or may not distribute profits. In addition, this sector also consists of *public enterprises* and *non-profit institutions* that are market producers of goods and services other than higher education. The non-profit institutions that serve enterprises are better known as sectoral Collective Research Centres in Belgium. R&D data from private and public enterprises are collected by means of the R&D business survey in Flanders, while the data from sectoral collective research centres are collected through the R&D survey of non-profit sectors.

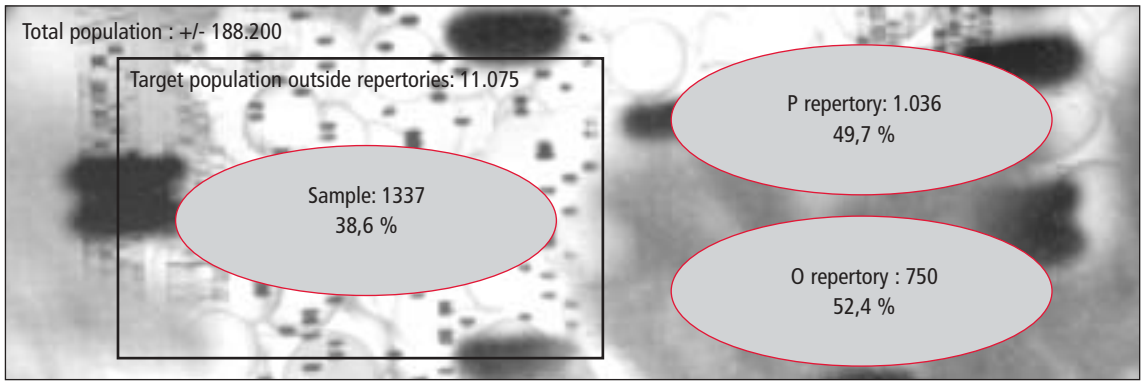
1.3.1 Identifying target population and survey respondents

The target population for R&D surveys for enterprises in Flanders consists of all enterprises in all sectors of industry and services of all sizes. The R&D activities are mainly concentrated within a limited number of enterprises, especially the large enterprises, although there are small enterprises that are very active in the field of R&D. For this purpose, a so-called "P" repertory has been created, and takes a census of all the enterprises that are permanently active in the field of R&D. Based upon the P repertory, a so-called "O" repertory has also been created, with the companies that can not be included in the P repertory yet, but for which several sources have indicated that they also perform R&D activities. The O repertory also contains enterprises that occasionally perform these activities. The enterprises in the repertories are all questioned during the surveys. It is very necessary to maintain completely up-to-date P and O repertories of enterprises.

R&D performed by the rest of the population of enterprises, that have not been included in either of the two repertories is measured by means of a random sample. It is necessary to consider R&D in other enterprises, which are not part of the repertories but do perform non-permanent and less intensive R&D projects, hence this sample. It is representative and stratified in function of the sectors of industry and services, as well as the size class of the enterprises. Because this sample generates a considerable amount of work, the CFS-STAT is investigating the possibility to measure R&D outside the repertories based upon statistical methods suited for future surveys.

For the 2002 survey, based upon the information about the enterprises provided by

Figure 1 > ***Total population of enterprises in Flanders: partition and response rate in the 2002 survey***



Source: Belfirst (2002), IWT (2002), calculations Federal Science Policy, 2003.

the business register Belfirst CD-ROM of March 2002, the target population of non-inventoried enterprises with at least 10 employees, with a normal legal situation and active in the sectors with Nace Bel code 01-99, has been defined for Flanders. For the banking and insurance services, the Belfirst source has been complemented with those of the employers' organisations. Furthermore, companies with less than 10 employees, in the services 72.2 (software consultancy and supply) and 74.2 (architectural, engineering and other technical activities) have also been included in this population.

The response rate of Flemish enterprises selected for the 2002 survey was 45,6%. Figure 1 gives an overview of the number of enterprises that were selected and their participation to the 2002 survey in different categories.

The questionary used for the survey consists of a minimum number of basic questions about R&D activities, to allow us to produce harmonized statistics that are comparable at national and international levels. For the 2002 survey two types of forms were presented to enterprises, depending on their category. The P and O repertory enterprises have received a form of long type, with questions about the R&D expenditures and personnel and their sub-aggregates. The sample enterprises however have received a shorter form, focusing on important R&D variables.

1.3.2 Estimation procedures of R&D

R&D in the business sector is the result of the aggregation of the estimated R&D in enterprises situated in the P and O repertories, in the population not included in these repertories and in the sectoral collective research centres. A sectoral and regional redistribution is also performed in order to provide a realistic image of R&D at sectoral and regional levels. In the first place an estimate is made of intramural R&D expenditures and of R&D personnel in full-time equivalents. Then an estimate is made of other R&D categories concerning the extramural expenditures, the personnel expressed in physical persons ("headcount") and the female personnel, and finally the sub-aggregates of R&D expenditures and personnel. When processing R&D data, the industry and the size class of the enterprise are taken into account, following the recommendations of the Frascati Manual (International Standard Industrial Classification, ISIC, arranged for the purposes of R&D, and size groups classified on the basis of employment).

R&D of enterprises from the P repertory

The estimate is based upon the verified statements about R&D of the enterprises that have filled out the survey, but also upon the partial and complete estimates for the enterprises that have given a partial response or no response at all. For the partially and non-responding enterprises, the missing value on R&D is estimated by means of additional information (imputation methods). This information can be predictions given in the previous survey, the most recent data of previous surveys and information provided in the present survey by responding enterprises from the same industry and the same size class. The ratio between intramural R&D expenditures/R&D personnel in full-time equivalents (FTE) and of the R&D personnel/Total employment, as well as the trend growth of R&D variables are used to adjust the additional information.

As for the complete non-response, the estimation of R&D variables is only based upon the additional information and the ratios. The ratios are taken into account, assuming that these are identical within the responding units and non-responding units for reference groups. No distinction is made according to the region of origin, not only to avoid a limited number of observations, but also because the R&D activities in Belgium seem to be less influenced by the region, and this according to studies on the subject.

R&D of enterprises in the O repertory

R&D of responding and partially responding enterprises in this repertory is estimated in the same way as that of enterprises in the P repertory, in other words at the enterprise level. For enterprises that have not responded at all however, R&D is not estimated at the enter-

Table 1 > ***Intramural expenditures and personnel in FTE for R&D in the business sector in Flanders per category in 2001***

Category	Intramural R&D expenditures		Total R&D personnel	
	Millions of Euro	% of the total	Full-time equivalents	% of the total
P repertory	2350.125	*83.40*	17741	*74.77*
O repertory	200.414	*7.11*	2257	*9.51*
Population outside repertories	210.878	*7.48*	3249	*13.70*
Sectoral centres for collective research	60.490	*2.15*	526	*2.22*
Sectoral redistribution	0.000	*0.00*	0	*0.00*
Regional redistribution	-4.134	*-0.15*	-46	*-0.20*
Business sector	2817.773	*100.00*	23726	*100.00*

Source: Federal Commission of Cooperation, Concertation Group CFS/STAT ; calculations Federal Science Policy,2003.

prise level but at the level of industry and size class, by replacing the R&D results within enterprises of this category by those that have responded or have partially responded. The number of enterprises is used as a weight factor in this replacement. This extrapolation factor is easy to obtain compared to factors related to economic variables such as employment and turnover, which are not always available for each enterprise.

R&D of the population outside the repertories

An estimate of R&D of the population, excluding the repertories P and O, is made by extrapolating the R&D results for enterprises in the sample that have responded or partially responded at the sector and the size class level of firms. The extrapolation factors are also based upon the number of enterprises.

R&D of sectoral collective research centres

In this category R&D is estimated based upon the R&D survey of non-profit sectors. The methods for estimation are basically the same as those used for enterprises from the P repertory.

Sectoral and regional redistributions of R&D

The OECD recommends redistributing R&D for multi-product enterprises and of the sectors of R&D services (73) and wholesale, retail trade and motor vehicle repair (50-52), according to the criterium of product use. The regional redistribution concerns the enterprises that have R&D establishments in different regions. The sectoral and regional redistributions want to give a truthful image of R&D at product and regional levels. These redistributions are based upon declarations of enterprises from the repertories in the current survey or previous surveys.

Table 1 shows the distribution in 2001 of intramural expenditures and personnel on R&D in Flemish business sector per category. The share of P repertory is naturally the most important and that of population outside repertories substantially lower. For more detailed results on R&D at the level of sector and size class, you can consult the tables in annex of this chapter.

> 1.4 BOUNDARIES AND PROBLEMS ENCOUNTERED WHEN MEASURING R&D IN BUSINESS ENTERPRISE SECTOR

It is obvious that IWT and its Belgian partners have made a great deal of efforts in the framework of the cooperation agreement in order to collect, process and produce internationally comparable R&D data as quickly as possible. But additional efforts seem to be necessary to improve the quality of this data, in particular on the level of the entities participating in the surveys. The enterprises responding to the surveys should be able to report the data based upon the definitions and basic conventions of the Frascati Manual. This requires a close collaboration with the entities responding to the surveys, in particular to find the best contact person to fill in

the questionary. This contact person should also be aware of the potential possibilities to use the data and pay attention to requirements concerning R&D statistics.

Difficulties with R&D measurement in the business sector are usually about problems of distinguishing R&D from related industrial activities, about identifying R&D in software development and about identification of R&D in services. In addition there are the differences in perception of R&D according to the concept of the System of National Accounts (SNA) and the Frascati Manual.

It is difficult to distinguish between experimental development and pre-production, including demonstration and corresponding trials. Nevertheless it is important that enterprises see to it that they exclude the industrial activities in which R&D is only sporadically used. According to the definition of R&D, the main goal of the activities is to make further technical improvements on the product or the process. The Frascati Manual (2002) also identifies some supplementary criteria for separating R&D from related scientific, technological and industrial activities.
As for clinical trials in the pharmaceutical industry, three standard phases which take place before permission of manufacturing are now considered to be part of R&D activities according to the Frascati Manual (2002). The nature of software development makes it difficult to clearly outline the R&D element, if this element should be present. The update towards a more powerful version, an addition or a modification of a program or an existing system can be considered as R&D, if scientific and/or technological progress was made, leading to knowledge expansion. The borderline of R&D within service activities and sectors are not easy to define. It is not as easy to identify projects with R&D in services than in manufacturing because it is not necessarily "specialised". In addition the borderline between R&D and other innovating activities that are not part of R&D is not clear. Furthermore the concept of R&D is relatively unknown within service activities and sectors, and it sometimes is not even recognised by the enterprises involved themselves.

As part of our conclusion we note that the R&D data of the business sector are only a quantitative reflection of very complex patterns of activities and company structures. Qualitative elements should be added for a better analysis or interpretation. The problems indicated above regarding the quality of data and the comparability are characteristic for all data on dynamic socio-economic activities.

REFERENCES

- OECD, 2002, "Frascati Manual: Proposed standard practice for Surveys on Research and experimental Development, The Measurement of Scientific and Technological Activities", OECD, Paris.

- Commission Coopération fédérale de la conférence interministérielle de la Politique scientifique, Groupe de concertation spécialisé inventaire et statistiques en matière de R&D, 1995, « Vade-mecum pour l'utilisateur des statistiques et des indicateurs en matière de science, technologie et innovation », Bruxelles.

- Capron H., M. Cincera, A. Hollant, W. Meeusen, S. Suetens, P.Teirlinck, 1999, "ANBERD – Harmonisation of Belgian Industrial R&D Expenditures Statistic – Final Report", Belgian Department for Scientific, Technological and Cultural Affairs (OSTC).

- Commission Coopération fédérale, Groupe de concertation, Groupe ad hoc Profit, 2001, « Méthodologie pour l'estimation de l'effort de R&D des entreprises », rapport interne SSTC.

- Commission Coopération fédérale, Groupe de concertation, Groupe ad hoc Profit, 2002, « Cadre méthodologique pour l'enquête R&D des entreprises 2002 », rapport interne SSTC.

- Commission Coopération fédérale, Groupe de concertation, Groupe ad hoc Profit, 2002, « Tirage de l'échantillon pour l'enquête R&D des entreprises 2002 », rapport interne SSTC.

- Commission Coopération fédérale, Groupe de concertation, Groupe ad hoc Profit, 2002, « Etapes méthodologiques pour l'estimation de R&D des entreprises – Enquête 2002 », rapport interne SSTC.

- Commission Coopération fédérale, Groupe de concertation, Groupe ad hoc Profit, 2003, « Rapport de l'enquête R&D des entreprises 2002 », rapport interne SSTC.

- European Commission, 2003, Investing in research : an action plan for Europe, Office for official publications of the European Communities, Luxembourg.

- European Commission, 2002, Benchmarking National Research Policies: Executive summaries of the five benchmarking reports compiled by independent expert groups, Office for official publications of the European Communities, Luxembourg.

ANNEX

Table 1 > ***INTRAMURAL EXPENDITURES on R&D of Business Sector (BERD) by industry in Flanders (thousands current EUR)***

Nace BEL	Description	2000	2001	%share	%growth	2002f	%growth
01,02,05	Agriculture	47924.0	45718.3	*1,62*	*-4.60*	45033.6	*-1.50*
10-14	Mining	914.2	1135.8	*0,04*	*24.25*	1069.4	*-5.85*
15	Food products and beverages	77535.8	82446.6	*2,93*	*6.33*	84583.3	*2.59*
16	Tobacco products	747.0	795.3	*0,03*	*6.47*	803.3	*1.00*
17	Textiles	51146.2	54406.8	*1,93*	*6.38*	57024.2	*4.81*
18	Wearing apparel and fur	13082.1	14094.9	*0,50*	*7.74*	14199.5	*0.74*
19	Leather, leather products and footwear	3130.4	3167.4	*0,11*	*1.18*	3266.1	*3.12*
20	Wood and cork (except furniture)	4643.3	6171.8	*0,22*	*32.92*	6273.1	*1.64*
21	Paper and paper products	6472.0	6688.5	*0,24*	*3.35*	7075.2	*5.78*
22	Publishing, printing and reproduction of recorded media	16876.6	17023.8	*0,60*	*0.87*	18538.9	*8.90*
23	Coke, refined petroleum products and nuclear fuel	12950.8	13034.2	*0,46*	*0.64*	13145.3	*0.85*
24 (less 24.4)	Chemicals excluding pharmaceuticals	417442.0	453552.4	*16,10*	*8.65*	506228.9	*11.61*
24.4	Pharmaceuticals	392104.1	525875.8	*18,66*	*34.12*	613908.6	*16.74*
25	Rubber and plastics products	59613.7	60756.5	*2,16*	*1.92*	63140.7	*3.92*
26	Other non-metallic mineral products	20902.2	22739.0	*0,81*	*8.79*	19779.6	*-13.01*
27.1-27.3+27.51/52	Iron and steel	28497.9	30344.6	*1,08*	*6.48*	31511.2	*3.84*
27.4+27.53/54	Non-ferrous metals	30529.0	35775.9	*1,27*	*17.19*	33146.2	*-7.35*
28	Fabricated metal products, except machinery and equipment	69780.2	73374.1	*2,60*	*5.15*	74717.6	*1.83*
29	Machinery and equipment nec	150972.9	147030.2	*5,22*	*-2.61*	142196.7	*-3.29*
30	Office, accounting and computing machinery	9093.5	10280.7	*0,36*	*13.06*	10570.5	*2.82*
31	Electrical machinery and apparatus nec	53082.7	55357.0	*1,96*	*4.28*	57200.2	*3.33*
32 (less 32.1)	Radio, TV and communication equipment nec	524757.4	600604.0	*21,31*	*14.45*	539465.3	*-10.18*
32.1	Electronic valves, tubes and components	50352.7	58675.7	*2,08*	*16.53*	57641.7	*-1.76*
33	Instruments, watches and clocks	13495.9	14770.2	*0,52*	*9.44*	15693.2	*6.25*
34	Motor Vehicles	89232.1	80088.0	*2,84*	*-10.25*	75494.7	*-5.74*
35.1	Building and repairing of ships and boats	1183.4	1100.2	*0,04*	*-7.03*	1103.5	*0.31*
35.2	Railway and tramway locomotives and rolling stock	8875.0	9192.3	*0,33*	*3.58*	9133.5	*-0.64*
35.3	Aircraft and spacecraft	2833.2	2871.3	*0,10*	*1.34*	3409.6	*18.75*
35.4+35.5	Other transport equipment nec	654.6	902.5	*0,03*	*37.86*	699.9	*-22.44*
36.1	Furniture	15983.2	18527.8	*0,66*	*15.92*	18641.3	*0.61*
36.2-36.5	Manufacturing nec	7495.6	8050.0	*0,29*	*7.40*	8466.7	*5.18*
37	Recycling	1580.4	1691.5	*0,06*	*7.03*	1676.1	*-0.91*
40.41	Electricity, gas & water	27230.2	26725.2	*0,95*	*-1.85*	23804.2	*-10.93*
45	Construction	23425.9	27151.9	*0,96*	*15.91*	28235.4	*3.99*
50-52	Wholesale and retail trade, repairs	28628.1	31038.7	*1,10*	*8.42*	33874.0	*9.13*
55	Hotels and restaurants	867.2	1018.7	*0,04*	*17.47*	1093.0	*7.28*
60-64 (less 64.2)	Transport, storage and communications (excluding telecommunications)	27642.9	28209.6	*1,00*	*2.05*	28431.4	*0.79*
64.2	Telecommunications	14567.4	16487.5	*0,59*	*13.18*	17476.5	*6.00*
65-67	Financial intermediation	3382.7	3584.8	*0,13*	*5.97*	3758.9	*4.86*
70.71	Real estate and renting	865.0	871.9	*0,03*	*0.79*	976.2	*11.96*
72 (less 72.2)	Other computer and related activities nec	37103.6	41033.4	*1,46*	*10.59*	39474.3	*-3.80*
72.2	Software consultancy and supply	49927.0	54699.0	*1,94*	*9.56*	63715.0	*16.48*
73	Research and development	1618.9	2106.7	*0,07*	*30.13*	2708.8	*28.58*
74	Other business activities	119614.3	123316.6	*4,38*	*3.10*	136155.5	*10.41*
75-99	Community, social and personal services	4915.2	5286.1	*0,19*	*7.55*	5656.3	*7.00*
01-99	**TOTAL BUSINESS SECTOR**	**2523672.2**	**2817773.1**	***100,00***	***11.65***	**2920197.1**	***3.63***

Intramural Expenditures on R&D of Business (BERD) by size class in Flanders (thousands current EUR)

Size class of company	2000	2001	%share	%growth	2002f	%growth
Under 50 employees	367784.6	396688.3	*14,08*	*7.86*	425053.4	*7.15*
From 50 to 249 employees	437394.3	463595.6	*16,45*	*5.99*	478791.0	*3.28*
250 employees and over	1718493.3	1957489.2	*69,47*	*13.91*	2016352.7	*3.01*
TOTAL BUSINESS SECTOR	**2523672.2**	**2817773.1**	***100,00***	***11.65***	**2920197.1**	***3.63***

Source: Federal Cooperation Commission, Concertation Group CFS/STAT; Federal Science Policy calculations, july 2003.
f: Forecast for 2002.

Table 2 > ***TOTAL PERSONNEL on R&D of Business Sector by industry in Flanders (full-time equivalent)***

Nace BEL	Description	2000	2001	%share	%growth	2002f	%growth
01,02,05	Agriculture	328	354	*1,49*	*7.98*	354	*0.10*
10-14	Mining	17	17	*0,07*	*3.77*	17	*-2.10*
15	Food products and beverages	937	954	*4,02*	*1.82*	966	*1.21*
16	Tobacco products	11	11	*0,05*	*2.49*	11	*1.52*
17	Textiles	754	810	*3,41*	*7.41*	809	*-0.13*
18	Wearing apparel and fur	232	250	*1,05*	*7.60*	242	*-3.08*
19	Leather, leather products and footwear	53	54	*0,23*	*3.18*	57	*4.19*
20	Wood and cork (except furniture)	62	79	*0,33*	*27.52*	81	*2.96*
21	Paper and paper products	60	61	*0,26*	*2.78*	66	*7.76*
22	Publishing, printing and reproduction of recorded media	154	154	*0,65*	*-0.08*	155	*1.09*
23	Coke, refined petroleum products and nuclear fuel	107	107	*0,45*	*0.73*	110	*1.93*
24 (less 24.4)	Chemicals excluding pharmaceuticals	3376	3542	*14,93*	*4.93*	3564	*0.61*
24.4	Pharmaceuticals	1406	1864	*7,86*	*32.58*	2142	*14.90*
25	Rubber and plastics products	674	707	*2,98*	*4.84*	750	*6.19*
26	Other non-metallic mineral products	215	240	*1,01*	*11.75*	274	*14.05*
27.1-27.3+27.51/52	Iron and steel	301	284	*1,20*	*-5.50*	316	*10.98*
27.4+27.53/54	Non-ferrous metals	229	250	*1,05*	*9.37*	266	*6.28*
28	Fabricated metal products, except machinery and equipment	807	872	*3,68*	*8.01*	878	*0.66*
29	Machinery and equipment nec	1560	1585	*6,68*	*1.59*	1468	*-7.34*
30	Office, accounting and computing machinery	125	131	*0,55*	*4.50*	135	*3.19*
31	Electrical machinery and apparatus nec	532	554	*2,33*	*4.05*	579	*4.51*
32 (less 32.1)	Radio, TV and communication equipment nec	3528	4052	*17,08*	*14.85*	3690	*-8.94*
32.1	Electronic valves, tubes and components	465	546	*2,30*	*17.49*	542	*-0.75*
33	Instruments, watches and clocks	236	244	*1,03*	*3.42*	241	*-1.21*
34	Motor Vehicles	936	914	*3,85*	*-2.38*	869	*-4.90*
35.1	Building and repairing of ships and boats	17	14	*0,06*	*-13.81*	15	*2.68*
35.2	Railway and tramway locomotives and rolling stock	117	117	*0,49*	*0.55*	114	*-3.05*
35.3	Aircraft and spacecraft	55	56	*0,24*	*1.95*	69	*22.99*
35.4+35.5	Other transport equipment nec	8	11	*0,05*	*38.73*	9	*-19.99*
36.1	Furniture	243	264	*1,11*	*8.65*	255	*-3.26*
36.2-36.5	Manufacturing nec	80	86	*0,36*	*6.71*	85	*-1.31*
37	Recycling	20	20	*0,08*	*1.22*	19	*-3.55*
40.41	Electricity, gas & water	170	171	*0,72*	*0.15*	166	*-2.68*
45	Construction	231	280	*1,18*	*20.99*	277	*-1.00*
50-52	Wholesale and retail trade, repairs	388	417	*1,76*	*7.44*	437	*4.75*
55	Hotels and restaurants	13	13	*0,06*	*0.91*	13	*1.15*
60-64 (less 64.2)	Transport, storage and communications (excluding telecommunications)	181	194	*0,82*	*7.48*	195	*0.42*
64.2	Telecommunications	159	170	*0,72*	*6.90*	184	*8.21*
65-67	Financial intermediation	34	37	*0,15*	*7.04*	37	*1.70*
70.71	Real estate and renting	11	12	*0,05*	*11.72*	13	*11.22*
72 (less 72.2)	Other computer and related activities nec	522	552	*2,33*	*5.83*	547	*-0.88*
72.2	Software consultancy and supply	731	824	*3,47*	*12.79*	874	*6.05*
73	Research and development	19	24	*0,10*	*23.83*	26	*9.64*
74	Other business activities	1683	1747	*7,36*	*3.82*	1894	*8.38*
75-99	Community, social and personal services	72	80	*0,34*	*11.16*	85	*6.04*
01-99	**TOTAL BUSINESS**	**21857**	**23726**	***100,00***	***8.55***	**23895**	***0.71***

Total Personnel on R&D of Business by size class in Flanders (full-time equivalent)

Size class of company	2000	2001	%share	%growth	2002f	%growth
Under 50 employees	5042	5432	*22,90*	*7.74*	5776	*6.32*
From 50 to 249 employees	4471	4849	*20,44*	*8.44*	4912	*1.32*
250 employees and over	12343	13445	*56,67*	*8.93*	13207	*-1.77*
TOTAL BUSINESS	**21857**	**23726**	***100,00***	***8.55***	**23895**	***0.71***

Source: Federal Cooperation Commission, Concertation Group CFS/STAT; Federal Science Policy calculations, july 2003.
f: Forecast for 2002.

Chapter 2

R&D ACTIVITIES OF FLEMISH COMPANIES IN THE PRIVATE SECTOR: AN ANALYSIS FOR THE PERIOD 1998-2002[7]

Michele Cincera

> 2.1 INTRODUCTION

The role of Research and Development (R&D), and more generally of technological and innovative activities as one of the most important determinants of economic growth, has already been examined extensively in the economic literature. An economy's ability to understand, exploit and adapt to a rapidly changing technological environment is seen to be central to its prospects for improving standards of living and prosperity. New and better products produced by firms allow them to gain market shares, while process R&D allows firms to make cheaper products and reduce their production costs.

Recently the European Commission set an objective, known as the Barcelona objective, to increase the average of R&D investments from a level of about 2% today to 3% by 2010, of which two thirds should be funded by the private sector (European Commission, 2003). The main goals are to give Europe a stronger public research base and to make it more attractive to private investments in research and innovation. In order to achieve this objective, R&D investments should increase by 8% at European level every year and most EU countries have taken initiatives to foster investment in R&D and innovation. Flanders, with an R&D intensity of nearly 2.5% of its regional GDP in 2002, is well positioned to achieve the Barcelona objective. However, this relatively good performance can not be generalized for all sectors of the Flemish economy. It is therefore important to have a better picture of R&D activities carried out by Flemish business companies. For instance, examining the sectoral distribution of R&D investments both in manufacturing and in services, as well as the evolution of these activities over the recent period shed some light on the best performing sectors and the ones deserving more efforts. On the other hand differences in R&D intensity are also related to differences in innovation styles and should not be ignored.

As a matter of fact, R&D is a complex process that involves different stages and encompasses different types of activities. Another objective of this chapter is to go more deeply into the R&D black-box by looking at several dimensions of these activities. R&D investments can be broken down into several activities. For instance it is common in the literature of technological change to make a distinction between in-house and subcontracted R&D, product and process oriented R&D, or basic and applied research and experimental development. It is also interesting to examine the main sources for financing R&D. The resources for financing these activities mainly originate from the firms own funds, but external resources, in particular the direct and indirect public support to R&D also play an important role. Furthermore, R&D activities, although they are important, are not the only source for generating new knowledge or improving existing one. Other activities such as the acquisition of machinery and equipment or advanced software as well as technological collaborative agreements with other research actors are also important.

The analysis presented in this chapter is based on the two last R&D surveys organized by IWT in 2000 and 2002[8]. These surveys are addressed to the Flemish firms operating in the private business sector. Three categories of firms are considered. The first category, the so-called 'permanent-inventory', refers to the firms known as carrying out R&D on a permanent basis. The second category, the so-called 'pseudo-inventory', consists of companies never surveyed in the past but that recently received public R&D subsidies, or were earlier signalled having R&D on an occasional basis. Most of these companies are small and/or were recently created and are likely to be involved in R&D activities on a regular basis. The firms belonging to these two categories are systematically surveyed. The third category consists of a representative sample of the remaining population of firms (permanent and pseudo-inventory firms not included) operating in the Flemish private sector and with more than 10 employees[9]. The R&D expenditures, if any, reported by these firms are then extrapolated to end up with an unbiased estimation of the actual aggregated R&D expenditures at national and regional levels[10]. Table A1 in the appendix shows the breakdown of the number of firms in terms of industry sectors for the three categories.

Two R&D questionnaires have been sent to the firms, a long version for the firms in the permanent- and pseudo- inventories and a shorter version for the firms in the sample. For the long version, firms are asked to answer to a number of questions such as the general structure of the company, R&D expenditures, individual components of R&D, R&D personnel, or sources of funding of R&D activities. The questionary also contains questions related to technological collaborative agreements, innovation activities and research activities carried out by the firms' subsidiaries/mother company if any[11].

The analysis is based on several descriptive tables that summarize the main findings of the R&D surveys. Prior to the calculation of the different indicators and tables, several tests have been executed in order to check the consistency and the validity of the answers to the different R&D survey questions[12]. The main errors detected deal with figures reported in different currencies (euro/BEF) and units (thousands/millions) across questions and/or year periods for a given firm, abnormal annual growth rates for some variables, and discrepancies between the number of employees and turnover and the figures reported in the firms annual accounts. When the error was obvious, data has been corrected. In the other cases, data has been changed according to the appreciation of IWT.

Actual R&D expenditures and personnel are available for each year of the period 1998 – 2001. R&D figures for 2002 are provisional. Also provisional figures for 2000 have been included, besides the figures reported in the later survey. For the other variables, the figures refer to the two years 1999 and 2001 combined. The sectoral breakdown of firms' activities is based on the NACEBEL nomenclature. Depending on the number of answers, three levels of disaggregation are considered (Tables A2 and A3 in the appendix) to insure a certain level of representativeness. Indeed, some firms did not answer to all questions of the R&D surveys and some firms were not surveyed in both surveys or did not respond to any of them. In order to assess the representativeness of the answers for a given variable, the ratio of the R&D expenditures of the respondents to that question over the R&D expenditures of all firms surveyed has been calculated for each table.

The layout of the chapter :
Section 2 presents the importance of R&D expenditures at both sectoral and firms' size levels. The R&D expenditures include intrapolated data for the firms that did not answer to the R&D variables, on the basis of former observations and sectoral tendencies. These figures are also presented in relative terms (R&D intensity) as a share of firms' output as measured by net sales and in growth rates to illustrate the evolution of R&D expenditures over the recent period.
Section 3 examines R&D personnel indicators, in particular the function and the level of education of human resources directly assigned to R&D activities.
Section 4 focuses on the different components of R&D activities. R&D is usually organized in three activities: fundamental research, applied research and development. A second distinction is between internal or intra-mural R&D and subcontracted or extra-mural R&D. Another distinction is between product and process oriented R&D activities. The output of R&D activities is not fully appropriable to inventors. This market failure explains why public authorities may intervene to support R&D. Then, given the risks and uncertainties of research activities, firms may face liquidity constraints such as credit rationing by lenders to finance their R&D investments.
Section 5 gives an insight into the sources of funding of R&D activities. During the past decade, the involvement of Multinational Enterprises (MNEs) in overseas R&D has increased significantly.
Section 6 investigates the importance of this phenomenon in Flanders over the recent period.
Section 7 is devoted to R&D collaborative agreements between Flemish companies and other research actors.
Section 8 deals with other than R&D innovation activities. These activities occur in the downstream stage of the process of technological change and are aimed at introducing invented or improved goods and services into the market. Section 9 concludes.

> 2.2 INTRA-MURAL R&D EXPENDITURES

a) R&D by industry sector

Table 1 gives the total R&D expenditures by industry sector for the firms surveyed in the R&D surveys of 2000 and 2002. These figures correspond to the expenditures reported by the firms in the R&D surveys plus the intra-polated amounts for missing values. This table does not include the extrapolated expenditures for the representative sample of the universe of Flemish firms operating in the private sector (third category of firms surveyed) which account for about 8 to 10% of the Flemish total R&D aggregate (BERD) for the private sector over the period 1998 – 2000[13].

Table 1 > ***Intrapolated intra mural R&D expenses by sector – 1998 – 2002e***

NACE-Bel code + Description		expim98	d%	expim99	d%	Δ%	expim00e	d%	expim00	d%	Δ%	expim01	d%	Δ%	expim02e	d%
01-05	agriculture, hunting and forestry	5204	0,3	6253	0,3	20,1	6596	0,3	6209	0,3	-0,7	6557	0,3	5,6	6276	0,2
10-14	mining	30	0,0	30	0,0	1,5	30	0,0	716	0,0	2287,5	735	0,0	2,6	753	0,0
15-16	food, beverages and tobacco	68234	3,9	70696	3,6	3,6	72290	3,5	64543	2,8	-8,7	69300	2,7	7,4	71078	2,7
17	textiles	26450	1,5	28133	1,4	6,4	29241	1,4	26167	1,2	-7,0	27414	1,1	4,8	28976	1,1
18	wearing apparel	0	0,0	446	0,0		0	0,0	127	0,0	-71,5	303	0,0	138,0	205	0,0
19	eather products and footwear	53	0,0	54	0,0	1,5	55	0,0	211	0,0	290,5	147	0,0	-30,3	160	0,0
20	wood and cork (not furniture)	662	0,0	738	0,0	11,4	749	0,0	1591	0,1	115,8	1527	0,1	-4,0	1661	0,1
21	pulp, paper and paper products	4040	0,2	4570	0,2	13,1	4859	0,2	4228	0,2	-7,5	4543	0,2	7,5	4752	0,2
22	publishing, printing and reproduction of recorded media	4703	0,3	4854	0,2	3,2	5810	0,3	4682	0,2	-3,5	4659	0,2	-0,5	4805	0,2
23	coke, refined petroleum products and nuclear fuel	56400	3,2	57276	2,9	1,6	58123	2,8	80626	3,5	40,8	80667	3,2	0,1	80708	3,1
24	excl. 244 chemicals and chemical products (excl. pharmaceuticals)	333579	19,0	353527	18,0	6,0	358662	17,1	396456	17,4	12,1	425949	16,9	7,4	460926	17,7
244	pharmaceuticals	293144	16,7	326864	16,7	11,5	322897	15,4	415508	18,3	27,1	537254	21,3	29,3	619415	23,8
25	rubber and plastic products	39646	2,3	44129	2,3	11,3	43485	2,1	41029	1,8	-7,0	40634	1,6	-1,0	42121	1,6
26	non-metallic mineral products	8824	0,5	10642	0,5	20,6	7707	0,4	8025	0,4	-24,6	7583	0,3	-5,5	7585	0,3
27	basic metals	64031	3,6	72620	3,7	13,4	69327	3,3	82853	3,6	14,1	91087	3,6	9,9	86752	3,3
28	fabricated metal products (excl. mach. & equipm.)	12345	0,7	12757	0,7	3,3	15577	0,7	20683	0,9	62,1	22387	0,9	8,2	23617	0,9
29	machinery, n.e.c.	77100	4,4	88254	4,5	14,5	88748	4,2	138803	6,1	57,3	132733	5,3	-4,4	129957	5,0
30	office, accounting and computing machinery	68057	3,9	74040	3,8	8,8	87235	4,2	32417	1,4	-56,2	33215	1,3	2,5	34866	1,3
31	electrical machinery	33719	1,9	35064	1,8	4,0	38580	1,8	28075	1,2	-19,9	29086	1,2	3,6	29277	1,1
32	excl. 321 tv, radio and communications equipment	333100	18,9	390972	20,0	17,4	461866	22,1	514602	22,6	31,6	590763	23,4	14,8	528760	20,3
32	electronic components	37527	2,1	42030	2,1	12,0	52094	2,5	50697	2,2	20,6	52552	2,1	3,7	52935	2,0
33	medical, precision and optical instruments, …	11504	0,7	11307	0,6	-1,7	11599	0,6	9829	0,4	-13,1	10898	0,4	10,9	12062	0,5
3	motor vehicles	114007	6,5	125980	6,4	10,5	131224	6,3	68505	3,0	-45,6	63232	2,5	-7,7	70689	2,7
35	other transport equipment	304	0,0	437	0,0	43,6	457	0,0	153	0,0	-65,0	128	0,0	-16,3	50	0,0
36	excl. 361+365 other manufacturing	6014	0,3	5490	0,3	-8,7	5941	0,3	7050	0,3	28,4	7492	0,3	6,3	8089	0,3
361	furniture	4788	0,3	4640	0,2	-3,1	4622	0,2	8914	0,4	92,1	8966	0,4	0,6	9045	0,3
365	toys	142	0,0	355	0,0	149,1	275	0,0	744	0,0	109,6	786	0,0	5,6	832	0,0
3	recycling	805	0,0	944	0,0	17,3	1000	0,0	1070	0,0	13,3	1195	0,0	11,7	1220	0,0
40	electricity, gas and water supply	586	0,0	1549	0,1	164,4	1282	0,1	532	0,0	-65,7	718	0,0	35,0	680	0,0
45	construction	6929	0,4	7167	0,4	3,4	7118	0,3	7441	0,3	3,8	7767	0,3	4,4	9626	0,4
50-55	wholesale, retail trade and motor vehicle repair etc.	11315	0,6	12490	0,6	10,4	12114	0,6	29744	1,3	138,1	33439	1,3	12,4	37881	1,5
60-64	excl. 642 transport and storage	5077	0,3	5820	0,3	14,6	7027	0,3	6917	0,3	18,8	8088	0,3	16,9	8155	0,3
642	telecommunications	0	0,0	0	0,0		0	0,0	1989	0,1		2162	0,1	8,7	2179	0,1
65-67	financial intermediation (incl. insurances)	2614	0,1	2589	0,1	-0,9	2709	0,1	2438	0,1	-5,8	2561	0,1	5,0	2839	0,1
70-7	other business activities	40177	2,3	44515	2,3	10,8	47862	2,3	60268	2,7	35,4	63918	2,5	6,1	63974	2,5
72 excl. 722	computer and related activities (excl. software consult.)	2555	0,1	3250	0,2	27,2	4083	0,2	11582	0,5	256,4	10844	0,4	-6,4	11405	0,4
72	software consultancy	34218	1,9	49821	2,5	45,6	68960	3,3	51217	2,3	2,8	54907	2,2	7,2	55459	2,1
73	r&d	1318	0,1	1338	0,1	1,5	1358	0,1	8473	0,4	533,4	13092	0,5	54,5	28635	1,1
74	excl. 742 other business activities n.e.c.	27767	1,6	29599	1,5	6,6	29583	1,4	32568	1,4	10,0	33327	1,3	2,3	28447	1,1
742	engineering	19923	1,1	24391	1,2	22,4	29748	1,4	43865	1,9	79,8	38356	1,5	-12,6	37027	1,4
75	community, social and personal service activ. etc.	2248	0,1	3087	0,2	37,3	2675	0,1	1941	0,1	-37,1	2313	0,1	19,2	2489	0,1
TOTAL		1759140	100	1958718	100	11,3	2093566	100	2273487	100	16,1	2523281	100	11,0	2606372	100

Notes: expim = intra-mural R&D expenditures; d% = distribution in percentage of total R&D across industry sectors, Δ% = annual growth rate, e = provisional data. Sources: own calculations, IWT R&D surveys 2000 and 2002

These figures are thus only calculated based on the firms in the 'inventory'. But these firms represent the bulk of R&D activities in the private sector. Total intra-mural R&D expenditures account for 90 to 92% of the estimated total expenditures of firms. In terms of sectoral distribution, some discrepancies can be found with the corresponding distribution at the Flemish regional level (ANBERD series). These differences can be explained by the fact that R&D expenditures for the firms with R&D activities in several industry sectors are allocated to the principal sector and by the fact that R&D expenses by the firms in the sample are not taken into account in the totals reported.

On the whole, firms' R&D activities in Flanders are strongly specialized in the TV, radio and communication equipment, chemicals and pharmaceutical sectors. As can be seen in Table 1, these sectors accounted in 1999 for nearly 55% of total R&D performed in the business enterprise sector. This share was even higher in 2002, with 61.6%. For the services sector, firms' R&D activities accounted for 10.8% of the Flemish total R&D in 2001 compared with 9.5% in 1999. The Herfindhal index indicates that the degree of specialization of R&D activities has increased over the recent period. This index was 0.115 in 1999 against 0.138 in 2001. These values can be compared to 0.024, which is the value corresponding to an equal distribution of R&D across each industry sector.

In terms of growth, total intra-mural R&D expenditures in the Flemish private sector grew at an annual average rate of 12.8% over the period 1998-2001. As can be seen in Table 1, this performance is highly influenced by the acceleration of R&D activities between 1999 and 2000. In terms of the 3% objective by the year 2010, the evolution of R&D in Flanders is above the target of an annual growth rate of R&D investments of 6%[14] as estimated by Capron and Duelz (2003). The evolution of R&D expenditures in the three main industry sectors of specialisation is also positive. The pharmaceuticals and TV, radio and communication equipment industry sectors experienced annual average growth rates of 22.6% and 21.3% respectively in the boom of the technology hype. This performance is less pronounced for the chemical sector (8.5%).

b) R&D by firm size

The relationship between the firm's size and R&D activities has been investigated for a long time[15]. The question is whether there are any scale advantages to R&D for large firms or whether these activities rather emerge in small entrepreneurial firms. Following the original work of Joseph Schumpeter (1942), several factors have been proposed for explaining this relationship. Given the costs and uncertainties inherent to R&D activities as well as the importance of scale and scope economies in the production of new innovations, small firms are less likely to engage in R&D activities. Furthermore, the appropriability conditions of the returns associated with technological activities, and hence the incentives to do R&D, are more important for large firms characterized by a high market power, and these firms benefit from higher own financial resources to finance these activities. The size relationship depends also heavily on industry characteristics. For instance, large enterprises invest more in R&D in sectors with high concentration and barriers to entry, while small firms are more innovative in sectors with low concentration in newly emerging or growing technologies (Acs and Audretsch, 1987). On the other hand, firms characterized by strong market power may be less concerned by competitive pressures and as such might invest less in R&D. Large sized organizations can also suffer from a loss of managerial control and from excessive bureaucratisation which are associated with decreasing returns to scale of R&D activities.

Table 2 presents the total R&D expenditures in the Flemish private sector by firm's size classes and in absolute terms. The first class refers to the firms with less than 50 employees and the third to the one with more than 250 employees. It follows that in 2001 the latter category concentrates 78.7% of total private R&D expenditures as compared to 77.5% in 1999. Medium sized firms, that is firms with a number of employees comprised between 50 and 250, represent about 12% of total R&D and small firms about 9% in 2001.

Table 2 > ***Intrapolated intra mural R&D expenses by firms' size – 1998 – 2002e***

Size	expim98	d%	expim99	d%	expim00e	d%	expim00	d%	expim01	d%	expim02e	d%
1-49	200565	*11,4*	218674	*11,2*	241523	*11,5*	215641	*9,5*	230600	*9,1*	242794	*9,3*
50-249	209507	*11,9*	222364	*11,4*	232990	*11,1*	301942	*13,3*	305630	*12,1*	322887	*12,4*
more than 250	1349069	*76,7*	1517680	*77,5*	1619053	*77,3*	1755903	*77,2*	1987052	*78,7*	2040691	*78,3*
TOTAL	**1759140**	***100***	**1958718**	***100***	**2093566**	***100***	**2273487**	***100***	**2523281**	***100***	**2606372**	***100***

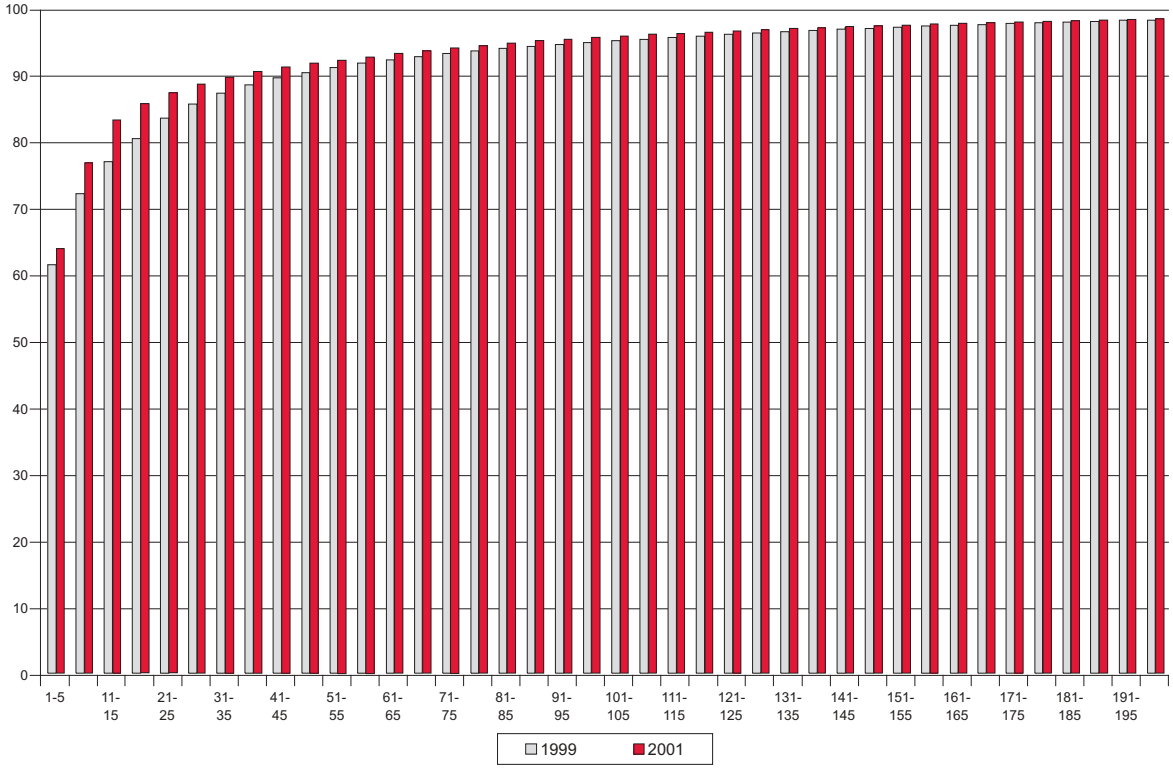
Notes: expim = intra-mural R&D expenditures; d% = distribution in percentage of total R&D across industry sectors, e = provisional data.
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Another feature of the Flemish technological landscape is the high concentration of R&D activities among a few large firms. Figure 1 sheds some light on the R&D expenditures of the top 200 R&D Flemish spenders in 1999 and 2001 respectively. As can be observed, this activity is extremely concentrated. Indeed, the five firms with the highest R&D budgets account for 61.3% of the total R&D expenditures in the private sector in 1999 (63.7% in 2001). For the top 10 companies, these shares are 72.0% and 76.6% respectively. The cumulated distribution for the top 200 firms is nearly 100% of the 'inventory'. It follows that R&D activities in the Flemish private sector heavily depend upon a few very large firms. Table 3 lists the top 10 companies in terms of R&D expenditure and personnel in 1999 and 2001.

c) R&D intensity

Figures in absolute terms are useful to measure the importance of R&D activities in the economy. In order to assess these activities in relative terms, the R&D intensity is often used. R&D intensity is defined as the percentage of R&D expenses with respect to output, i.e. value added or turnover. Table 4 gives the average intra-mural R&D intensity by industry sector and by size class over the period 1998-2002[16]. These figures are calculated based on the firm net sales. If follows that the

Figure 1 > ***Cumulated distribution of R&D expenditures of the top 200 Flemish firms (1999 and 2001)***



Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 3 > ***Top 10 R&D spenders in Flanders, 1999 and 2001***

	R&D expenditures rank 1999	R&D expenditures rank 2001	R&D personnel rank 2001
Janssen Pharmaceutica	1	1	2
Alcatel Bell	2	2	1
Philips Industrial Activities	4	3	3
Agfa-Gevaert	5	4	5
Procter and Gamble Eurocor	3	5	6
Siemens Atea	6	6	4
Esso	9	7	8
Huntsman ICI Europe	8	8	12
Barco	7	9	7
Alcatel Microelectronics	10	10	14

Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 4 > ***Average intra mural R&D intensity (by size – 1998-2002e)***

Size	RI98	repr.%	RI99	repr.%	Ri00e	repr.%	RI00	repr.%	RI01	repr.%	RI02e	repr.%
1-49	10,09	*84,47*	10,02	*86,45*	10,46	*72,21*	11,04	*86,23*	10,33	*81,95*	10,45	*83,19*
50-249	2,61	*94,00*	2,50	*90,44*	2,32	*87,71*	4,30	*82,92*	4,13	*86,00*	5,28	*76,56*
more than 250	3,08	*92,20*	3,28	*91,81*	4,35	*91,77*	3,51	*101,22*	3,44	*93,89*	2,88	*42,31*
TOTAL	6,72	*91,94*	6,75	*91,46*	7,04	*90,16*	7,84	*98,61*	7,52	*92,62*	7,97	*48,15*

Notes: RI = R&D intensity (R&D expenditures in % of net sales); repr.% = representativeness (% of R&D for which intra mural R&D and net sales are available with respect to total R&D of respondents), e = provisional data.
Sources: own calculations, IWT R&D surveys 2000 and 2002.

smallest firms, i.e. firms with less than 50 employees, allocate a larger share of their resources to R&D as compared to larger companies. It should be noted that in this context, small R&D-active firms are often high-tech starters with small turnovers. In 1999, the R&D intensity of these firms was 10.02%, while for medium and large size firms these indicators were 2.50% and 3.28% respectively. In 2001, the R&D intensity for these three groups of firms was: 10.33%, 4.13% and 3.44%. It should be noted that these averages hide a large variance with some large firms reporting R&D intensities of more than 15% of sales. All in all, the R&D intensity has increased from 6.75% to 7.52% over the period 1999-2001. In sectoral terms, some sectors are more R&D intensive than others and the evolution over time is more differentiated. Table 5 reports the R&D intensities according to industry sectors both in the manufacturing and in the services. It follows that for the manufacturing sector, pharmaceuticals (11.39% in 1999 and 8.5% in 2001), and ICT-hardware and instruments (11.45% and 5.91%) industries are the most R&D intensive sectors. For services, the R&D intensities of the firms in the sectors of immaterial services (15.40% and 20.36%) and software development (18.72% and 19.13%) are the highest. At the other end, wood and furniture (1.30% and 0.69%), paper and printing (1.38% and 0.54%) metal and metallic products (1.43% and 1.87%) and transport equipment (1.37% in 2001) are the industry sectors with the lowest R&D intensities. The sharp upswing in the business cycle possibly explains the backfall in R&D intensity in some sectors since sales increased more than the increase in R&D personnel. It is also common to distinguish between four categories of sectors according to their R&D intensity: low, medium-low, medium high and high R&D intensive sectors. This classification proposed by the OECD (2003) has been retained in this chapter to analyze the evolution of R&D activities over the recent time period[17].

> 2.3 R&D PERSONNEL

R&D personnel are another helpful input indicator to gauge the resources allocated to R&D activities. The R&D personnel consists

Table 5 > ***Average intra mural R&D expenses: R&D intensity (by sector – 1998-2002e)***

NACE-Bel code	Description	RI98	repr.%	RI99	repr.%	Ri00e	repr.%	RI00	repr.%	RI01	repr.%	RI02e	repr.%
15 + 16	food & tobacco	2,54	*98,84*	2,51	*99,49*	3,39	*69,43*	3,64	*99,93*	3,49	*99,75*	4,34	*92,01*
17…19	textiles & wearing	2,55	*99,93*	3,06	*100,00*	2,58	*100,00*	3,09	*92,58*	2,24	*88,95*	3,59	*87,93*
20 + 36.1	wood and furniture	1,15	*98,41*	1,30	*98,39*	0,96	*99,43*	0,75	*99,88*	0,69	*99,88*	0,94	*100,00*
21 + 22	paper & printing	1,04	*100,00*	1,38	*100,00*	1,56	*100,00*	0,42	*100,00*	0,54	*98,72*	0,79	*72,58*
23 + 2 (excl. 24.4)	refineries & chemical products	1,84	*97,06*	1,97	*95,35*	3,80	*88,74*	5,20	*106,15*	2,56	*65,78*	2,59	*56,51*
24.4	pharmaceuticals	13,24	*93,88*	11,39	*90,08*	11,14	*93,46*	9,70	*99,99*	8,51	*100,00*	3,02	*1,32*
25	rubber & plastics	1,80	*98,58*	1,81	*98,96*	1,73	*100,00*	1,94	*97,86*	1,98	*98,19*	4,92	*93,51*
27 + 28	metal and metalic products	1,13	*86,02*	1,43	*92,88*	1,52	*88,29*	2,19	*99,14*	1,86	*99,15*	2,23	*64,46*
29 + 31	machines & equipments (incl. electric.)	5,28	*98,65*	6,26	*99,89*	5,30	*99,61*	6,25	*99,79*	5,91	*99,94*	5,79	*89,33*
30 + 32 + 33	ICT-hardware & instruments	10,96	*87,14*	11,45	*88,52*	11,28	*88,42*	6,75	*99,98*	7,75	*99,98*	8,62	*99,01*
34 + 35	transport	2,20	*97,63*	2,35	*98,05*	1,94	*97,99*	1,12	*99,14*	1,37	*99,10*	1,60	*99,71*
45	construction	7,01	*100,00*	2,36	*100,00*	2,14	*100,00*	4,93	*99,90*	3,78	*100,00*	5,39	*88,76*
1 + 10 + 26 + 36.5+ 37 + 40 + 41	other industries incl. agriculture	4,63	*100,00*	4,98	*94,70*	5,74	*93,90*	7,01	*99,90*	7,96	*99,85*	6,02	*94,19*
50 … 64	material services	5,90	*100,00*	4,07	*100,00*	3,93	*99,41*	4,10	*93,41*	4,44	*94,02*	6,01	*80,59*
65 … 74 (excl.64.2 en 72.2)	immaterial services	16,32	*77,94*	15,40	*79,38*	15,05	*73,98*	21,44	*51,61*	20,36	*57,01*	21,60	*53,90*
64.2 + 72.2	software development	18,41	*100,00*	18,72	*99,54*	20,90	*98,22*	20,01	*90,31*	19,13	*92,69*	16,15	*97,88*
TOTAL		**6,72**	***91,94***	**6,75**	***91,46***	**7,04**	***90,16***	**7,84**	***98,61***	**7,52**	***92,62***	**7,97**	***48,150***

Notes: RI = R&D intensity (R&D expenditure in % of net sales); repr.% = representativeness (% of R&D for which intra-mural R&D and net sales are available with respect to total R&D of respondents); e = provisional data.
Sources: own calculations, IWT R&D surveys 2000 and 2002.)

Table 6 > ***Intrapolated R&D personnel (in full-time equivalent) by sector and size – 2000 – 2002e***

NACE-Bel code	Description	RDemp00	d%	RDemp01	d%	Δ%	RDemp02e	d%	Δ%e
15 + 16	food & tobacco	788	*4,3*	792	*4,0*	*0,6*	801	*4,0*	*1,1*
17…19	textiles & wearing	369	*2,0*	385	*1,9*	*4,4*	400	*2,0*	*3,9*
20 + 36.1	wood and furniture	192	*1,1*	183	*0,9*	*-4,9*	186	*0,9*	*1,5*
21 + 22	paper & printing	96	*0,5*	103	*0,5*	*6,9*	107	*0,5*	*4,2*
23 + 24 (excl. 24.4)	refineries & chemical products	3707	*20,2*	3850	*19,4*	*3,9*	3866	*19,4*	*0,4*
24.4	pharmaceuticals	1471	*8,0*	1857	*9,4*	*26,2*	2114	*10,6*	*13,9*
25	rubber & plastics	180	*1,0*	185	*0,9*	*2,7*	207	*1,0*	*11,9*
27 + 28	metal and metalic products	994	*5,4*	1015	*5,1*	*2,1*	1041	*5,2*	*2,5*
29 + 31	machines & equipments (incl. electrical)	1996	*10,9*	2032	*10,2*	*1,8*	1988	*10,0*	*-2,2*
30 + 32 + 33	ICT-hardware & instruments	4218	*23,0*	4773	*24,1*	*13,2*	4419	*22,2*	*-7,4*
34 + 35	transport	953	*5,2*	918	*4,6*	*-3,7*	898	*4,5*	*-2,1*
45	construction	89	*0,5*	123	*0,6*	*38,0*	137	*0,7*	*11,1*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	557	*3,0*	556	*2,8*	*-0,1*	585	*2,9*	*5,1*
50 … 64	material services	405	*2,2*	452	*2,3*	*11,7*	476	*2,4*	*5,2*
65 … 74 (excl.64.2 en 72.2)	immaterial services	1643	*9,0*	1869	*9,4*	*13,8*	1938	*9,7*	*3,7*
64.2 + 72.2	software development	654	*3,6*	734	*3,7*	*12,2*	759	*3,8*	*3,5*
TOTAL		**18311**	***100***	**19827**	***100***	***8,3***	**19922**	***100***	***0,5***
Size		**RDemp00**	**d%**	**RDemp01**	**d%**	**Δ%**	**RDemp02e**	**d%**	**Δ%e**
1+2+3 **1-49**		2510	*13,7*	2750	*13,9*	*9,6*	2974	*14,9*	*8,1*
4+5 **50-249**		3466	*18,9*	3662	*18,5*	*5,7*	3779	*19,0*	*3,2*
6+7 **more than 250**		12336	*67,4*	13415	*67,7*	*8,7*	13170	*66,1*	*-1,8*
TOTAL		**18311**	***100***	**19827**	***100***	***8,3***	**19922**	***100***	***0,5***

Notes: RDemp = total R&D personnel; d% = distribution in percentage of R&D personnel across industry sectors, Δ% = annual growth rate, e = provisional data. Sources: own calculations, IWT R&D surveys 2000 and 2002.

of all persons performing R&D including researchers, technicians and similar personnel, people providing services directly linked to R&D work, such as managers and other personnel, mainly support staff. Table 6 gives the intrapolated number of R&D employees across industry and services sectors as well as by firms´ size class[18]. It follows that the most important sectors employing this kind of personnel are ICT-hardware and instruments, refineries and chemicals, and machines and equipments sectors (respective shares of 24.1%, 19.4% and 10.2% with respect to total R&D personnel in 2001). As compared to R&D expenditures, this ranking is somewhat different, which can be explained by the fact that some sectors are more "R&D-labor" intensive, that is they employ more R&D employees per euro of spent R&D. This appears to be the case for the machines and equipments sector which does not belong to the three most important sectors in terms of R&D expenditures.

Table 7 shows the average R&D expenses per R&D employee. On average, firms allocate 80556 euros per employee. It should be noted that these expenses include also the investments costs and other working expenses associated with R&D activities. These figures are the highest for the larger companies as well as in the pharmaceuticals and more surprisingly in the paper and printing sectors.

The distribution of the R&D personnel by function is given in Table 8. Researchers represent 43% of the R&D total personnel while managers, technicians and support staff account for 10%, 30% and 17% respectively. Once again this distribution substantially varies across industry sectors and firms' sizes. The importance of researchers appears to be closely related to the R&D intensity of the sector. In terms of size, small and large companies, with 44%, share the same proportion of researchers. Table 10 provides the breakdown of R&D workers by level of education. R&D employees with a university degree represent more than 50% of the total R&D workforce. While this share is higher for the small enterprises, there seems to be no correlation between this level of education and the sector's R&D intensity.

Table 7 > ***Average R&D expenditures by R&D personnel by sector and size – 2000 – 2002e***

NACE-Bel code	Description	expim/RDemp00	expim/RDemp01	expim/RDemp02e
15 + 16	food & tobacco	70	75	79
17…19	textiles & wearing	76	74	76
20 + 36.1	wood and furniture	63	60	64
21 + 22	paper & printing	101	101	99
23 + 24 (excl. 24.4)	refineries & chemical products	90	94	107
24.4	pharmaceuticals	101	102	112
25	rubber & plastics	94	94	92
27 + 28	metal and metalic products	77	78	80
29 + 31	machines & equipments (incl. electrical)	78	79	78
30 + 32 + 33	CT-hardware & instruments	80	82	81
34 + 35	transport	81	83	79
45	construction	84	78	81
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	85	85	84
50 … 64	material services	74	74	74
65 … 74 (excl.64.2 en 72.2)	immaterial services	76	75	78
64.2 + 72.2	software development	76	77	79
TOTAL		80	81	83
Size		**expim/RDemp00**	**expim/RDemp01**	**expim/RDemp02**
1-49		75	75	78
550-249		78	80	82
more than 250		98	99	101
TOTAL		80	81	83

Notes: expim = intrapolated intra-mural R&D expenditure; RDemp = intrapolated total R&D personnel, e = provisional data.
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 8 >

Total R&D personnel by function (by sector and by size – 1999+2001)

NACE-Bel code	Description	M%	R%	T%	Oth%	repr.%
15 + 16	food & tobacco	12	34	43	11	*95*
17…19	textiles & wearing	22	21	33	24	*87*
20 + 36.1	wood and furniture	28	12	32	28	*86*
21 + 22	paper & printing	22	27	44	7	*67*
23 + 24 (excl. 24.4)	refineries & chemical products	8	36	21	35	*99*
24.4	pharmaceuticals	3	50	40	6	*13*
25	rubber & plastics	10	32	43	15	*70*
27 + 28	metal and metalic products	9	30	37	23	*65*
29 + 31	machines & equipments (incl. electrical)	10	44	38	8	*87*
30 + 32 + 33	ICT-hardware & instruments	9	47	30	14	*100*
34 + 35	transport	7	38	27	29	*88*
45	construction	22	13	51	13	*74*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	13	35	38	14	*94*
50 … 64	material services	22	40	26	13	*64*
65 … 74 (excl.64.2 en 72.2)	immaterial services	12	52	22	14	*73*
64.2 + 72.2	software development	11	50	34	5	*77*
TOTAL		**10**	**43**	**30**	**17**	***84***
Size		**M%**	**R%**	**T%**	**Oth%**	**repr.%**
1-49		18	44	30	8	*74*
550-249		12	39	36	13	*81*
more than 250		8	44	29	19	*87*
TOTAL		**10**	**43**	**30**	**17**	***84***

Notes: M% = share of managers; R% = share of researchers; T% = share of technicians; Oth% = share of other R&D personnel; repr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel). Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 9 >

Growth rate of total R&D personnel share by function (by sector and by size – 1999+2001)

Sectors	M99%	M01%	Δ%	R99%	R01%	Δ%	T99%	T01%	Δ%	O99%	O01%	Δ%	repr.%
low tech	14	12	*-14*	32	31	*-3*	44	43	*-2*	11	14	*26*	*43*
medium low tech	17	10	*-50*	25	33	*27*	50	46	*-7*	4	13	*109*	*19*
medium high tech	10	4	*-85*	55	20	*-100*	12	23	*65*	22	52	*88*	*66*
high tech	13	7	*-54*	39	46	*15*	34	34	*2*	14	12	*-13*	*77*
other services	10	15	*41*	46	69	*40*	10	11	*14*	1	5	*179*	*26*
high tech services	9	11	*28*	49	36	*-30*	21	35	*51*	22	17	*-27*	*41*
Total	**12**	**8**	***-47***	**43**	**40**	***-6***	**29**	**32**	***11***	**15**	**20**	***28***	***6***
Size	**M99%**	**M01%**	**Δ%**	**R99%**	**R01%**	**Δ%**	**T99%**	**T01%**	**Δ%**	**O99%**	**O01%**	**Δ%**	**repr.%**
1-49	17	18	*4*	54	49	*-10*	23	27	*16*	2	5	*124*	*28*
50-249	11	9	*-21*	33	43	*25*	35	34	*-2*	13	14	*9*	*46*
more than 250	12	7	*-58*	43	39	*-10*	29	32	*13*	16	22	*30*	*70*
Total	**12**	**8**	***-47***	**43**	**40**	***-6***	**29**	**32**	***11***	**15**	**20**	***28***	***61***

Notes: M% = share of managers; R% = share of researchers; T% = share of technicians; O% = share of other R&D personnel; Δ% = annual growth rate R&D personnel share, repr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel). Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 9 illustrates the evolution of the R&D personnel by function over the period 1999-2001. The relative decline of the share of researchers and especially managers indicates a shift of the composition of the R&D workforce towards technician and R&D support staff. In terms of the level of education, the share of R&D personnel holding Ph.D. or university degrees has decreased (Table 11). Obviously, these categories have lower elasticity of labor supply in a period of growth.

Table 10 > ***Total R&D personnel by level of education (by sector and by size – 1999+2001)***

NACE-Bel code	Description	D%	U%	HE%	Oth%	repr.%
15 + 16	food & tobacco	7	36	37	20	*95*
17…19	textiles & wearing	1	41	23	35	*75*
20 + 36.1	wood and furniture	0	42	22	36	*86*
21 + 22	paper & printing	2	49	30	19	*70*
23 + 24 (excl. 24.4)	refineries & chemical products	10	22	33	34	*98*
24.4	pharmaceuticals	15	26	37	21	*96*
25	rubber & plastics	3	33	20	44	*60*
27 + 28	metal and metalic products	7	29	27	37	*90*
29 + 31	machines & equipments (incl. electrical)	3	43	30	25	*86*
30 + 32 + 33	ICT-hardware & instruments	3	74	12	11	*100*
34 + 35	transport	1	40	30	29	*88*
45	construction	0	46	15	40	*76*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	9	38	25	28	*96*
50 … 64	material services	6	66	18	11	*64*
65 … 74 (excl.64.2 en 72.2)	immaterial services	12	45	27	15	*87*
64.2 + 72.2	software development	8	69	18	4	*81*
TOTAL		**6**	**53**	**22**	**19**	***94***
Size		**D%**	**U%**	**HE%**	**Oth%**	**repr.%**
1-49		11	54	23	13	*79*
50-249		7	41	30	23	*85*
more than 250		6	54	21	19	*98*
TOTAL		**6**	**53**	**22**	**19**	***94***

Notes: D% = share of personnel with a Ph.D degree; U% = share of personnel with a university degree; HE% = share of personnel with a higher education degree; Oth% = share of personnel with another degree; repr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 11 > ***Growth rate of Total R&D personnel share by level of education (by sector and by size – 1999+2001)***

Sectors	D99%	D01%	Δ%	U99%	U01%	Δ%	HE99%	HE01%	Δ%	O99%	O01%	Δ%	repr.%
low tech	4	6	*47*	40	30	*-60*	38	44	*27*	17	21	*19*	*40*
medium low tech	6	5	*-39*	28	29	*6*	28	33	*33*	38	34	*-13*	*51*
medium high tech	9	10	*11*	25	23	*-14*	29	32	*18*	37	35	*-4*	*65*
high tech	3	3	*-46*	77	73	*-10*	10	13	*64*	10	11	*8*	*77*
other services	16	15	*-15*	58	62	*12*	4	7	*75*	21	16	*-25*	*14*
high tech services	7	5	*-64*	56	57	*4*	12	16	*69*	25	21	*-18*	*44*
Total	**5**	**5**	***-23***	**59**	**57**	***-6***	**17**	**20**	***34***	**19**	**18**	***-5***	***63***
Size	**D99**	**D01**	**Δ%**	**U99**	**U01**	**Δ%**	**HE99**	**HE01**	**Δ%**	**O99**	**O01**	**Δ%**	**repr.%**
1-49	13	11	*-12*	60	62	*3*	17	19	*8*	10	8	*-17*	*26*
50-249	4	3	*-8*	43	40	*-5*	30	33	*10*	24	23	*-3*	*42*
more than 250	5	4	*-11*	61	59	*-3*	15	18	*19*	19	18	*-5*	*73*
Total	**5**	**5**	***-12***	**59**	**57**	***-3***	**17**	**20**	***17***	**19**	**18**	***-5***	***63***

Notes: D% = share of personnel with a Ph.D degree; U% = share of personnel with a university degree; HE% = share of personnel with a higher education degree; O% = share of personnel with another degree; Δ% = annual growth rate R&D personnel share; repr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

> 2.4 R&D BY TYPE OF ACTIVITY

a) Intra- and extra- mural R&D

As shown in Table 12, the distinction between intra-mural, i.e. in-house R&D and extra-mural, i.e. sub-contracted R&D indicates that with about 77% of total R&D, it is mainly the former activity that contributes to the production of new goods and services. As emphasized by Veugelers and Cassiman (2001), the decision of the innovative firm to produce technology itself (intra-mural R&D) or to source technology externally (extra-mural R&D), remains a complex issue. The theoretical literature, drawing on transaction costs economics and property rights, considers the choice between external sourcing and internal development as substitutes (Coase, 1937, Arrow, 1962). For Geroski (1995), given the occurrence of major transaction costs, external research facilities will generally provide generic rather than specialised inputs into the R&D programmes of their clients.

Table 13 gives the breakdown of extra-mural R&D subcontracted to third parties and geographic origin. Universities and research institutes (together 35%) and companies located in Flanders (37%) appear to be the most important subcontractors with 72% of total subcontracted R&D. It should be noted that for some industry sectors, the figures should be interpreted with caution since the representativeness is too low to allow for firm conclusions.

b) Research and Development

The Process of innovation is complex and it is common to operate a distinct separation of the stages of research and development. In the upstream stage, research can be defined as a planned search and exploration for discovering new knowledge while development is a process of translating research findings and other knowledge into a plan or design for new products, services, and processes or a plan or design for bringing significant improvements on the existing

Table 12 > ***Intra mural and extra-mural R&D expenditures (by sector and by size – 1999+2001)***

NACE-Bel code	Description	expim%	expem%
15 + 16	**food & tobacco**	70	30
17…19	**textiles & wearing**	83	17
20 + 36.1	**wood and furniture**	84	16
21 + 22	**paper & printing**	75	25
23 + 24 (excl. 24.4)	**refineries & chemical products**	88	12
24.4	**pharmaceuticals**	64	36
25	**rubber & plastics**	72	28
27 + 28	**metal and metalic products**	71	29
29 + 31	**machines & equipments (incl. electrical)**	85	15
30 + 32 + 33	**ICT-hardware & instruments**	86	14
34 + 35	**transport**	82	18
45	**construction**	58	42
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	88	12
50 … 64	**material services**	79	21
65 … 74 (excl.64.2 en 72.2)	**immaterial services**	77	23
64.2 + 72.2	**software development**	95	5
TOTAL		**77**	**23**
Size		**expim%**	**expem%**
1-49		77	23
50-249		84	26
more than 250		77	23
TOTAL		**77**	**23**

Notes: expim% (expem%) = share in percent of intra (extra) mural R&D with respect to total R&D.
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 13 > ***Intra mural R&D expenses share by source of subcontractor (by sector and by size – 1999+2001)***

NACE-Bel code	Description	CGF	CGB	CGA	CF	CB	CA	RCF	RCB	RCA	UF	UB	UA	repr.%
15 + 16	food & tobacco	22	0	17	5	0	0	10	0	12	29	1	4	*80*
17…19	textiles & wearing	20	0	0	16	4	12	31	0	7	9	1	0	*60*
20 + 36.1	wood and furniture	40	0	0	18	0	16	9	0	0	17	0	0	*13*
21 + 22	paper & printing	6	0	40	8	0	29	2	1	1	13	0	0	*37*
23 + 2 (excl. 24.4)	refineries & chemical products	10	1	19	5	3	8	9	8	1	34	3	0	*59*
24.4	pharmaceuticals	6	0	0	26	25	29	1	0	6	7	1	0	*4*
25	rubber & plastics	33	0	2	16	0	1	10	0	11	18	0	10	*19*
27 + 28	metal and metalic products	23	0	3	23	1	4	17	1	4	23	1	1	*89*
29 + 31	machines & equipments (incl. electrical)	22	2	6	24	4	10	11	0	1	19	2	0	*31*
30 + 32 + 33	ICT-hardware & instruments	7	0	10	16	5	23	11	0	0	27	0	0	*70*
34 + 35	transport	14	0	13	19	0	41	0	0	0	13	0	0	*66*
4	construction	4	0	0	26	3	5	34	0	3	20	6	0	*15*
1 + 10 + 26 + 36.5+ 37 + 40 + 41	other industries incl. agriculture	22	0	0	16	2	1	18	0	6	26	8	0	*44*
50 … 64	material services	25	0	8	15	8	5	19	7	3	10	0	1	*15*
65 … 74 (excl.64.2 en 72.2)	immaterial services	21	0	7	17	1	15	11	0	1	23	2	1	*35*
64.2 + 72.2	software development	30	0	9	26	2	8	6	0	2	18	0	0	*60*
TOTAL		**20**	**0**	**8**	**17**	**3**	**11**	**14**	**1**	**3**	**21**	**2**	**1**	*46*
Size		**CGF**	**CGB**	**CGA**	**CF**	**CB**	**CA**	**RCF**	**RCB**	**RCA**	**UF**	**UB**	**UA**	**repr.%**
1-49		23	0	6	20	3	6	13	1	2	23	1	1	*34*
50-249		18	0	9	13	3	13	14	3	3	20	3	0	*47*
more than 250		14	1	11	14	1	17	14	1	6	19	2	2	*47*
TOTAL		**20**	**0**	**8**	**17**	**3**	**11**	**14**	**1**	**3**	**21**	**2**	**1**	*46*

Notes: CG(F,B,A) = companies of the group (Flanders, Belgium, Abroad); C(F,B,A) = companies (Flanders, Belgium, Abroad); RC(F,B,A) = collective research centres (Flanders, Belgium, Abroad); U(F,B,A) = Universities (Flanders, Belgium, Abroad); repr.% = representativeness (% of firms' R&D that responded to the question with respect to total R&D). Sources: own calculations, IWT R&D surveys 2000 and 2002.

products. It can be concluded from Table 11 that on average 73% of R&D activities concern the development stage against 27% for research. Compared to these figures, small firms appear to be more involved in research activities while firms in the textile and wearing, paper and printing, rubber and plastics and software development are concentrating more resources on development activities. In terms of the evolution of these activities (Table 15), a shift from research to development, especially in high-tech sectors, can be observed, although figures are not very representative.

c) R&D by type of costs

The breakdown of R&D expenditures by type of costs, i.e. salaries of the R&D personnel, investment costs and working costs is given in Table 16. Again these figures are provided by industry sector and firms' class of size. Not surprisingly, the payment of the researchers' salaries represents with 65% the main component of R&D costs. Investments account for 12% and working expenditures for 24% of these costs. These shares are in lines with the ones observed in other countries[19]. In terms of growth (Table 17), the representativeness is too low to allow for any firm conclusions at the sectoral level. On the whole, physical investments in R&D appear however to have increased to the detriment of the other components.

d) Product and process R&D

Process R&D allows firms to reduce their production costs and therefore to enlarge their price-cost margin. With product R&D, firms are able to charge higher prices by increasing consumer willingness to pay for new or improved products and services. The distribution of R&D between product, process and both product/process activities shows that firms are mainly carrying out research activities aimed at inventing and producing new products (goods and/or services). As can be noted from Table 18, the share of product R&D represents 62%

Table 14 > ***Intra mural R&D expenses by type of activity: Research vs. Development (by sector and by size – 1999+2001)***

NACE-Bel code	Description	R%	D%	repr.%
15 + 16	**food & tobacco**	29	71	*78*
17…19	**textiles & wearing**	22	78	*79*
20 + 36.1	**wood and furniture**	31	69	*50*
21 + 22	**paper & printing**	20	80	*54*
23 + 24 (excl. 24.4)	**refineries & chemical products**	26	74	*98*
24.4	**pharmaceuticals**	27	73	*66*
25	**rubber & plastics**	21	79	*56*
27 + 28	**metal and metalic products**	26	74	*84*
29 + 31	**machines & equipments (incl. electrical)**	25	75	*64*
30 + 32 + 33	**ICT-hardware & instruments**	24	76	*98*
34 + 35	**transport**	26	74	*65*
45	**construction**	42	58	*32*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	30	70	*97*
50 … 64	**material services**	28	72	*35*
65 … 74 (excl.64.2 en 72.2)	**immaterial services**	35	65	*79*
64.2 + 72.2	**software development**	21	79	*88*
TOTAL		**27**	**73**	*84*
Size		**R%**	**D%**	**repr.%**
1-49		29	71	*74*
50-249		26	74	*80*
more than 250		24	76	*85*
TOTAL		**27**	**73**	*84*

Notes: R% = share in percent of research; D% = share in percent of development; repr.% = representativeness (% of firms' R&D that responded to the question with respect to total R&D).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 15 > ***Growth rate of share of intra mural R&D expenses by type of activity (by sector and by size – growth 1999 – 2001)***

Sector	R99%	R01%	Δ%	D99%	D01%	Δ %	repr.%
low tech	36	26	*-32*	64	74	*14*	*24*
medium low tech	25	23	*-7*	75	77	*2*	*40*
medium high tech	24	24	*-2*	76	76	*1*	*46*
high tech	33	18	*-62*	67	82	*21*	*50*
other services	35	51	*39*	65	49	*-29*	*6*
high tech services	25	14	*-60*	75	86	*14*	*49*
Total	**30**	**23**	*-26*	**70**	**77**	*9*	*47*
Size	**R99%**	**R01%**	**Δ%**	**D99%**	**D01%**	**Δ%**	**repr.%**
1-49	32	24	*-26*	68	76	*10*	*20*
50-249	26	22	*-19*	74	78	*6*	*32*
more than 250	29	21	*-33*	71	79	*11*	*49*
Total	**30**	**23**	*-26*	**70**	**77**	*9*	*47*

Notes: R% = share of research R&D; D% = share of development R&D; Δ% = annual growth rate R&D personnel; repr.% = representativeness (% of firms' R&D that responded to the question with respect to total R&D).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 16 > ***Intra mural R&D expenses by type of costs: Wages; Investments vs. other costs (by sector and by size – 1999+2001)***

NACE-Bel code	Description	W%	I%	O%	repr.%
15 + 16	food & tobacco	61	12	27	*90*
17…19	textiles & wearing	54	15	31	*79*
20 + 36.1	wood and furniture	61	8	31	*46*
21 + 22	paper & printing	62	14	25	*54*
23 + 24 (excl. 24.4)	refineries & chemical products	65	11	24	*98*
24.4	pharmaceuticals	53	21	25	*66*
25	rubber & plastics	62	14	24	*59*
27 + 28	metal and metalic products	63	15	22	*83*
29 + 31	machines & equipments (incl. electrical)	67	11	22	*64*
30 + 32 + 33	ICT-hardware & instruments	67	10	23	*99*
34 + 35	transport	67	13	20	*65*
45	construction	56	25	20	*27*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	67	8	25	*56*
50 … 64	material services	63	10	26	*34*
65 … 74 (excl.64.2 en 72.2)	immaterial services	66	11	23	*79*
64.2 + 72.2	software development	73	11	16	*88*
TOTAL		**65**	**12**	**24**	***8***
Size		**W%**	**I%**	**O%**	**repr.%**
1-49		65	13	23	*73*
50-249		67	10	24	*71*
more than 250		63	10	27	*86*
TOTAL		**65**	**12**	**24**	***84***

Notes: W% = share in percent of researchers' wages; I% = share in percent of R&D investments; O% share in percent of other R&D costs (working expenses); repr.% = representativeness (% of firms' R&D that responded to the question with respect to total R&D). Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 17 > ***Intra mural R&D expenses by type of costs (by sector and by size – growth 1999 – 2001)***

Sector	W99%	W01%	Δ%	I99%	I01%	Δ%	O99%	O01%	Δ%	repr.%
low tech	63	56	*-13*	6	20	*123*	31	25	*-23*	*37*
medium low tech	64	57	*-11*	12	25	*74*	24	17	*-33*	*25*
medium high tech	65	62	*-4*	6	14	*82*	29	24	*-19*	*46*
high tech	67	70	*3*	7	9	*21*	25	21	*-18*	*50*
other services	83	77	*-6*	1	6	*192*	17	17	*2*	*5*
high tech services	79	71	*-10*	4	10	*88*	17	19	*8*	*48*
Total	**68**	**64**	***-7***	**6**	**15**	***84***	**26**	**22**	***-17***	***46***
Size	**W99%**	**W01%**	**Δ%**	**I99%**	**I01%**	**Δ%**	**O99%**	**O01%**	**Δ%**	**repr.%**
1-49	69	62	*-10*	7	17	*88*	24	20	*-18*	*20*
50-249	70	68	*-3*	5	11	*75*	24	20	*-18*	*37*
more than 250	62	60	*-4*	6	13	*79*	32	27	*-16*	*48*
Total	**68**	**64**	***-7***	**6**	**15**	***84***	**26**	**22**	***-17***	***46***

Notes: W% = share of R&D personnel wages; I% = share of R&D investments; O% = share of other R&D costs; Δ% = annual growth rate R&D personnel; repr.% = representativeness (% of firms' R&D that responded to the question with respect to total R&D). Sources: own calculations, IWT R&D surveys 2000 and 2002.

against 24% for process oriented R&D and 14% for both activities combined. In terms of growth, process oriented R&D grew by 11% over the period analyzed and product oriented R&D declined by 7% (Table 19).

> 2.5 R&D BY SOURCE OF FUNDING

The lion's share of innovative activities is funded by the firms own financial resources, though public funding, such as subsidies or

Table 18 > **Intra mural R&D expenses by type of activity: Product Process vs. Mix (by sector and by size – 1999+2001)**

NACE-Bel code	Description	prod%	proc%	mix%	repr.%
15 + 16	food & tobacco	61	30	9	*78*
17…19	textiles & wearing	67	22	11	*79*
20 + 36.1	wood and furniture	55	13	32	*50*
21 + 22	paper & printing	45	51	4	*54*
23 + 24 (excl. 24.4)	refineries & chemical products	57	34	9	*98*
24.4	pharmaceuticals	63	13	25	*66*
25	rubber & plastics	64	28	8	*56*
27 + 28	metal and metalic products	59	27	14	*85*
29 + 31	machines & equipments (incl. electrical)	70	19	10	*60*
30 + 32 + 33	ICT-hardware & instruments	76	17	7	*99*
34 + 35	transport	78	20	1	*65*
45	construction	53	30	17	*32*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	52	31	17	*98*
50 … 64	material services	59	25	16	*35*
65 … 74 (excl.64.2 en 72.2)	immaterial services	54	23	23	*79*
64.2 + 72.2	software development	68	17	15	*87*
TOTAL		**62**	**24**	**14**	***85***
Size		**prod%**	**proc%**	**mix%**	**smpl%**
1-49		64	21	15	*74*
50-249		59	27	15	*80*
more than 250		62	31	7	*86*
TOTAL		**62**	**24**	**14**	***85***

Notes: prod% = share in percent of product oriented intra-mural R&D expenditures; proc% = share in percent of process oriented intra-mural R&D expenditures; mix% = share in percent of product/process oriented intra-mural R&D expenditures; repr.% = representativeness (% of firms' R&D that responded to the question with respect to total R&D).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 19 > **Growth rate of intra mural R&D expenses by type of activity (by sector and by size – 1999+2001)**

Sector	PR99	PR01	Δ%	PC99	PC01	Δ%	MX99	MX01	Δ%	repr.%
low tech	66	60	*-11*	27	27	*-1*	7	14	*73*	24
medium low tech	67	64	*-3*	29	23	*-23*	5	13	*100*	38
medium high tech	68	63	*-8*	18	26	*37*	14	12	*-20*	45
high tech	72	73	*2*	20	22	*8*	7	5	*-50*	50
other services	68	62	*-9*	10	16	*44*	22	22	*0*	7
high tech services	73	63	*-14*	10	16	*48*	17	21	*18*	49
Total	**69**	**64**	***-7***	**20**	**23**	***11***	**11**	**13**	***18***	**46**
Size	**PR99**	**PR01**	**Δ%**	**PC99**	**PC01**	**Δ%**	**MX99**	**MX01**	**Δ%**	**repr.%**
1-49	70	65	*-7*	14	21	*44*	16	13	*-19*	21
50-249	66	65	*-2*	28	19	*-40*	6	16	*103*	32
more than 250	70	61	*-13*	26	30	*16*	4	9	*71*	49
Total	**69**	**64**	***-7***	**20**	**23**	***11***	**11**	**13**	***18***	**46**

Notes: PR% = share of product oriented R&D; PC% = share of process oriented R&D; MX% = share of combined product/process R&D; Δ% = annual growth rate R&D personnel; repr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel). Sources: own calculations, IWT R&D surveys 2000 and 2002.

tax incentives, plays an important role in supporting R&D efforts. On the one hand, investments in intangible such as R&D are riskier and more uncertain as compared to investments in physical capital and R&D typically provides less collateral to external investors or banks since they can not make accurate appraisals of the values associated with this type of investment. As a result, firms willing to invest in R&D projects may

encounter credit rationing by potential financiers and be constraint if they do not have enough internal resources to finance their R&D projects. On the other hand, given the imperfect appropriability of the outcomes of innovative activities, firms will invest less in R&D than the socially optimal level. This appropriability problem arises from the non-rival and partially excludable property of the knowledge product. Non rivalry means that the use of an innovation by an economic agent does not preclude others from using it, while partial excludability implies that the owner of an innovation can not impede other to benefit from it free of charge. This market failure has been acknowledged for a long time[20]. The literature on public R&D discusses several ways to compensate for the imperfect functioning of such markets. Public technology procurement, R&D subsidies or tax breaks for instance increase the expected returns of R&D activities by lowering the costs of these activities while R&D collaborations facilitate the exploitation of scale economies in R&D and the internalization of the externalities generated by these activities. More directly, the intellectual property right system with patents, trademarks or copyrights restricts competitors to exploit the knowledge created. Patents for instance are granted as a temporary monopoly right for the innovator while at the same time disclosing technical information in the public domain.

As expected, 88% of R&D is financed by the firms' own resources (Table 20). This share is smaller for smaller firms and firms in the construction sector. Table 22 shows that public authorities, in particular the Flemish government (62%), represent the main source of external financing. Public funding appears to play an even higher role in services sectors.

In terms of growth, the share of externally financed R&D reveals a decline of 15% (Table 21). In terms of the external sources, Table 23 indicates a decrease of 10% of the share of R&D financed by the Flemish government.

Table 20 > ***Intra mural R&D expenses: internal vs. external funding (by sector and by size – 1999+2001)***

NACE-Bel code	Description	internal%	external%	repr.%
15 + 16	**food & tobacco**	94	6	*90*
17…19	**textiles & wearing**	87	13	*79*
20 + 36.1	**wood and furniture**	97	3	*50*
21 + 22	**paper & printing**	93	7	*54*
23 + 24 (excl. 24.4)	**refineries & chemical products**	96	4	*98*
24.4	**pharmaceuticals**	96	4	*66*
25	**rubber & plastics**	96	4	*75*
27 + 28	**metal and metalic products**	92	8	*93*
29 + 31	**machines & equipments (incl. electrical)**	85	15	*65*
30 + 32 + 33	**ICT-hardware & instruments**	87	13	*99*
34 + 35	**transport**	89	11	*65*
45	**construction**	74	26	*32*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	90	10	*58*
50 …64	**material services**	87	13	*35*
65 … 74 (excl.64.2 en 72.2)	**immaterial services**	81	19	*80*
64.2 + 72.2	**software development**	86	14	*88*
TOTAL		**88**	**12**	***85***
Size		**internal%**	**external%**	**repr.%**
1-49		84	16	*75*
50-249		94	6	*73*
more than 250		94	6	*86*
TOTAL		**88**	**12**	***85***

Notes: internal = intra-mural R&D expenditures; external = subcontracted R&D expenditures; repr. = representativeness (% of firms' R&D that responded to the question with respect to total R&D).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

This negative trend is more apparent for smaller firms and firms in the medium low tech and services sectors. Although in absolute amounts the external funding of the Flemish government increased from 15.1 to 17.2 millions euros for the firms that reported on that issue, other sources were still more expansive[21]. The share of R&D financed by the European Union and foreign public authorities rose by 25% over the recent past. These results have to be interpreted with care given the low response rate

Table 21 > ***Growth rate of intra mural R&D expenses by source of funding (by sector and by size – 1999+2001)***

Sector	IF99	IF01	Δ%	EF99	EF02	Δ%	repr.%
low tech	90	93	*4*	10	7	*-39*	*38*
medium low tech	87	97	*12*	13	3	*-164*	*51*
medium high tech	85	92	*8*	15	8	*-63*	*46*
high tech	90	82	*-9*	10	18	*58*	*50*
other services	91	79	*-14*	9	21	*86*	*6*
high tech services	79	79	*1*	21	21	*-4*	*49*
Total	**87**	**88**	***2***	**13**	**12**	***-15***	***48***
Size	**IF99**	**IF01**	**Δ%**	**EF99**	**EF02**	**Δ%**	**repr.%**
1-49	81	84	*4*	19	16	*-20*	*21*
50-249	92	93	*1*	8	7	*-8*	*40*
more than 250	92	92	*0*	8	8	*4*	*50*
Total	**87**	**88**	***2***	**13**	**12**	***-15***	***48***

Notes: IF% = share of R&D internally financed; EF% = share of R&D externally financed; Δ% = annual growth rate R&D personnel; repr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel). Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 22 > ***Intra mural R&D expenses by source of external funding (by sector and by size – 1999+2001)***

NACE-Bel code	Description	GF	GB	GEU	GA	CGF	CGB	CGA	CF	CB	CA	repr.%
15 + 16	**food & tobacco**	65	9	15	0	5	0	6	0	0	0	*49*
17…19	**textiles & wearing**	77	13	4	0	0	0	0	6	0	0	*38*
20 + 36.1	**wood and furniture**	100	0	0	0	0	0	0	0	0	0	*16*
21 + 22	**paper & printing**	100	0	0	0	0	0	0	0	0	0	*0*
23 + 24 (excl. 24.4	**refineries & chemical products**	83	0	1	8	0	0	0	0	3	5	*64*
24.4	**pharmaceuticals**											*0*
25	**rubber & plastics**	70	8	3	3	8	0	8	0	0	0	*45*
27 + 28	**metal and metalic products**	76	6	11	0	5	0	1	1	0	0	*78*
29 + 31	**machines & equipments (incl. electrical)**	69	3	8	0	1	0	6	6	0	7	*16*
30 + 32 + 33	**ICT-hardware & instruments**	57	3	18	2	4	0	4	5	0	6	*98*
34 + 35	**transport**	49	37	0	0	0	0	0	0	0	14	*50*
45	**construction**	80	0	20	0	0	0	0	0	0	0	*30*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	58	14	9	0	2	0	4	6	0	6	*38*
50 … 64	**material services**	75	1	4	1	11	0	0	0	0	8	*13*
65 … 74 (excl.64.2 en 72.2)	**immaterial services**	45	1	14	5	4	2	4	7	6	12	*39*
64.2 + 72.2	**software development**	61	5	6	0	8	0	4	10	1	4	*70*
TOTAL		**64**	**5**	**10**	**2**	**4**	**0**	**3**	**5**	**1**	**6**	***55***
Size		**GF**	**GB**	**GEU**	**GA**	**CGF**	**CGB**	**CGA**	**CF**	**CB**	**CA**	**repr.%**
1-49		62	3	10	2	5	1	3	6	2	6	*41*
50-249		65	10	10	1	0	0	6	2	0	6	*30*
more than 250		70	6	9	2	4	0	3	1	0	5	*58*
TOTAL		**64**	**5**	**10**	**2**	**4**	**0**	**3**	**5**	**1**	**6**	***55***

Notes: G(F,B,EU,A) = Government (Flanders, Belgium, EU, Abroad); CF(F,B,A) = Companies of the group (Flanders, Belgium, Abroad); C(F,B,A) = companies (Flanders, Belgium, Abroad); repr.%= representativeness (% of firms' R&D that responded to the question with respect to total R&D). Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 23 > ***Growth rate of intra mural R&D expenses by source of external funding (by sector and by size – growth 1999 – 2001)***

Sector	GF99	GF01	π%	GB99	GB01	π%	GEU99	GEU01	π%	GA99	GA01	π%	CGF99	CGF01	π%	repr.%
low tech	75	70	-7	5	0		20	30	41	0	0		0	0		
medium low tech	94	83	-12	0	0		0	17	444	0	0		6	0		
medium high tech	80	78	-3	10	6	-51	0	1		0	2		0	3		
high tech	56	51	-8	1	9	190	26	21	-19	0	8		6	0		
other services	42	7	-183	0	0		36	93	95	0	0		0	0		
high tech services	66	62	-6	0	0		9	31	129	4	0		0	0		
Total	**70**	**63**	**-10**	**4**	**3**	**-3**	**14**	**25**	**55**	**1**	**2**	**127**	**2**	**1**	**-120**	
Size	**GF99**	**GF01**	**π%**	**GB99**	**GB01**	**π%**	**GEU99**	**GEU01**	**π%**	**GA99**	**GA01**	**π%**	**CGF99**	**CGF01**	**π %**	
1-49	65	51	-25	0	4		15	34	82	1	4	109	4	1	-120	
50-249	73	85	16	5	0		13	13	-4	0	0		0	0		
more than 250	78	70	-11	9	5	-65	13	17	22	0	1		0	0		
Total	**70**	**63**	**-10**	**4**	**3**	**-3**	**14**	**25**	**55**	**1**	**2**	**127**	**2**	**1**	**-120**	
Sector	**CGB99**	**CGB01**	**π%**	**CGA99**	**CGA01**	**π%**	**CF99**	**CF01**	**π%**	**CB99**	**CB01**	**π%**	**CA99**	**CA01**	**π%**	**repr.%**
low tech	0	0		0	0		0	0		0	0		0	0		23
medium low tech	0	0		0	0		0	0		0	0		0	0		44
medium high tech	0	0		0	2		0	5		0	0		10	3	-120	39
high tech	0	0		0	9		4	1	-146	0	0		6	0		49
other services	0	0		0	0		0	0		0	0		22	0		1
high tech services	0	0		1	3	120	1	3	64	1	0		18	1	-304	10
Total	**0**	**0**		**0**	**3**	**312**	**1**	**2**	**38**	**0**	**0**		**8**	**1**	**-230**	**43**
Size	**CGB99**	**CGB01**	**π%**	**CGA99**	**CGA01**	**π%**	**CF99**	**CF01**	**π%**	**CB99**	**CB01**	**π%**	**CA99**	**CA01**	**π%**	**smpl**
1-49	0	0		0	2	179	0	3	187	0	0		14	1	-234	11
50-249	0	0		0	0		5	2	-92	0	0		5	1	-207	10
more than 250	0	0		0	8		0	0		0	0		0	0		48
Total	**0**	**0**		**0**	**3**	**312**	**1**	**2**	**38**	**0**	**0**		**8**	**1**	**-230**	**43**

Notes: G(F,B,EU,A) = government (Flanders, Belgium, European Union, Abroad); CG(F,B,A) = companies of the group (Flanders, Belgium, Abroad); C(F,B,A) = companies (Flanders, Belgium, Abroad); π% = annual growth rate R&D personnel; repr.%= representativeness (% of firms' R&D that responded to the question with respect to total R&D). Sources: own calculations, IWT R&D surveys 2000 and 2002.

(representativeness of 55%). In this response the average support from the Flemish government accounted for 7.2% of their R&D budgets. But total support of IWT to Flemish firms is about 3% of total R&D expenditures in the private sector.

> 2.6 INTERNATIONALIZATION OF R&D

Another feature of the Flemish Innovation System rests in the high importance of foreign multinational enterprises (MNEs) in R&D activities. In the R&D literature two reasons are often mentioned to explain the delocalization of R&D in MNEs. On the one hand, foreign subsidiaries can be specialised in the adaptation to the local market of products and processes developed in the first place in the headquarters of MNEs. On the other hand, these firms can delocalize their research facilities in a host country to take advantage of the local availability of a highly qualified workforce and knowledge base. According to Granstrand et al. (1992), the reasons for the growing decentralisation and internationalisation of R&D activities can be classified into three main groups of factors: demand-side, supply-side and environmental factors. The demand-side factors include a greater adaptation of products and technologies to local markets, a higher proximity to customers, an increase of competitiveness through the transfer of technology and the pressures of subsidiaries to enhance their status within a corporation. Among the main supply-side factors, the monitoring of the development of technology abroad and the hiring of a foreign and barely mobile highly skilled labour can be mentioned. Finally, the

Table 24 > **Intra mural R&D expenses: share of domestic vs. subsidiary companies (by sector and by size – 1999+2001)**

NACE-Bel code	Description	dom%	subs%	repr.%
15 + 16	food & tobacco	16	84	*51*
17…19	textiles & wearing	57	43	*63*
20 + 36.1	wood and furniture	100	0	*26*
21 + 22	paper & printing	21	79	*44*
23 + 24 (excl. 24.4)	refineries & chemical products	76	24	*69*
24.4	pharmaceuticals	0	100	*95*
25	rubber & plastics	3	97	*48*
27 + 28	metal and metalic products	16	84	*27*
29 + 31	machines & equipments (incl. electrical)	29	71	*17*
30 + 32 + 33	ICT-hardware & instruments	2	98	*88*
34 + 35	transport	14	86	*59*
45	construction	100	0	*25*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	74	26	*16*
50 … 64	material services	100	0	*12*
65 … 74 (excl.64.2 en 72.2)	immaterial services	19	81	*53*
64.2 + 72.2	software development	95	5	*23*
TOTAL		**13**	**87**	*76*
Size		**dom%**	**subs%**	**repr.%**
1-49		79	21	*31*
50-249		28	72	*43*
more than 250		11	89	*81*
TOTAL		**13**	**87**	*76*

Notes: dom% = share of R&D carried out by domestic firms; subs% = share of R&D carried out by subsidiaries of foreign MNEs; repr.%= representativeness (% of firms' R&D that responded to the question with respect to total R&D).
Sources: own calculations, IWT R&D surveys 2000 and 2002.

environmental factors concern the legislation on intellectual property, the provision of R&D incentives by the domestic government, e.g. tax advantages and subsidies for R&D, as well as governmental pressures to improve the subsidiary's capabilities beyond the simple assembly of proven products to innovative activities.

Table 24 reports the share of intra-mural R&D broken down by domestic firms and affiliates of foreign MNEs. On the whole, the latter accounts for nearly 87% of the total R&D figure. It follows that the presence of foreign R&D subsidiaries is the most important in pharmaceuticals, ICT-hardware and instruments and rubber and plastics sectors. The share of these companies in total R&D appears to be also much higher for the largest companies. In terms of R&D intensity, Table 25 indicates that R&D expenditures in percentage of turnover is smaller, especially in the most recent years, for the subsidiaries of foreign MNEs as compared to domestic firms.

> 2.7 R&D COLLABORATIONS

Technological collaborative agreements can be defined as "all alliances aimed at

Table 25 > **R&D intensity of domestic and subsidiary companies – 1998 – 2002e**

domestic vs. subsidiary	RI98	repr.%	RI99	repr.%	Ri00e	repr.%	RI00	repr.%	RI01	repr.%	RI02e	repr.%
domestic	6,78	*46*	6,76	*46*	7,15	*45*	8,49	*25*	8,00	*27*	8,32	*49*
subsidiary	6,38	*54*	6,69	*54*	6,46	*55*	5,92	*75*	5,99	*73*	6,89	*51*
TOTAL	**6,72**	*100*	**6,75**	*100*	**7,04**	*100*	**7,84**	*100*	**7,52**	*100*	**7,97**	*100*

Notes: RI = intra-mural R&D intensity; epr.% = representativeness (% of firms' R&D personnel that responded to the question with respect to total R&D personnel). Sources: own calculations, IWT R&D surveys 2000 and 2002.

developing, enhancing and combining technological capabilities, as well as applying technologies and bringing them to the marketplace" (Hagedoorn and Schakenraad, 1994). According to Dogdson (2001), there are many ways to explain why organisations collaborate in their R&D activities. Economists will put forward cost reduction and efficiencies as reasons. But other reasons do exist. One might consider technological reasons (shorter product-cycle), qualitative issues (organizational learning) or strategic themes (standard creation, competitor exclusion or locking-in key players). Technological collaborations may involve a variety of different partners. They can occur between functional departments and/or subsidiaries within the same firm, between firms and their competitors, between complementary firms such as suppliers, customers, subcontractors and distributors, between private firms and public institutions, or between firms and stakeholders and interest groups (Dunning, 1997). For instance, universities have always been a major knowledge creator in national systems of innovation. Tighter university-industry collaboration is believed to have the potential to enhance the economic impact of the knowledge created in the academia (OECD, 1999).

As can be seen in Table 26[22], among the main partners involved in R&D collaborations with Flemish companies, universities and research centres represent 39%; suppliers account for 23% and clients for 18%. As far as the geographic origin is concerned, Flemish companies appear to collaborate nearly as much with partners located abroad (42%) as in Flanders (45%). Partners located in the Capital and in Wallonia only represent 13% of R&D collaborations. Small firms and firms in the textile and the construction industries collaborate more with local partners, while firms in the food, rubber, pharmaceuticals and immaterial services sectors collaborate more with universities.

Table 26 > ***R&D cooperative agreements (by sector and by size and by type of partners and geographic origin – 1999+2001)***

NACE-Bel code	Description	CLG	OCL	SG	OS	OCG	OC	RC	Uni	Oth	FL	BE	Abr
15 + 16	food & tobacco	7	18	2	13	9	7	16	25	25	41	10	48
17…19	textiles & wearing	7	22	8	27	2	3	18	7	7	60	9	31
20 + 36.1	wood and furniture	4	15	19	33	4	11	4	11	11	44	30	26
21 + 22	paper & printing	3	13	8	30	13	8	13	10	10	28	3	70
23 + 24 (excl. 24.4)	refineries & chemical products	10	22	5	13	10	9	9	19	19	38	9	53
24.4	pharmaceuticals	0	0	0	0	15	23	8	31	31	38	23	38
25	rubber & plastics	7	21	1	18	7	8	14	20	20	37	13	50
27 + 28	metal and metalic products	9	19	7	15	6	12	18	14	14	45	17	38
29 + 31	machines & equipments (incl. electrical)	7	17	6	18	7	9	15	19	19	44	15	41
30 + 32 + 33	ICT-hardware & instruments	14	17	9	17	8	10	10	16	16	42	12	46
34 + 35	transport	6	16	6	34	9	6	3	19	19	38	9	53
45	construction	13	8	10	10	18	3	18	15	15	63	5	33
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	7	11	6	16	17	10	16	16	16	49	18	33
50 … 64	material services	10	17	11	17	8	11	11	14	14	49	12	39
65 … 74 (excl.64.2 en 72.2)	immaterial services	8	21	4	14	5	12	10	21	21	48	15	37
64.2 + 72.2	software development	7	26	0	21	6	16	7	18	18	55	12	33
TOTAL		9	18	6	17	8	10	12	17	17	45	13	42
Size		**CLG**	**OCL**	**SG**	**OS**	**OCG**	**OC**	**RC**	**Uni**	**Oth**	**FL**	**BE**	**Abr**
1-49		7	21	4	14	5	12	14	20	20	52	11	36
50-249		8	18	6	17	10	9	13	15	15	42	14	44
more than 250		11	15	8	16	9	10	12	18	18	41	14	45
TOTAL		9	18	6	17	8	10	12	17	17	45	13	42

Notes: CLG = Customers of the group; OCL = other customers; SG = suppliers of the group; OS = other suppliers; OCG = other companies of the group; OC = other companies; RC = research centres; Uni = universities; Oth. = other partners; FL = Flanders; BE = Brussels Capital and Wallonia; Abr. = abroad.
Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table 27 > **Non R&D innovative activities and types of innovation activity (by sector and by size – 2001)**

NACE-Bel code	Description	macacq	patacq	softacq	innoproc	innoprod
15 + 16	food & tobacco	29	3	24	43	62
17…19	textiles & wearing	43	0	35	42	66
20 + 36.1	wood and furniture	58	0	25	42	58
21 + 22	paper & printing	29	18	29	35	24
23 + 24 (excl. 24.4)	refineries & chemical products	41	18	25	52	62
25	rubber & plastics	52	17	22	48	70
24.4	drugs	25	0	25	25	50
27 + 28	metal and metalic products	46	10	24	44	46
29 + 31	machines & equipments (incl. electrical)	38	14	28	38	76
30 + 32 + 33	ICT-hardware & instruments	51	12	51	48	75
34 + 35	transport	30	0	10	35	50
45	construction	33	7	20	44	19
1 + 10 + 26 + 36.5 + 37 + 40 + 41	other industries incl. agriculture	37	8	24	44	49
50 … 64	material services	30	13	19	37	52
65 … 74 (excl.64.2 en 72.2)	immaterial services	29	19	30	34	47
64.2 + 72.2	software development	22	10	30	31	59
TOTAL		36	12	27	40	56
Size		**macacq**	**patacq**	**softacq**	**innoproc**	**innoprod**
1-49		29	11	23	33	52
50-249		40	10	27	45	61
more than 250		55	17	46	56	63
TOTAL		36	12	27	40	56

Notes: share of firms that acquired machinery and equipment (macacq), patents and licenses (patacq), and/or advanced softwares (softacq) externally developed and that carry out efforts for introducing new processes or technologically improved processes (innoproc) and/or new products or technologically improved products (innoprod) on the market during 2000-2001.
Sources: own calculations, IWT R&D surveys 2000 and 2002.

> 2.8 INNOVATION ACTIVITIES

Traditional indicators of technological change e.g. R&D patents, were originally developed to measure innovative activities in the manufacturing industries. These indicators are mainly concerned with the process of generation and production of new products and processes, and much less with the way they are disseminated within the firm or the industry. Over the past decade, a variety of new STI indicators have been developed. One example is the Community Innovation Survey, which provides data at the firm level on R&D and non-R&D resources, devoted to innovation and on the output of the innovation processes[23]. The R&D survey also contains questions related to non-R&D innovative activities.

Table 27 reports information in regards to the acquisition of new technologies through another channel than R&D during the period 2000-2001[24]. These activities of R&D active firms are broken down into three categories: acquisition of machinery and equipment goods externally developed (36%), acquisition of patents and licenses externally developed (12%), and acquisition of advanced software externally developed (27%). They show an important complementarity of R&D with other activities aimed at acquiring knowledge. Table 27 also shows the share of R&D active companies that carry out efforts for introducing new processes or technologically improved processes (40%) and/or new products or technologically improved products (56%) on the market during 2000-2001. In sectoral terms, these shares vary considerably from one industry to the other and are remarkably higher for larger companies.

> 2.9 CONCLUSION

Based on the last two R&D surveys organized by IWT, this study provides a descriptive analysis of R&D and innovation activities carried out by Flemish firms in the private sector over the period 1998-2002. At the end of the economic boom characterizing the beginning of the new millennium, firms´ investments in R&D increased considerably over this recent period. In 2001, high technology sectors, such as TV, radio and communication equipment, chemicals and pharmaceuticals, account for nearly 62% of total R&D performed in the private enterprise sector. In terms of the 3% objective, the evolution of private R&D expenditures in Flanders, with a yearly growth rate of nearly 13%, is well above the target of an annual growth rate of R&D of about 6%. However, the reported estimated figures of 2002 already indicate a slowdown.

The Flemish S&T landscape is also characterized by a very high concentration of R&D activities among a few large firms. The ten top R&D spenders represent 72% and nearly 77% of total private R&D in 1999 and 2001 respectively. With a share of 43%, researchers are by far the main category of total R&D personnel. However this share has declined over the period investigated. In terms of the level of education, R&D employees holding a university degree represent more than 50% of total R&D human resources. Here as well, this share has declined in the interval 1999-2001. These evolutions suggest some rigidity in the supply of higher level R&D personnel.

The breakdown of R&D investment by type of activity indicates that 77% of total R&D is carried out by the firms themselves. Among the third parties to whom R&D is subcontracted, universities and other companies located in Flanders appear to be key actors. 73% of R&D expenditures are allocated to experimental development and the wages of the R&D personnel with a share of 65% are by far the main component of total R&D costs. Finally, Flemish R&D firms appear to be more involved in product oriented R&D (62% of total R&D expenditures). In terms of sources of funding, R&D activities are mainly financed by the firms (88%). This share remained steady over the recent period. The Flemish government accounts for a large share (65%) of the external funding, though this share declined relatively from 1999 to 2001.

Another feature of the Flemish S&T system rests in the high importance of affiliates of foreign MNEs (87% of total R&D expenditures), especially in pharmaceuticals, ICT-hardware, instruments and chemicals and rubber and plastics. As far as R&D collaborations are concerned, universities or research institutes, suppliers and customers – in that order- are the main partners; and 45% of the total number of R&D collaborations are still with Flemish partners. Besides R&D, other innovation activities such as the purchase of machinery and equipment, patents, licenses or advanced software developed externally are also important. These investments are much higher for larger firms. Large companies put also more effort for introducing new or improved processes and product into the market.

REFERENCES

- Acs Z., D. Audretsch, 1987, "Innovation, Market Structure, and Firm Size", Review of Economics and Statistics, 69, pp. 567-75.
- Arrow K., 1962, "Economic Welfare and the Allocation of Resources for Invention", in R. Nelson (ed.), The Rate and Direction of Inventive Activity, Princeton, pp. 609-626.
- Bond S., D. Harhoff, J. Van Reenen, 1999, "Investment, R&D and Financial Constraints in Britain and Germany", Institute for Fiscal Studies Working Paper #W99/05.
- Capron H. M. Cincera, A. Hollant, W. Meeusen, 1999, "Harmonisation of Belgian Annual Business Expenditures on Research and Development (ANBERD) data - 1973-1996", report for the Belgian Federal Office for Scientific, Technical and Cultural Affairs (OSTC) and OECD, August 1999.
- Capron H., D. Duelz, 2003, "Plus de Recherche pour l'Europe, Objectif : 3% du PIB. Une évaluation de l'effort additionnel belge nécessaire pour la contribution à l'objectif"; Report for the Belgian Federal Science Policy Office, May 2003.
- Cincera M, 2003, "Structure, consistency and validation tests of data in the 2000 and 2002 Flemish R&D surveys", report for IWT, Brussels.
- Coase R.H., 1937, The Nature of the Firm, 4 Economica N.S., pp.386-405.
- Delanghe H., M. Tiri, J. Larosse, D. Carchon, 2003, Innovatie-inspanningen van Vlaamse ondernemingen: een exploratie van de CIS-3-enquête, IWT studies 45.
- Dodgson M., 2001, "Strategic Research Partnerships: Their Role, and Some Issues of Measuring Their Extent and Outcomes Experiences from Europe and Asia", Strategic Research Partnerships: Proceedings from an NSF Workshop, National Science Foundation.
- Dunning J.H., 1997, Alliance Capitalism and Global Business, Routledge Studies in International Business and the World Economy, 400p.
- European Commission, 2003, Investing in research: an action plan for Europe, COM(2003) 226 final/2.
- Geroski P., 1995, "Markets for Technology: Knowledge, Innovation and Approbriability", in P. Stoneman (ed.), Handbook of the Economics of Innovation and Technological Change, Oxford, UK: Blackwell Publishers Ltd, pp. 90-131.
- Granstrand O., L. Hakanson, S. Sjolander, 1992, Technology Management and International Business, Wiley, Chichester.
- Kalenga R., 2004, Methodology for R&D efforts of enterprises in Flanders in R&D activities of the business sector in Flanders: Results of the R&D surveys in the context of the 3% target, IWT-Study 46.
- OECD Secretariat, 1998, "Trends in University/Industry Research Partnerships", STI review, 23.
- OECD, 2003, Science, Technology and Industry Scoreboard, Paris.
- Hagedoorn J., J. Schakenraad, 1994, "The Effect of Strategic Technology Alliances on Company Performance", Strategic Management Journal, 15, pp. 291-309.
- Schumpeter, J.A., (1942), Capitalism, Socialism and Democracy, New York: Harper.
- Symeonidis G., 1996, "Innovation, firm size and market structure - Schumpeterian hypotheses and some new themes", Economics Department working paper 161, OECD.
- Veugelers R., B. Cassiman, 2001, "Complementarity in the Innovation Strategy: Internal R&D, External Technology Acquisition, and Cooperation in R&D", mimeo DTEW, KULeuven

ANNEX

Table A1 > ***Structure of R&D surveys (2000 and 2002)***

		2000						2002						2002			
NACE-Bel code	Description	Perma	%	Pseudo	%	Sample	%	Perma	%	Pseudo	%	Sample	%	Long	%	Short	%
15 + 16	**food & tobacco**	72	*8*	0	*0*	143	*6*	67	*7*	59	*6*	150	*8*	123	*45*	153	*55*
17…19	**textiles & wearing**	56	*6*	5	*6*	189	*8*	57	*6*	62	*7*	120	*6*	119	*50*	120	*50*
20 + 36.1	**wood and furniture**	27	*3*	1	*1*	85	*3*	19	*2*	26	*3*	64	*3*	45	*41*	64	*59*
21 + 22	**paper & printing**	24	*3*	4	*5*	170	*7*	23	*2*	24	*3*	87	*4*	47	*35*	87	*65*
23 + 24 (excl. 24.4)	**refineries & chemical products**	73	*8*	1	*1*	98	*4*	78	*8*	41	*4*	72	*4*	118	*62*	73	*38*
24.4	**pharmaceuticals**	12	*1*	0	*0*	8	*0*	13	*1*	4	*0*	18	*1*	17	*49*	18	*51*
25	**rubber & plastics**	39	*4*	1	*1*	121	*5*	43	*4*	29	*3*	48	*2*	71	*59*	49	*41*
27 + 28	**metal and metalic products**	80	*9*	2	*3*	181	*7*	76	*8*	81	*9*	144	*7*	156	*52*	145	*48*
29 + 31	**machines & equipments (incl. electric.)**	103	*11*	3	*4*	160	*6*	100	*10*	60	*6*	195	*10*	160	*45*	195	*55*
30 + 32 + 33	**ICT-hardware & instruments**	55	*6*	3	*4*	50	*2*	42	*4*	32	*3*	58	*3*	73	*55*	59	*45*
34 + 35	**transport**	23	*3*	23	*30*	104	*4*	29	*3*	27	*3*	51	*3*	55	*51*	52	*49*
45	**construction**	30	*3*	0	*0*	2	*0*	27	*3*	31	*3*	153	*8*	58	*27*	153	*73*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	46	*5*	2	*3*	108	*4*	41	*4*	50	*5*	95	*5*	91	*49*	95	*51*
50 … 64	**material services**	87	*10*	13	*17*	496	*20*	101	*10*	161	*17*	307	*16*	259	*46*	310	*54*
65 … 74 (excl.64.2 en 72.2)	**immaterial services**	121	*13*	14	*18*	419	*17*	187	*19*	206	*22*	237	*12*	390	*62*	240	*38*
64.2 + 72.2	**software development**	64	*7*	5	*6*	167	*7*	61	*6*	53	*6*	169	*9*	114	*40*	169	*60*
TOTAL		**912**	*100*	**77**	*100*	**2501**	*100*	**964**	*100*	**946**	*100*	**1968**	*100*	**1896**	*49*	**1982**	*51*

Notes: Perma = number of firms in the permanent inventory; Pseudo = number of firms in the pseudo inventory; sample = number of firms in the representative sample. Sources: own calculations, IWT R&D surveys 2000 and 2002.

Table A2 > ***NACEBEL nomenclature of economic activities***

01	Agriculture, hunting and related service activities
02	Forestry, logging and related service activities
05	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
10	Mining of coal and lignite; extraction of peat
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excl
12	Mining of uranium and thorium ores
13	Mining of metal ores
14	Other mining and quarrying
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness and footwear
20	Manufacture of wood and of products of wood and cork; except furniture, manufacture of articles of cork
21	Manufacture of pulp, paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastic products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c
30	Manufacture of office machinery and computers
31	Manufacture of electrical machinery and apparatus n.e.c
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c
37	Recycling
40	Electricity, gas, steam and hot water supply
41	Collection, purification and distribution of water
45	Construction
50	Sale, Maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51	Wholesale trade and commission trade, except motor vehicles and motorcycles
52	retail trade, except of motor vehicles and motor cycles; repair of household goods
55	Hotels and restaurants
60	Land transport; transport via pipelines
61	Water transport
62	Air transport
63	Supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications
65	Financial intermediation, except insurance and pension funding
66	Insurance and pension funding, except compulsory social security
67	Activities auxiliary to financial intermediation
70	Real estate activities
71	Renting of machinery and equipment without operator and of personal and household goods
72	Computer and related activities
73	Research and development
74	Other business activities
75	Public administration and defence; compulsory social security

Table A3 > ***Classification of industry sectors according to technological intensity***

	NACEBEL
High-technology industries	
Aircraft and spacecraft	353
Pharmaceuticals	244
Office, accounting and computing machinery	30
Radio, TV and communications equipment	32
Medical, precision and optical instruments	33
Medium-high-technology industries	
Electrical machinery and apparatus, n.e.c.	31
Motor vehicles, trailers and semi-trailers	34
Chemicals excluding pharmaceuticals	24 excl. 244
Railroad equipment and transport equipment, n.e.c.	352 + 359
Machinery and equipment, n.e.c.	29
Medium-low-technology industries	
Building and repairing of ships and boats	351
Rubber and plastics products	25
Coke, refined petroleum products and nuclear fuel	23
Other non-metallic mineral products	26
Basic metals and fabricated metal products	27-28
Low-technology industries	
Manufacturing, n.e.c.; Recycling	36-37
Wood, pulp, paper, paper products, printing and publishing	20-22
Food products, beverages and tobacco	15-16
Textiles, textile products, leather and footwear	17-19
Low& medium technology services	
Wholesale, retail trade, motor vehicle repair,…	50-59
Transport and storage	60-64 excl. 642
Financial intermediation (incl. insurances	65-67
High-technology services	642+722

Sources: OECD (2003)

Table A4 > ***Intrapolated intra mural R&D expenditures by sector – 1998 – 2002e***

NACE-Bel code	Description	expim98	d%	expim99	d%	expim00e	d%	expim00	d%	expim01	d%	expim02e	d%
15 + 16	**food & tobacco**	68234	*3,9*	70696	*3,6*	72290	*3,5*	64543	*2,8*	69300	*2,7*	71078	*2,7*
17-19	**textiles & wearing**	26503	*1,5*	28634	*1,5*	29296	*1,4*	26506	*1,2*	27864	*1,1*	29342	*1,1*
20 + 361	**wood and furniture**	6634	*0,4*	6773	*0,3*	6958	*0,3*	11554	*0,5*	11661	*0,5*	11841	*0,5*
21 + 22	**paper & printing**	8815	*0,5*	9518	*0,5*	10743	*0,5*	9359	*0,4*	9652	*0,4*	10057	*0,4*
23 + 24 (excl. 244)	**refineries & chemical products**	389979	*22,2*	410804	*21,0*	416784	*19,9*	477082	*21,0*	506616	*20,1*	541634	*20,8*
244	**pharmaceuticals**	281070	*16,0*	314469	*16,1*	310502	*14,8*	384377	*16,9*	510321	*20,2*	594095	*22,8*
25	**rubber & plastics**	39646	*2,3*	44129	*2,3*	43485	*2,1*	41029	*1,8*	40634	*1,6*	42121	*1,6*
27 + 28	**metal and metalic products**	76376	*4,3*	85377	*4,4*	84903	*4,1*	103536	*4,6*	113474	*4,5*	110369	*4,2*
29 + 31	**machines & equipments (incl. electri.)**	111452	*6,3*	124045	*6,3*	128054	*6,1*	167525	*7,4*	162573	*6,4*	159783	*6,1*
30 + 32 + 33	**ICT-hardware & instruments**	449556	*25,6*	517621	*26,4*	612070	*29,2*	606898	*26,7*	686673	*27,2*	628073	*24,1*
34 + 35	**transport**	114311	*6,5*	126417	*6,5*	131681	*6,3*	68658	*3,0*	63360	*2,5*	70739	*2,7*
45	**construction**	6929	*0,4*	7167	*0,4*	7118	*0,3*	7441	*0,3*	7767	*0,3*	9626	*0,4*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	32424	*1,8*	36169	*1,8*	33565	*1,6*	55967	*2,5*	52542	*2,1*	51301	*2,0*
50-64	**material services**	14865	*0,8*	16414	*0,8*	17406	*0,8*	34897	*1,5*	39410	*1,6*	44121	*1,7*
65-74 (excl. 642 + 722)	**immaterial services**	96602	*5,5*	108979	*5,6*	119058	*5,7*	161544	*7,1*	164871	*6,5*	175130	*6,7*
642 + 722	**software development**	35745	*2,0*	51507	*2,6*	69654	*3,3*	52571	*2,3*	56564	*2,2*	57060	*2,2*
TOTAL		**1759140**	*100*	**1958718**	*100*	**2093566**	*100*	**2273487**	*100*	**2523281**	*100*	**2606372**	*100*
Size		**expim98**	**d%**	**expim99**	**d%**	**expim00e**	**d%**	**expim00**	**d%**	**expim01**	**d%**	**expim02e**	**d%**
1-49		200565	*11,4*	218674	*11,2*	241523	*11,5*	215641	*9,5*	230600	*9,1*	242794	*9,3*
50-249		209507	*11,9*	222364	*11,4*	232990	*11,1*	301942	*13,3*	305630	*12,1*	322887	*12,4*
more than 250		1349069	*76,7*	1517680	*77,5*	1619053	*77,3*	1755903	*77,2*	1987052	*78,7*	2040691	*78,3*
TOTAL		**1759140**	*100*	**1958718**	*100*	**2093566**	*100,0*	**2273487**	*100*	**2523281**	*100*	**2606372**	*100*

Notes: expim = intra-mural R&D expenditure; d% = distribution in percentage of total R&D across industry sectors; e = provisional data.
Sources: OSTC and own calculations, IWT R&D surveys 2000 and 2002.

Table A5 > ***Intra mural R&D expenses by sector and by size – 1998 – 2002e***

NACE-Bel code	Description	expim98	d%	expim99	d%	expim00e	d%	expim00	d%	expim01	d%	expim02e	d%
15 + 16	**food & tobacco**	23496	*2,5*	24249	*2,2*	40951	*3,3*	36688	*2,4*	41803	*2,4*	41129	*2,8*
17…19	**textiles & wearing**	8939	*0,9*	9986	*0,9*	8926	*0,7*	10281	*0,7*	11011	*0,6*	11796	*0,8*
20 + 36.1	**wood and furniture**	778	*0,1*	1079	*0,1*	1311	*0,1*	814	*0,1*	825	*0,0*	1063	*0,1*
21 + 22	**paper & printing**	3716	*0,4*	4290	*0,4*	5283	*0,4*	1826	*0,1*	2271	*0,1*	2556	*0,2*
23 + 24 (excl. 24.4)	**refineries & chemical products**	112737	*11,9*	123425	*11,1*	124909	*10,2*	258494	*16,9*	274531	*15,5*	300294	*20,3*
24.4	**pharmaceuticals**	259255	*27,4*	290482	*26,2*	285180	*23,2*	360166	*23,5*	486954	*27,5*	566469	*38,3*
25	**rubber & plastics**	19435	*2,1*	23933	*2,2*	22683	*1,8*	12126	*0,8*	12625	*0,7*	14132	*1,0*
27 + 28	**metal and metalic products**	9865	*1,0*	18349	*1,7*	12809	*1,0*	72147	*4,7*	79290	*4,5*	68046	*4,6*
29 + 31	**machines & equipments (incl. electric.)**	41466	*4,4*	54865	*4,9*	48772	*4,0*	50416	*3,3*	58375	*3,3*	50961	*3,4*
30 + 32 + 33	**ICT-hardware & instruments**	375021	*39,6*	434508	*39,2*	523121	*42,6*	556418	*36,4*	635742	*35,9*	276552	*18,7*
34 + 35	**transport**	20887	*2,2*	29295	*2,6*	33318	*2,7*	16369	*1,1*	11143	*0,6*	8631	*0,6*
45	**construction**	3666	*0,4*	3206	*0,3*	4361	*0,4*	1988	*0,1*	1866	*0,1*	1691	*0,1*
1 + 10 + 26 + 36.5 + 37 + 40 + 41	**other industries incl. agriculture**	12090	*1,3*	14763	*1,3*	14330	*1,2*	59303	*3,9*	52945	*3,0*	27499	*1,9*
50 … 64	**material services**	6747	*0,7*	7241	*0,7*	7938	*0,6*	8470	*0,6*	10276	*0,6*	10313	*0,7*
65 … 74 (excl.64.2 en 72.2)	**immaterial services**	26489	*2,8*	34276	*3,1*	41309	*3,4*	68163	*4,5*	75233	*4,2*	75272	*5,1*
64.2 + 72.2	**software development**	21371	*2,3*	35656	*3,2*	52403	*4,3*	16025	*1,0*	18228	*1,0*	23416	*1,6*
TOTAL		**945958**	*100*	**1109604**	*100*	**1227603**	*100*	**1529694**	*100*	**1773118**	*100*	**1479821**	*100*
Size		**expim98**	**d%**	**expim99**	**d%**	**expim00e**	**d%**	**expim00**	**d%**	**expim01**	**d%**	**expim02e**	**d%**
1-49		45882	*4,9*	55301	*5,0*	84072	*6,8*	60733	*4,0*	74180	*4,2*	87341	*5,9*
50-249		57191	*6,0*	70140	*6,3*	81440	*6,6*	168801	*11,0*	171703	*9,7*	147913	*10,0*
more than 250		842886	*89,1*	984162	*88,7*	1062091	*86,5*	1300160	*85,0*	1527235	*86,1*	1244567	*84,1*
TOTAL		**945958**	*100*	**1109604**	*100*	**1227603**	*100*	**1529694**	*100*	**1773118**	*100*	**1479821**	*100*

Notes: expim = intra-mural R&D expenditure; d% = distribution in percentage of total R&D across industry sectors; e = provisional data.
Sources: OSTC and own calculations, IWT R&D surveys 2000 and 2002.

Chapter 3

TOTAL R&D INTENSITY IN FLANDERS 1993-2001[25]

Reinhilde Veugelers

> 3.1. INTRODUCTION

In March 2000 at the European Summit in Lisbon, the European Leaders have made it their goal to make Europe the world's most "competitive, knowledge-based economy" by end 2010. Stimulating R&D and innovation plays a central role in realising the Lisbon objective. Two years later, in March 2002, at the Barcelona summit, the goal was to increase R&D expenditures in the EU to 3% of the GDP by 2010. Furthermore, as an additional goal, one third of the R&D expenses was to be financed by the government.

In this context Flanders has translated these European objectives by means of the Innovation Pact, in which it fully supports the Barcelona target. This Innovation Pact, signed in March 2003, consists of a formal commitment of all parties involved in innovation in Flanders (companies, universities and research organisations) to realize the 3% goal and attain it by cooperating and making complementary efforts. For Flanders, implementing the 3% norm and the 1/3-2/3 ratio for public-private financing implies that statistical data about R&D in Flanders ought to be available. This policy document is intended to collect relevant available statistical information in order to map the most recent status of R&D expenditures in Flanders[26].

The R&D statistics are based upon retrospective surveys in organisations that have performed R&D activities in Flanders. For this exercise we have tried to stay as close as possible to the international standards[27] and their national implementations. Concertation Group CFS-STAT is the body that makes methodological agreements on R&D in Belgium. This policy document is based upon these agreements and upon statistical data, validated by this group.

The period of analysis is 1993-2001, the 2002 data being an estimate[28]. 1993 is the first year in which the data were collected according to the current methods. This document contains the processed data from the biannual R&D surveys of 2000-2002 and is therefore an actualisation of the previous Steunpunt policy document, published in the Flemish Indicator Book 2003, which only contains the data until 2000. Before giving the data, we will briefly describe the methodology used.

> 3.2 THE R&D INDICATORS USED

In the internationally used terminology, **the Gross Domestic Expenditures on R&D (GERD)** are the gross domestic expenditures for R&D activities in the analysed territory over a period of twelve months. This includes: R&D activities performed in the analysed territory, financed by sources outside this territory, but not the payments of foreign residents for R&D activities outside the territory. In other words, this only comprises intramural expenditures.

The gross domestic expenditures on R&D or GERD are mainly analysed based on two concepts:

- **GERD per implementation sector**, in which expenditures are identified according to the location of the activity (who does R&D?):
  - Companies: **BERD: Business Expenditures** on R&D (enterprises as well as collective research institutions)
  - Government: **GOVERD: Government Expenditures on R&D**
  - Higher Education: **HERD: Higher Education Expenditures on R&D** (universities as well as research institutions connected to universities[29], and colleges)
  - Non-profit institutions: **PNP: Not for Profit Organisations Expenditures on R&D** (semi-public as well as private organisations and international organisations)

These are R&D activities performed within the statistical unit. By destination, only the intramural expenditures are taken into account, irrespective of where the means are coming from.

- **GERD per source of funding**, the expenses being identified according to the origins of the funds (who is financing R&D?):
  - companies,
  - government,
  - non-profit institutions,
  - higher education
  - abroad.

Table 1 > ***Total intramural R&D expenditures in the Flemish region. In millions of EUR, current prices***

	1993	94	95	96	97	98	99	2000	2001
BERD	1347	1409	1460	1604	1798	1941	2138	2524	2818
HERDreg°	311	331	344	367	400	438	477	484	525
GOVERD°°	96	104	109	146	160	192	220	234	250
PNP	29	32	31	32	32	32	33	34	35
GERDreg	1783	1876	1944	2149	2390	2603	2868	3276	3628

Source: Own calculations based upon the Commissie Federale Samenwerking, CFS/STAT, October 2003

Table 2 > ***Total intramural R&D expenditures in the Flemish community. In millions of EUR, current prices***

	1993	94	95	96	97	98	99	2000	2001
BERD	**1347**	**1409**	**1460**	**1604**	**1798**	**1941**	**2138**	**2524**	**2818**
HERDcom°	**362**	**384**	**402**	**412**	**469**	**501**	**533**	**552**	**589**
GOVERD°°	**96**	**104**	**109**	**146**	**160**	**192**	**220**	**234**	**250**
PNP	**29**	**32**	**31**	**32**	**32**	**32**	**33**	**34**	**35**
GERDcom	**1834**	**1929**	**2002**	**2194**	**2459**	**2666**	**2924**	**3344**	**3692**

Source: Commissie Federale Samenwerking, Overleggroep CFS/STAT, October 2003
Note (table 1 and 2):
° The difference between the regional and community data for HERD are the institutions situated in the Brussels Capital Region: VUB, KUB, Erasmus, EHSAL and College for Science and Art; and University Institute for Judaism; These institutions have not been included in the HERDregion, but they have been included in the HERDcommunity;
°° For the period 1993-2002, the institutions IMEC and VIB are calculated with GOVERD and not with HERD, as was the case in the past.

Table 3 > ***Total intramural R&D expenditures in the Flemish community In millions of EUR, current prices***

	1993	94	95	96	97	98	99	2000	2001
GERDreg	**1843**	**1900**	**1944**	**2124**	**2333**	**2499**	**2716**	**3064**	**3327**
GERDcom	**1896**	**1953**	**2002**	**2169**	**2400**	**2559**	**2769**	**3127**	**3386**

Source: Own calculations based upon the Commissie Federale Samenwerking, CFS/STAT, October 2003

Table 4 > ***Gross Domestic Product in the Flemish Region in current prices in millions of EUR***

	1993	94	95	96	97	98	99	2000	2001
GDPR	**103686**	**109426**	**114646**	**117052**	**123691**	**127541**	**134183**	**141510**	**145732**

Source: APS website, October 2003

Table 5 > ***Total intramural expenditures on R&D as % of the GDPR in Flanders, current prices***

	1993	94	95	96	97	98	99	2000	2001
%GERDreg/GDPR	*1,72*	*1,71*	*1,69*	*1,84*	*1,93*	*2,04*	*2,14*	*2,32*	*2,49*
%GERDcom/GDPR	*1,77*	*1,76*	*1,75*	*1,87*	*1,99*	*2,09*	*2,18*	*2,36*	*2,53*

Source: Own calculations based upon the Commissie Federale Samenwerking, CFS/STAT, October 2003
Note (table 5) : When the total R&D expenditures are expressed as a % of the GDP, the resulting percentages provide us with figures that can be interpreted in constant prices, at least if we assume that the numerator and the denominator are subject to the same deflator. This is the most frequently used international procedure. When we deflate the R&D with the specific MSTI deflator (see above), which is not specific for Flanders, and the GDP with its own specific and Flemish deflator, we obtain the following figures:

Constant prices 95	1993	94	95	96	97	98	99	2000	2001
%GERDreg/GDPR	*1,72*	*1,71*	*1,69*	*1,84*	*1,94*	*2,04*	*2,14*	*2,32*	*2,50*
%GERDcom/GDPR	*1,77*	*1,76*	*1,75*	*1,88*	*1,99*	*2,09*	*2,19*	*2,37*	*2,54*

Source: Own calculations based upon the Commissie Federale Samenwerking, CFS/STAT, October 2003.

The joint efforts of all sectors make up the total gross R&D expenditures for a certain geographical area. These are the

GERD: Gross Expenditures on R&D:
GERD= BERD + GOVERD + HERD + PNP

To facilitate international comparisons, the GERD is expressed as a percentage of the Gross Domestic Product (GDP). This indicator measures the R&D intensity, adjusting for the size of the territory. The "3% norm" deals with the GERD as % of the GDP. When applying these international definitions within Belgium for the Flanders region, CFS-STAT has agreed upon using the following procedure: the allocation is done through geographical location of the responding unit.

When applying this to Flanders, we need to take into account the specific Belgian federal state structure, distinguishing regional from community matters. For the BERD, GOVERD, PNP, BBP, the Flemish Region is used as territory unit.

The HERD, the expenditures in higher education, however, are part of the community.
The Flemish Community's political position is to add R&D activities of the Flemish community institutions located in the Brussels Capital Region to the Flemish figures, for the approach per source of funding (public means in particular) as well as for the implementation of research. This policy document includes the HERD for the Flemish Community as well as those for the Flemish Region. The Community approach follows the Flemish Government's political position, the Regional approach is the internationally used procedure to apply all GERD and GDP components to the same unit, in this case the region. The difference between these approaches, being the expenditures in Flemish institutions from higher education located in the Brussels Capital region, provides a small difference for the total GERD figures[30].

> 3.3 GERD PER ACTIVITY SECTOR FOR FLANDERS 1993-2001

For the analysed period, 1993-2001, we will indicate the different components of the total R&D expenditures for Flanders: BERD, HERD, GOVERD and PNP. The **total R&D expenditures in Flanders (GERD)** can be calculated as the sum of BERD, HERD, GOVERD and PNP. Because of the two approaches for HERD, according to region or community, there are also two approaches for GERD: respectively GERDreg and GERDcom (table 1 and 2).

The results show that the expenditures in companies represent the majority of the total R&D expenditures: in 2001 76% of R&D expenditures was spent in companies. This percentage does not fluctuate a lot over the years: Universities are the second largest source of R&D with 14.5% of the total GERD at regional level in 2001 (16% at community level).

When comparing them over time, the data should be expressed in constant prices, in order to identify real trends (also see WTI-Indicator Book, 2003). The deflator used within CFS-STAT to recalculate R&D expenditures in constant prices is the OECD MSTI deflator, specifically designed for R&D expenditures. (Source: DWTC, 2003)[31] (table 3)

These data are slightly different from the data reported in the Indicator Book 2003, although the underlying data in current prices are identical, but because a more recent version of the MSTI deflator was used.

> 3.4 R&D INTENSITY: GERD AS % OF GDPR FOR FLANDERS 1993-2001

If we express the total expenditures on R&D (GERD) as a % of the GDPR for 2001, we will obtain a percentage of 2.48% for the GERD at regional level and 2.52% for the GERD at community level. We can observe a substantial increase, especially in the data from the latest survey 2000-2001.

If we confront these figures with the 3% goal, we can see that an extra effort will be necessary, in spite of the increase that we have observed since 1996 (table 4 and 5).

In comparison, the table below indicates the relationship between R&D expenditures

and the GDP for Belgium and some relevant other European countries, the US and Japan for 1993 and 2000/2002. In order to compare Flanders on an international level, the regional data have to be used: 1.71 in 1993 and 2.47 in 2001. This shows that, if Flanders was still far behind on most other countries in 1993, it has improved a lot and in 2001 Flanders even scored better than the rest of Belgium and the EU 15. However, the US and Japan are still way ahead. (table 6)

> 3.5 TOTAL R&D EXPENDITURES PER SECTOR OF FUNDING

An important dimension of the total expenditures on R&D is the source of funding. More specifically, it is important to investigate which part of the GERD is funded by the public or the private sectors. This distinction is also part of the Barcelona goal, in which the R&D efforts have to be divided according to the 1/3-2/3 ratio over the public and the private sectors. This requires of course an insight into the status of this division.
For the 2001 GERD in Flanders in current prices, the tables below are based upon the following calculations:

- For the R&D part performed in enterprises, **BERD**, the division according to source of funding, as reported in the R&D surveys, is 91.1%: enterprises, 4.4%: government, 4.5%: abroad. This foreign funding is 49% private, 51% public[32]. This is a total of 93.3% private, 6.7% public.

- The R&D expenditures of Flemish universities HERD can be divided according to the source of funding, as reported in the R&D surveys. (table 7)

  The allocation of foreign monetary flows into public and private origins is not available directly from the surveys. We calculate the division between public and private only based upon non-foreign sources of funding. According to the CFS-STAT agreements, the own means of the HERD, GOVERD and PNP are considered to be public means:

For 2001, the total division of GERD at Flemish regional level into private and public funding gives us a division of 77% for private funding against 23% public funding. (table 9)

0.77 = (0.933 * 2818 + 0.196 * 525 + 0.235 * 250 + 0.058*35) / 3628

0.23 = (0.067 * 2818 + 0.804 * 525 + 0.765 * 250 + 0.942 * 35) / 3628

The total division of GERD at Flemish community level instead of Flemish regional level into private and public funding for 2001 gives us a division of 76% for private funding against 24% for public funding. (table 10)

0.76 = (0.933 * 2818 + 0.182 * 589 + 0.235 * 250 + 0.058 * 35) / 3692

0.24 = (0.067 * 2818 + 0.864 * 589 + 0.843 * 250 + 0.485 * 35) / 3692

> 3.6 CONCLUSION

Partly thanks to an increase observed since 1996 and especially during the most recent period, Flanders is doing well in terms of total R&D expenditures as % of the GDPR. For 2001 we obtain a percentage of 2.47% according to the regional approach, 2.51% for the community approach. In comparison to the EU, Flanders is well above average, but it is still far from 3%, which is the Barcelona goal for 2010.

Most of the R&D expenditures are located in companies. Enterprises finance most of R&D in Flanders, 76% to 77%, depending on which approach is used. With 1.9% (GERDprivate/GDPR), it is close to the 2% goal. With 0.57% to 0.61%, depending on which approach is used, the government is further away from its 1% goal.

Table 6 > **R&D intensities for Belgium and the principal trading partners and free trade zones – in % in 1993 and 2001**

	1993	2001
Belgium	1,70	2,17
France	2,40	2,18
Germany	2,35	2,50
The Netherlands	1,93	1,94
UK	2,05	1,90
Japan	2,82	3,09
US	2,52	2,72
EU-15	1,87	1,89

Source: BRISTI: Belgium: CFS-STAT (2003); Other countries: OECD (2003); Calculations POD Wetenschapsbeleid
Note : The data refer to 2000 for France, the Netherlands, the United States and the European Union; 2001 for Belgium, the United Kingdom and Japan; and 2002 for Germany.

Table 7 > **HERD, GOVERD and PNP : Source of funding, 2001**

	Own Means	Enterprises	Government + Intermediary+ PNP + Higher Education	Abroad
HERDreg	2.8%	18.9%	74.7%	3.6%
HERDcom	2.6%	17.5%	76.1%	3.9%
GOVERD	8.6%	17.1%	47.0%	27.3%
PNP	3.4%	5.8%	90.8%	0.0%

Source: Own calculations based upon CFS-STAT, October 2003

Table 8 > **HERD, GOVERD and PNP: Private vs Public Funding, 2001**

	Private	Public
HERDreg	19.6%	80.4%
HERDcom	18.2%	81.8%
GOVERD	23.5%	76.5%
PNP	5.8%	94.2%

Source: Own calculations based upon CFS-STAT, October 2003

Table 9 > **GERD Region: Private vs Public Funding, 2001**

2001	GERD		% GERD/GDPR
Private funding	2793	77%	1.92
Public funding	835	23%	0.57
TOTAL	3628	100%	2.49

Source: Own calculations based upon CFS-STAT, October 2003

Table 10 > **GERD Community: Private vs Public Funding, 2001**

2001	GERD		% GERD/GDPR
Private funding	2797	76%	1.92
Public funding	895	24%	0.61
TOTAL	3692	100%	2.53

Source: Own calculations based upon CFS-STAT, October 2003

QUESTIONARY / VRAGENLIJST

ONDERZOEK & ONTWIKKELING IN DE ONDERNEMINGEN IN VLAANDEREN 2002

OFFICIËLE O&O-ENQUÊTE OVER DE PERIODE 2000-2001

DOEL VAN DEZE ENQUÊTE

De informatie die u verschaft is essentieel voor de samenstelling van de officiële O&O-statistieken van overheden in België en internationale organisaties (Europese Commissie, OESO). In het bijzonder kunnen de Vlaamse Minister van Innovatie en het IWT het Vlaams beleid voor O&O en innovatie beter afstemmen op de reële evoluties.
Ook wetenschappelijk onderzoek en marktonderzoek maken gebruik van de overzichten die door deze enquête worden geproduceerd.

AUTORITEIT

Het IWT organiseert deze enquête in uitvoering van een Samenwerkingsakkoord van 16 juli 1993 tussen de Belgische overheden betreffende de verzameling van gegevens voor O&O. Het IWT is belast door de Vlaamse Minister van Financiën en Begroting, Innovatie, Media en Ruimtelijke Ordening, Dirk Van Mechelen, met de verzameling van gegevens bij de Vlaamse bedrijven.

CONFIDENTIALITEIT

Het IWT verbindt er zich toe om geen statistieken te verspreiden waaruit individuele informatie kan afgeleid worden zonder toestemming van de betrokken bedrijven.
Om duplicatie van kosten en administratieve belasting van de ondernemingen te voorkomen kunnen de bedrijfsdata wel overgemaakt worden aan andere betrokken overheden die zich eveneens garant stellen voor de niet-verspreiding naar het publiek.

Instituut voor de Aanmoediging van Innovatie
door Wetenschap en Technologie in Vlaanderen

INLEIDING

Deze enquête onderzoekt de inspanningen voor Onderzoek en Ontwikkeling (O&O) in de sector van de ondernemingen. De gevraagde gegevens hebben betrekking op de boekjaren 2000 en 2001.

De enquête richt zich tot alle soorten bedrijven, groot of klein, actief in de verwerkende nijverheid of in de dienstensector, met de bedoeling de O&O-activiteit te meten en dit op een betrouwbare en vergelijkbare wijze. Met het oog op internationale vergelijkingen maken we gebruik van de definities die door de OESO (Organisatie voor Economische Samenwerking en Ontwikkeling) zijn uitgewerkt in de Frascati-handleiding. In de vragenlijst zelf zal u telkens de nodige verwijzingen vinden naar de definities die nodig zijn voor een correcte invulling van de betreffende vragen.

Gelieve er op te letten enkel te rapporteren voor activiteiten van uw onderneming op het Belgisch grondgebied. Waar er sprake is van "Gewesten" wordt bedoeld: het grondgebied van respectievelijk Vlaanderen, Wallonië en het Brussels Hoofdstedelijk Gewest.

Gelieve bij het invullen van de enquête relaties met andere "vestigingen" binnen de onderneming niet te verwarren met relaties met andere (dochter)ondernemingen binnen de groep.

INHOUD VAN DE VRAGENLIJST

Deze vragenlijst bevat twee modules en bijlagen.

MODULE 1: WIE BENT U?

Deze module vraagt naar de essentiële administratieve en bedrijfseconomische kenmerken van uw onderneming. Alle respondenten worden gevraagd om dit deel te beantwoorden, ongeacht of zij aan O&O doen of niet

MODULE 2: UW O&O-INSPANNINGEN

Deze module is bedoeld voor het meten van de O&O-activiteiten (uitgaven en personeel). Tevens zijn enkele vragen opgenomen om het O&O-profiel van uw onderneming beter te bepalen. Van belang zijn ook de vragen naar de O&O-inspanningen binnen uw groep indien van toepassing.
Ondernemingen die geen eigen O&O-activiteiten hebben hoeven in deze module slechts enkele vragen in te vullen.

ELEKTRONISCH VRAGENFORMULIER

Wij ontvangen graag uw ingevuld formulier via de voorziene terugstuurenveloppe, maar u kunt ook gebruik maken van het elektronisch invulformulier dat toegankelijk is op een gepersonaliseerde en beveiligde web-pagina via **WWW.IWT.BE/O&O2002 (zie brief voor uw paswoord)**
Deze wijze van communicatie biedt verschillende voordelen voor beide partijen en draagt dus onze voorkeur weg. U wordt beter geassisteerd bij het beantwoorden (via documentatie, routing). De data worden rechtstreeks opgenomen in een databank zodat er geen overnamefouten kunnen gebeuren. Bovendien vindt u ook een aantal velden vooringevuld wanneer we reeds over deze informatie beschikken.

BIJKOMENDE INFORMATIE OF VRAGEN?

Contacteer Jan Larosse, Wetenschappelijk Adviseur IWT-Observatorium

Telefoon: 02/2090981 - Fax: 02/2231181 - E-mail: jl@iwt.be

MODULE 1: WIE BENT U?

A. ADMINISTRATIEVE GEGEVENS

Om het invullen te vergemakkelijken kunt u uit de informatiefiche, op de achterkant van de uitnodigingsbrief, de gegevens overnemen die reeds uit andere bronnen bekend zijn. Gelieve te controleren of uw informatie steeds betrekking heeft op de onderneming met het **BTW-nummer** dat u invult in 1.4.

1. ALGEMENE INLICHTINGEN OVER DE ONDERNEMING

Indien de informatie op de omslag niet (meer) correct is, gelieve ze dan hier te corrigeren.

1.1. Verantwoordelijke persoon Dhr ◯ Mevr ◯
Naam en Voornaam:

.....

Functie:

.....

1.2. Officiële naam van de onderneming:

.....

1.3. Acroniem of handelsnaam:

.....

1.4. B.T.W. nummer:

␣␣␣.␣␣␣.␣␣␣

1.5 Adres:
Straat:

.....

Postcode:
␣␣␣␣

Plaats:

.....

1.6. Telefoon:
␣␣␣␣␣␣␣␣␣␣

1.8. E-mail:

.....

1.7. Fax:
␣␣␣␣␣␣␣␣␣␣

1.9. Internetadres:

.....

2. PERSOON DIE DE ENQUÊTE HEEFT INGEVULD

2.1. Dhr ◯ Mevr ◯

Naam en Voornaam:

.....

2.2. Telefoon:
␣␣␣␣␣␣␣␣␣␣

2.3. E-mail:

.....

2.4. Functie:

.....

2.5. Afdeling:

.....

B. ECONOMISCHE GEGEVENS

3. PERIODE BOEKJAAR

Om het invullen voor U zoveel mogelijk te vereenvoudigen, vragen wij U de gegevens voor de boekjaren 2000 en 2001 te geven. Zodoende kunt u voor een deel van de gevraagde informatie volledig terugvallen op uw boekhouding.

3.1. Lopen de boekjaren 2000, 2001 en 2002 over de periode van 1 januari tot 31 december?
JA ◯ NEEN ◯

3.2. Zo NEEN, gelieve de boekjaarperiodes van uw onderneming te vermelden.

Boekjaar 2000 : van ☐☐.☐☐.☐☐ tot ☐☐.☐☐.☐☐

Boekjaar 2001 : van ☐☐.☐☐.☐☐ tot ☐☐.☐☐.☐☐

Boekjaar 2002 : van ☐☐.☐☐.☐☐ tot ☐☐.☐☐.☐☐

4. BELANGRIJKE VERANDERINGEN

Hebben volgende belangrijke veranderingen plaatsgevonden in uw onderneming tussen begin 2000 en einde 2001? Zo JA, gelieve de betreffende ondernemingen te vermelden.

4.1. Fusie met een andere onderneming (of een deel van) een andere onderneming
JA ◯ NEEN ◯

4.2. Splitsing in verscheidene ondernemingen
JA ◯ NEEN ◯

4.3. Sluiting van een deel van de onderneming
JA ◯ NEEN ◯

---

5. PERSONEEL

5.1. Gemiddeld aantal personeelsleden

	Fysieke eenheden	**Voltijdse eenheden**
Boekjaar 2000:	☐☐☐☐☐☐☐	☐☐☐☐☐☐☐
Boekjaar 2001:	☐☐☐☐☐☐☐	☐☐☐☐☐☐☐
Vooruitzicht 2002:	☐☐☐☐☐☐☐	☐☐☐☐☐☐☐

De voltijdse eenheid (VTE) kan met een manjaar worden vergeleken. Bijvoorbeeld, een fysieke persoon die 2,5 dagen per week werkt vertegenwoordigt 0,5 VTE.

5.2. Welk percentage van uw personeelsleden (in 2001) heeft een hogere opleiding genoten (universiteit of hoger onderwijs van het lange type)?

☐☐☐ %

6. OMZET

6.1. Totale omzet (in duizenden euro)

Boekjaar 2000: ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊0⌋⌊0⌋⌊0⌋

Boekjaar 2001: ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊0⌋⌊0⌋⌊0⌋

Vooruitzicht 2002: ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊0⌋⌊0⌋⌊0⌋

6.2. Wat was de verdeling van de omzet in boekjaar 2001 ?

België	EXPORT binnen EU	EXPORT buiten EU	Totaal
⌊_⌋⌊_⌋⌊_⌋%	⌊_⌋⌊_⌋⌊_⌋%	⌊_⌋⌊_⌋⌊_⌋%	⌊1⌋⌊0⌋⌊0⌋%

7. BEDRIJFSACTIVITEIT

7.1. Wat is de economische hoofdactiviteit van uw onderneming?

Geef uw keuze (cfr. annex 1): ⌊_⌋⌊_⌋⌊_⌋

Beschrijf nauwkeurig deze activiteit:

.....

.....

.....

8. AANDEELHOUDERSSTRUCTUUR

8.1. Maakte de onderneming deel uit van een groep tussen begin 2000 en einde 2001?

JA ○ NEEN ○

Een groep is een operationele eenheid samengesteld uit individuele bedrijven met elk hun rechtspersoonlijkheid die een gemeenschappelijke controlerende aandeelhouder hebben.

Zo JA, wat was de positie van uw onderneming in de groep?

Moederbedrijf ○ Filiaal ○

8.2. In welk land ligt de thuisbasis van de controlerende aandeelhouder? Vul in.

België ○

Buitenland ○ Specificeer: .....

8.3. Is uw onderneming een KMO volgens onderstaande voorwaarden (Europese definitie)?

Een bedrijf is een KMO indien het tegelijkertijd aan de drie volgende voorwaarden voldoet:

1. het bedrijf telt minder dan 250 werknemers;

2. de omzet bedraagt maximum 40 miljoen euro of het jaarlijkse balanstotaal bedraagt maximum 27 miljoen euro en;

3. maximum 25 % van het kapitaal is in het bezit van een of meerdere bedrijven die volgens de hier gegeven criteria zelf geen KMO zijn.

JA ○ NEEN ○

MODULE 2: UW O&O-INSPANNINGEN

Onderzoek en experimentele ontwikkeling (O&O) omvatten al het creatieve werk dat door de onderneming op systematische manier ondernomen wordt met het oog op de UITBREIDING VAN DE KENNIS (ONDERZOEK) als ook het gebruik van deze kennis om NIEUWE TOEPASSINGEN te ontwikkelen (ONTWIKKELING).

OPGELET: O&O onderscheidt zich van engineering, kwaliteitszorg, design of pre-productie doordat er een nadrukkelijke nieuwheidswaarde aan verbonden is. Het is creatief werk en omvat geen aankoop van technologie onder de vorm van octrooien en licenties.

A. IDENTIFICATIE VAN O&O-ACTIVITEITEN

1. KENMERKEN VAN UW O&O-INSPANNINGEN

1.1. Werd door uw onderneming intern aan O&O gedaan tussen begin 2000 en einde 2001?

Interne O&O: uitgevoerd binnen de eigen onderneming.

JA ○ NEEN ○

1.2. Werd door uw onderneming O&O uitbesteed tussen begin 2000 en einde 2001?

Externe of uitbestede O&O: uitgevoerd door derden ten behoeve van uw onderneming.

JA ○ NEEN ○

1.3. Kan uw onderneming op systematische wijze beroep doen op een verbonden onderneming met eigen rechtspersoonlijkheid in België, die werkt als externe O&O-afdeling?

JA ○ NEEN ○

Zo JA, gelieve te preciseren

Naam van deze onderneming:

.....

Adres:

.....

Plaats

.....

2. KENMERKEN VAN UW INTERNE O&O-INSPANNINGEN

Zo JA voor 1.1. Op welke wijze oefent uw onderneming de interne O&O-activiteiten uit?

2.1. Permanent ○ Occasioneel ○

Permanente O&O-activiteiten bezitten een zekere continuïteit en systematiek.
Occasionele O&O-activiteiten zijn veeleer onregelmatig en niet systematisch.

2.2. Indien permanent: is O&O de hoofdactiviteit van uw onderneming?

JA ○ NEEN ○

2.3. Indien permanent: werd door uw onderneming al vanaf 1992 permanente O&O uitgevoerd?

JA ○ NEEN ○

Zo NEEN, gelieve het juiste jaar te preciseren vanaf wanneer permanente O&O werd begonnen: ☐☐☐☐

2.4. Indien permanent: heeft uw onderneming een eigen O&O-afdeling?

JA ○ NEEN ○

Een O&O-afdeling is een interne, afzonderlijke, gespecialiseerde organisatiestructuur.

B. GEGEVENS VOOR O&O-BESTEDINGEN

3. TOTALE BESTEDINGEN VOOR O&O

Bestedingen voor O&O kunnen gedaan worden binnen de ondernemingen (interne bestedingen) of erbuiten (uitbestedingen).

3.1. Verdeling van de totale bestedingen voor O&O (interne bestedingen en uitbestedingen samen) (in duizenden euro).

	Boekjaar 2000	**Boekjaar 2001**	**Vooruitzicht 2002**
Interne O&O-bestedingen:	␣␣␣␣␣␣␣000	␣␣␣␣␣␣␣000	␣␣␣␣␣␣␣000
Uitbestedingen voor O&O:	␣␣␣␣␣␣␣000	␣␣␣␣␣␣␣000	␣␣␣␣␣␣␣000
Totale O&O-bestedingen:	␣␣␣␣␣␣␣000	␣␣␣␣␣␣␣000	␣␣␣␣␣␣␣000

Interne bestedingen *zijn alle* ***binnen*** *een onderneming voor O&O gedane bestedingen, ongeacht de financieringsbron. Zowel lopende bestedingen (personeelskosten) als investeringen (gebouwen en apparatuur). Bestedingen die buiten de onderneming maar ten behoeve van interne O&O worden gedaan, worden meegeteld.*

Uitbestedingen *zijn O&O-activiteiten die voor rekening van de onderneming worden uitgevoerd bij* ***derden****.*

4. FINANCIERING VAN DE INTERNE O&O-BESTEDINGEN IN 2001

4.1. Verdeling van de interne O&O-bestedingen naar herkomst van de geldmiddelen voor 2001

Eigen geldmiddelen (zowel uit eigen als uit vreemd vermogen)	␣␣␣%
Externe geldmiddelen (uit contracten en subsidies)	␣␣␣%
Totale interne O&O-bestedingen (cfr 3.1)	100%

4.2. Kunt U de externe geldmiddelen ter financiering van de interne O&O-bestedingen voor 2001 nader preciseren naar herkomst?

BELGISCHE OORSPRONG

Belgische overheden

- Vlaamse overheid ..... ☐☐☐%
- Federale overheid ..... ☐☐☐%
- Andere Belgische overheden ..... ☐☐☐%

Andere ondernemingen in België

- van eigen groep in Vlaanderen ..... ☐☐☐%
- andere in Vlaanderen ..... ☐☐☐%
- van eigen groep uit andere Gewesten ..... ☐☐☐%
- andere uit andere Gewesten ..... ☐☐☐%

Instellingen zonder winstoogmerk ..... ☐☐☐%

- uit Vlaanderen ..... ☐☐☐%
- uit andere Gewesten ..... ☐☐☐%

BUITENLANDSE OORSPRONG

Internationale overheden

- Europese Commissie ..... ☐☐☐%
- Andere organismen ..... ☐☐☐%

Buitenlandse ondernemingen

- Ondernemingen van uw eigen groep ..... ☐☐☐%
- Andere ..... ☐☐☐%

Externe geldmiddelen (cfr 4.1) ..... 1 0 0 %

5. VERDELING VAN DE INTERNE O&O-BESTEDINGEN PER TYPE O&O IN 2001

Kunt U uw interne O&O-bestedingen in 2001 verdelen per type O&O?

Onderzoek ☐☐☐%

Onderzoek bestaat uit experimenteel of theoretisch werk dat hoofdzakelijk wordt verricht om nieuwe kennis te verwerven aangaande de fundamenten van waarneembare verschijnselen en feiten.

Experimentele ontwikkeling ☐☐☐%

Experimentele ontwikkeling bestaat uit systematisch werk op basis van bestaande kennis, ten einde de vervaardiging van nieuwe materialen, producten of mechanismen mogelijk te maken, nieuwe procédés, systemen of diensten tot stand te brengen of reeds bestaande aanmerkelijk te verbeteren.

Interne O&O-bestedingen (cfr. 3.1.) 1|0|0%

6. VERDELING VAN DE INTERNE O&O-BESTEDINGEN PER BESTEDINGENSOORT IN 2001

Personeelskosten ☐☐☐%

Lonen en salarissen op jaarbasis en alle daarmee samenhangende kosten voor het O&O-personeel voor het jaar.

Investeringen ☐☐☐%

Jaarlijkse bruto bestedingen voor vaste activa voor het O&O-programma van de onderneming. Zij bestaan uit bestedingen voor grond, gebouwen, instrumenten en apparatuur.

Werkingskosten ☐☐☐%

Hieronder vallen aankopen van materiaal, voorraden en instrumenten ter ondersteuning van O&O en ook administratieve en andere vaste bedrijfskosten.

Interne O&O-bestedingen (cfr. 3.1.) 1|0|0%

7. VERDELING VAN DE INTERNE O&O-BESTEDINGEN PER TYPE INNOVATIE IN 2001

Productinnovatie ☐☐☐%

Productinnovaties zijn goederen of diensten die nieuw of duidelijk verbeterd zijn.

Procesinnovatie ☐☐☐%

Procesinnovatie houdt nieuwe en duidelijk verbeterde technologieën en nieuwe en duidelijk verbeterde methoden in voor het aanbieden van diensten en het leveren van producten.

Gemengd/Niet te klasseren ☐☐☐%

Interne O&O-bestedingen (cfr. 3.1.) 1|0|0%

8. VERDELING VAN DE UITBESTEDINGEN VAN O&O PER TYPE UITVOERDER IN 2001

Kunt u uw O&O uitbestedingen in 2001 verdelen volgens type uitvoerder

BELGISCHE UITVOERDERS

Vlaanderen

Ondernemingen van de eigen groep .....|_|_|_|%

Andere ondernemingen .....|_|_|_|%

Universiteiten en hogescholen.....|_|_|_|%

Onderzoekscentra .....|_|_|_|%

Andere Gewesten

Ondernemingen van de eigen groep .....|_|_|_|%

Andere ondernemingen .....|_|_|_|%

Universiteiten en hogescholen.....|_|_|_|%

Onderzoekscentra .....|_|_|_|%

BUITENLANDSE UITVOERDERS

Ondernemingen van de eigen groep .....|_|_|_|%

Andere ondernemingen .....|_|_|_|%

Universiteiten en hogescholen.....|_|_|_|%

Onderzoekscentra .....|_|_|_|%

O&O-uitbestedingen (cfr 3.1.) .....|1|0|0|%

C. GEGEVENS VOOR O&O-PERSONEEL

9. TOTAAL O&O-PERSONEEL

Allen die zich rechtstreeks met O&O bezighouden moeten worden meegerekend, evenals degenen die directe diensten verlenen, zoals hoofden van O&O-afdelingen, administrators en kantoorpersoneel.

9.1. Totaal O&O-personeel

	in fysieke eenheden		**in voltijdse eenheden**	
	Totaal	Vrouwen	Totaal	Vrouwen
Boekjaar 2000:	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊
Boekjaar 2001:	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊
Vooruitzicht 2002:	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊

9.2. Voor de ondernemingen die een interne O&O-afdeling hebben (cfr. 2.4.). Gelieve het totale O&O-personeel in fysieke eenheden voor deze afdeling in 2001 te geven.

⌊⌊⌊⌊

10. VERDELING VAN TOTAAL O&O-PERSONEEL VOLGENS FUNCTIE IN 2001

	in fysieke eenheden		**in voltijdse eenheden**	
	Totaal	Vrouwen	Totaal	Vrouwen
O&O-management	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊
Hoofden en administrators die belast zijn met de planning en leiding van O&O.				
Onderzoekers	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊
Deskundigen in het concipiëren of scheppen van nieuwe kennis, producten, processen, methoden en systemen, alsmede in het leiding geven aan de betreffende projecten.				
Technici	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊
Personen wier hoofdtaak technische kennis vereist en ervaring op een of meer wetenschappelijke en technische gebieden.				
Ander personeel	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊
Geschoolde en ongeschoolde vaklieden, secretariaats- en kantoorpersoneel die aan O&O-projecten deelnemen.				
Totaal O&O-personeel (cfr. 9.1.)	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊	⌊⌊⌊⌊

11. VERDELING VAN HET TOTALE O&O-PERSONEEL VOLGENS OPLEIDINGSNIVEAU VOOR 2001

	in fysieke eenheden		in voltijdse eenheden	
	Totaal	Vrouwen	Totaal	Vrouwen
Houders van een doctoraat	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋

Houders van een doctoraat of gelijkwaardig niveau behaald aan een universiteit of gespecialiseerd instituut op academisch niveau.

Houders van een universitair diploma of een diploma van het hoger onderwijs van het lange type	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋
Houders van een diploma van het hoger onderwijs van het korte type	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋

Het kenmerkende van deze studies is dat zij gespecialiseerd zijn in een bepaald onderwerp.

Andere kwalificaties	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋
Totaal O&O-personeel (cfr. 9.1.)	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋	⌊⌋⌊⌋⌊⌋⌊⌋

D. GEGEVENS OVER DE VERDELING VAN DE O&O-ACTIVITEITEN

12. VERDELING VAN INTERNE O&O-BESTEDINGEN VOLGENS ECONOMISCHE SECTOR

12.1. Werd de interne O&O-activiteit uitgevoerd voor verschillende economische activiteitssectoren?
JA ○ NEEN ○

12.2. Zo, JA, kan u de interne bestedingen voor boekjaar 2001 verdelen over de verschillende economische sectoren?

	Aandeel in 2001
Aandeel van hoofdsector in de interne O&O-bestedingen in 2001:	⌊⌋⌊⌋⌊⌋%

Aandeel van nevensectoren in de interne O&O-bestedingen in 2001:

Sectorcode ***Geef uw keuze (cfr. annex 1)***	Beschrijving	
⌊⌋⌊⌋⌊⌋	----------	⌊⌋⌊⌋⌊⌋%
⌊⌋⌊⌋⌊⌋	----------	⌊⌋⌊⌋⌊⌋%
⌊⌋⌊⌋⌊⌋	----------	⌊⌋⌊⌋⌊⌋%
Interne O&O-bestedingen in 2001 (cfr. 3.1)		1 0 0 %

(Vraag 13 is weggevallen)

14. LOKATIE VAN DE O&O-ACTIVITEITEN

14.1. Zijn de O&O-activiteiten van uw onderneming in België verdeeld over verschillende vestigingen?
JA ◯ NEEN ◯

14.2. Zo ja, kan U voor de vestigingen die aan O&O doen, het adres, de sector code, de interne O&O-bestedingen en het totaal O&O-personeel vermelden?

Vestigingen zijn onderdelen van uw onderneming op een andere lokatie die geen afzonderlijke rechtspersoon bezitten.

VESTIGING 1

Adres: ----------

Plaats ---------- Sectorcode cfr. annex 1 ⌊_⌋⌊_⌋⌊_⌋

	Boekjaar 2000	Boekjaar 2001	Vooruitzicht 2002
Interne O&O-bestedingen *(in duizenden euro)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋
Totaal O&O-personeel *(in voltijdse eenheden)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

VESTIGING 2

Adres: ----------

Plaats ---------- Sectorcode cfr. annex 1 ⌊_⌋⌊_⌋⌊_⌋

	Boekjaar 2000	Boekjaar 2001	Vooruitzicht 2002
Interne O&O-bestedingen *(in duizenden euro)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋
Totaal O&O-personeel *(in voltijdse eenheden)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

VESTIGING 3

Adres: ----------

Plaats ---------- Sectorcode cfr. annex 1 ⌊_⌋⌊_⌋⌊_⌋

	Boekjaar 2000	Boekjaar 2001	Vooruitzicht 2002
Interne O&O-bestedingen *(in duizenden euro)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋
Totaal O&O-personeel *(in voltijdse eenheden)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

VESTIGING 4

Adres: ----------

Plaats ---------- Sectorcode cfr. annex 1 ⌊_⌋⌊_⌋⌊_⌋

	Boekjaar 2000	Boekjaar 2001	Vooruitzicht 2002
Interne O&O-bestedingen *(in duizenden euro)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋
Totaal O&O-personeel *(in voltijdse eenheden)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

TOTAAL VOOR DE VERSCHILLENDE VESTIGINGEN

	Boekjaar 2000	Boekjaar 2001	Vooruitzicht 2002
Interne O&O-bestedingen *(in duizenden euro) (cfr. 3.1)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋0⌋0⌋0⌋
Totaal O&O-personeel *(in voltijdse eenheden) (cfr. 9.1)*	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

E. GEGEVENS VAN DE TECHNOLOGISCHE SAMENWERKING

Nieuwe kennisopbouw of nieuwe ontwikkelingen kunnen het resultaat zijn van een samenwerking met andere bedrijven (of instellingen) waarbij kenniselementen of nieuwe toepassingen gemeenschappelijk ontwikkeld worden of worden uitgewisseld. Samenwerking als vorm van kennisacquisitie bestaat in diverse vormen gaande van min of meer formele overeenkomsten op projectniveau met klanten en/of toeleveranciers voor de ontwikkeling van nieuwe technologieën, over joint-ventures tot informele kennisuitwisseling tussen partners.

15. TECHNOLOGISCHE SAMENWERKING

15.1. Heeft uw onderneming technologische kennis **ontwikkeld** binnen een samenwerking tussen begin 2000 en einde 2001?

JA ○ NEEN ○

15.2. Heeft uw onderneming technologische kennis **uitgewisseld** binnen een samenwerking tussen begin 2000 en einde 2001?

JA ○ NEEN ○

15.3. Gelieve in de volgende tabel aan te kruisen waar er tussen begin 2000 en 2001 technologische samenwerking was met vermelde partners.

TYPE PARTNER	GEOGRAFISCHE OMSCHRIJVING			
	Vlaanderen	*Andere Belgische gewesten*	*Buitenland*	
			Europese unie	*andere landen*
Klanten				
• *ondernemingen van de eigen groep*	○	○	○	○
• *ondernemingen buiten de eigen groep*	○	○	○	○
Leveranciers				
• *ondernemingen van de eigen groep*	○	○	○	○
• *ondernemingen buiten de eigen groep*	○	○	○	○
Andere ondernemingen				
• *ondernemingen van de eigen groep*	○	○	○	○
• *ondernemingen buiten de eigen groep*	○	○	○	○
Universiteiten en hoger onderwijs	○	○	○	○
Onderzoekscentra	○	○	○	○
Andere partners	○	○	○	○

Specificeer:

.....

F. GEGEVENS OVER O&O BINNEN DE GROEP

16. O&O VAN DE ONDERNEMINGEN DIE DEEL UITMAKEN VAN EEN GROEP

16.1. Indien uw onderneming deel uitmaakt van een groep (cfr vraag 8.1. in module 1):
Hoe omschrijft U de positie van uw onderneming binnen de O&O-activiteiten van uw groep tussen begin 2000 en einde 2001? U kunt slechts één type kiezen!

Enkel gebruiker: Uw O&O-resultaten worden in de groep niet verder gebruikt maar u maakt wel gebruik van O&O elders in de groep ..... ○

Onafhankelijk: U gebruikt geen O&O-resultaten van andere groepsondernemingen én deze andere gebruiken geen eventuele O&O-resultaten van uw onderneming ..... ○

Enkel leverancier: Uw O&O-resultaten worden elders in de groep gebruikt maar uw onderneming gebruikt geen resultaten van anderen ..... ○

Wisselwerking: de O&O-resultaten van uw onderneming worden elders in de groep gebruikt en vice-versa ..... ○

16.2. Heeft uw onderneming filialen in het buitenland waar O&O-activiteiten plaatsvinden?
JA ○ NEEN ○

Zo JA, kan u in dat geval voor het jaar 2001 de interne O&O-bestedingen, het O&O personeel en het land waar dat filiaal actief is vermelden?

FILIAAL 1

Land	**Interne O&O-bestedingen in EUR**	**Onderzoekers in voltijdse eenheden**
----------	␣␣␣.␣␣␣.000	␣␣␣␣.000

FILIAAL 2

Land	**Interne O&O-bestedingen in EUR**	**Onderzoekers in voltijdse eenheden**
----------	␣␣␣.␣␣␣.000	␣␣␣␣.000

FILIAAL 3

Land	**Interne O&O-bestedingen in EUR**	**Onderzoekers in voltijdse eenheden**
----------	␣␣␣.␣␣␣.000	␣␣␣␣.000

Gelieve zo nodig verder aan te vullen

G. INNOVATIE- EN TECHNOLOGIEPROFIEL

Innovatie omvat alle activiteiten die nodig zijn om een idee om te zetten in een nieuw of duidelijk verbeterd product of een nieuw of duidelijk verbeterd proces. De innovatie is het resultaat van nieuwe technologische ontwikkelingen, nieuwe combinaties van bestaande technologieën of exploitatie van andere door uw onderneming verworven kennis.

17. TECHNOLOGIEPOTENTIEEL

17.1. Heeft uw onderneming in de periode tussen begin 2000 en eind 2001 nieuwe technologieën verworven op andere wijze dan via O&O?

17.1.1. Waren er investeringen voor technologisch geavanceerde machines en uitrustingsgoederen:
JA ○ NEEN ○

17.1.2. Aanschaf van geavanceerde software (geen standaardpakketten):
JA ○ NEEN ○

17.1.3. Aanschaf van octrooien, licenties, en andere intellectuele rechten:
JA ○ NEEN ○

Zo JA, vermeld de totale bestedingen voor octrooien en licenties voor 2001 in duizenden euro

␣␣␣.␣␣␣.000

17.2. Kunt u aanduiden over welke **kerntechnologieën** uw bedrijf beschikt?
(Kerntechnologie met codenummer zoals in de Technologie-classificatie in annex 2.)
Gelieve uw belangrijkste kerntechnologie als eerste te vermelden.

De kerntechnologieën van een bedrijf zijn de strategische technologiedomeinen en know-how voor de productie van diensten en goederen waardoor het bedrijf zich onderscheidt van de andere bedrijven in het algemeen en van haar concurrenten in het bijzonder.

	Code nr.	Eigen beschrijving
Hoofd		
Ander		
Ander		
Ander		
Ander		

18. O&O EN INNOVATIE

Heeft uw onderneming in de periode tussen begin 2000 en einde 2001 nieuwe of sterk verbeterde producten op de markt gebracht, of nieuwe of sterk verbeterde processen in uw bedrijf geïntroduceerd, **als gevolg van uw O&O-activiteiten?**

PRODUCTINNOVATIE (GOEDEREN EN/OF DIENSTEN)

Productinnovaties zijn goederen of diensten die nieuw of duidelijk verbeterd zijn ten opzichte van de basiskenmerken ervan, de technische specificaties, de geïntegreerde software of andere immateriële componenten, het toekomstige gebruik ervan of de gebruiksvriendelijkheid. De innovatie moet nieuw zijn voor uw onderneming; ze moet niet noodzakelijk nieuw zijn voor de markt.

18.1. Heeft uw onderneming, als gevolg van uw O&O-activiteiten, tussen begin 2000 en einde 2001 voor uw onderneming nieuwe of duidelijk verbeterde producten op de markt gebracht?
JA ○ NEEN ○

Zo ja: Uw productinnovatie is vooral het resultaat van: (gelieve aan te kruisen)
- nieuwe technologische ontwikkelingen of nieuwe combinaties van technologieën ..... ○
  of
- exploitatie van niet-technologische vernieuwingen, zoals het verbreden van het assortiment of de exploitatie van niet-technologische kennis ..... ○

Kunt u de **belangrijkste** technologie vermelden die gebruikt is bij de realisatie van uw productinnovatie.
(gebruik hiervoor de technologieclassificatie in annex 2)

	Code nr.	Eigen beschrijving

PROCESINNOVATIE

Procesinnovatie houdt in : nieuwe en duidelijk verbeterde technologieën en nieuwe en duidelijk verbeterde methoden voor het aanbieden van diensten en het leveren van producten. Het resultaat ervan moet duidelijk zijn wat output, productkwaliteit (goederen/diensten) of productie- en distributiekosten betreft. De innovatie moet nieuw zijn voor uw onderneming; uw onderneming moet dat proces niet noodzakelijkerwijs als eerste te hebben gebruikt.

18.2. Heeft uw onderneming, als gevolg van uw O&O-activiteiten, tussen begin 2000 en einde 2001 nieuwe of duidelijk verbeterde productieprocessen tot stand gebracht, met inbegrip van methoden en manieren om diensten en producten te leveren?
JA ○ NEEN ○

Zo ja: Uw procesinnovatie is vooral het resultaat van: (gelieve aan te kruisen)
- nieuwe technologische ontwikkelingen of nieuwe combinaties van technologieën ..... ○
  of
- exploitatie van niet-technologische vernieuwingen of de exploitatie van niet-technologische kennis ..... ○

Kunt u de **belangrijkste** technologie vermelden die gebruikt is bij de realisatie van uw procesinnovatie.
(gebruik hiervoor de technologieclassificatie in annex 2)

	Code nr.	Eigen beschrijving

Instituut voor de Aanmoediging van Innovatie
door Wetenschap en Technologie in Vlaanderen

RESULTATEN:

Wenst u een verslag te ontvangen met de resultaten van deze enquête?
JA ○ NEEN ○

OPMERKINGEN EN SUGGESTIES BIJ DEZE VRAGENLIJST:

U KUNT DE INGEVULDE VRAGENLIJST KOSTELOOS TERUGSTUREN IN BIJGEVOEGDE TERUGSTUURENVELOPPE.

Wij danken u hartelijk voor uw medewerking!

ANNEX 1: CLASSIFICATIE NACE-BEL

Beschrijving	NACE-BEL codes	Uw keuze
PRIMAIRE SECTOR		
LANDBOUW, JACHT, BOSBOUW EN VISSERIJ	01, 02, 05	S 1
WINNING VAN DELFSTOFFEN	10 tot 14.	S 2
INDUSTRIE		
Voedingsproducten en dranken	15	S 3
Tabaksproducten	16	S 4
Textiel	17	S 5
Kleding en bontnijverheid	18	S 6
Leernijverheid en schoeisel	19	S 7
Hout en kurk (exclusief meubels); Kartonnijverheid, papier & artikelen van papier	20 en 21	S 8
Uitgeverijen, drukkerijen en reproduktie van opgenomen media	22	S 9
Cokes, geraffineerde petroleum en kernbrandstof	23	S 10
Chemische producten (exclusief farmaceutische producten)	24 zonder 244	S 11
Farmaceutische producten	244	S 12
Rubber en kunstoffen	25	S 13
Niet-metaalhoudende minerale producten	26	S 14
Metallurgie, ferro	271	S 15
Metallurgie, non-ferro	273	S 16
Vervaardiging van producten in metaal (exclusief machines, werktuigen)	28	S 17
Machines, n.e.g.	29	S 18
Kantoormachines en computers	30	S 19
Elektrische machines en apparaten	31	S 20
Elektronische onderdelen (inclusief halfgeleiders)	321	S 21
Audio-, video-, en telecommunicatieapparatuur	32 zonder 321	S 22
Medische apparatuur, optische- en precisie instrumenten en uurwerken	33	S 23
Automobielassemblage, aanhangwagens en opleggers	34	S 24
Vervaardiging van lucht- en ruimtevaartuigen	353	S 25
Overige transportmiddelen	35 zonder 353	S 26
Meubels	361	S 27
Overige industrie	366	S 28
Recuperatie van recycleerbaar afval	37	S 29
PRODUCTIE EN DISTRIBUTIE VAN ELEKTRICITEIT, GAS EN WATER	40 en 41	S 30
BOUWNIJVERHEID	45	S 31
DIENSTEN		
Groothandel	51	S 32
Kleinhandel, verkoop en reparatie van auto's	50,52	S 33
Hotels en restaurants	55	S 34
Vervoer en ondersteunende bedrijven	60 tot 63	S 35
Post	641	S 36
Telecommunicatie	642	S 37
Financiele instellingen, verzekeringen en hulpbedrijven	65 tot 67	S 38
Realisatie van programma's en gebruiksklare systemen	722	S 39
Overige informatica-activiteiten	72 zonder 722	S 40
Onderzoek en ontwikkeling	73	S 41
Overige zakelijke dienstverlening, verhuur, immobiliën	70,71,74	S 42
Openbaar bestuur, sociale en collective diensten, etc	75 tot 99	S 43

ANNEX 2: CLASSIFICATIE TECHNOLOGIEDOMEINEN

De "kerntechnologieën" van een onderneming zijn de gebieden van technologische know-how die vitaal zijn voor de productie van goederen en diensten en waardoor het bedrijf zich differentieert van andere bedrijven in het algemeen en van zijn concur-renten in het bijzonder. Onderstaande classificatie herneemt de hoofdlijnen van de TII-classificatie die gebruikt wordt door Europese technologietransfer organisaties. Zij is niet exhaustief in haar onderverdelingen. Daarom bestaat de mogelijkheid om voor de beschrijving van de eigen kerntechnologieën ook eigen omschrijvingen en toevoegingen te geven.

1 Biologie, biochemie
- 10 Landbouw
  - 100 Landbouw engineering
  - 101 Vee- en plantenteelt
  - 130 Aquacultuur
- 11 Bio-engineering en biologie
  - 110/113 Biomechanische en biofysische engineering
  - 111 Farmaceutica en biomedische engineering
  - 112 Biochemische engineering
  - 114 Genetische engineering
  - 122 Microbiologie
- 14 Gezondheidstechnologie
  - 141 Diagnostische technologie
  - 142 Medische engineering
  - 143 Stralingstechnologie

2 Energietechnologieën
- 20 Verbranding en ontsteking
- 21 Electriciteitsopwekking
  - 210 Warmtekoppeling
- 23 Energiebesparing
  - 230 Warmte engineering
  - 231 Verwarming en koeling
  - 233 Warmterecuperatie
- 24 Energieopslag
- 26 Hernieuwbare energie
  - 260 Biomassa
  - 264 Zonne-energie
  - 266 Windenergie

3 Milieutechnologiën
- 31 Reinigingstechnologie
  - 310 Gesloten kringloop technologie
- 32 Milieu Monitoring
  - 320 Ecologie
  - 322 Luchtmonitoring
  - 325 Bodemmonitoring
  - 326 Watermonitoring
- 34 Pollutiecontrole
  - 340 Luchtvervuilingscontrole
- 35 Waterbehandeling
  - 352 Afvalwaterbehandeling
- 36 Beschermingstechnologie
  - 360 Stralingsbescherming
- 37 Afvalbeheer en behandeling
  - 371 Recyclage technologie

4 Informatietechnologie, telecommunicatie
- 40 CAD/CAE/CAM/CIM Technologieën
  - 400 Computer Aided Design
  - 401 Computer Aided Engineering
  - 402 Computer Aided Manufacturing
  - 403 Computer integrated Manufacturing
- 42 Computer Hardware
  - 420 Computerarchitectuur
  - 421 Computer Graphics
  - 422 IC-technologie
  - 425 Geheugentechnologie
  - 426 Microproccesoren
  - 427 Optische computing (beeldverwerking, scanning)
  - 428 Spraakverwerking
  - 429 Systeembeveiliging
- 43 Computer Software
  - 430 Toepassingssoftware
    - 4300 Bedrijf en kantoor
    - 4301 Huis
    - 4302 Onderwijs
    - 4303 Productie
    - 4304 Medisch
    - 4305 Financieel
    - 4306 Geïntegreerde software
  - 431 Artificiële Intelligentie
  - 432 Databanken
  - 433 Dataverwerking
  - 434 Databeveiligingstechnologie
  - 435 Managementsystemen
  - 436 Netwerkmanagement
  - 437 Program. & Programmeertalen
- 44 Computer Training Services
- 45 Kantoorautomatisatie
- 46 Telecommunicatie
  - 460 Breedbandcommunicatie
  - 461 Informatietransmissie
  - 462 Mobiele communicatie
  - 463 Satelliet-communicatie
  - 464 Telemetrie
  - 465 Video-Technologie

5 Industriële basistechnologiën
- 50 Assemblage
- 51 Mengtechnologie
- 52 Zuiveringstechnologie (filtratie,separatie)
- 53 Elektronica
  - 530 Audio technologie
  - 531 Elektronische schakelingen
  - 532 Elektronische instrumenten
  - 534 Signaalverwerking
- 54 Hydraulica en pneumatica
- 55 Industriële logistiek
  - 550 Fabrieksbeheer
  - 551 Onderhoud
  - 552 Verpakking
  - 553 Plant Design
  - 554 Productie Engineering
  - 555 Personeelsmanagement
  - 556 Distributie
  - 557 Warehousing
- 56 Meting en controle
  - 560 Automatische meetsystemen
  - 561 Detectietechnologie
  - 562 Dimensiemetingen
  - 565 Fabricagecontrole (on-line, niet-destructief, …)
  - 566 Mechanisch, optisch, accoustisch meten
  - 567 Kwaliteitscontrole productieproces
  - 568 Sensortechnologieën
  - 569 Warmtemetingen
- 58 Optica
  - 580 Lasertechnologie
  - 581 Lenzen en spiegels
  - 582 Optronica
  - 583 Fotografie
  - 584 Optische vezels
  - 59 Plasma Technologie

6 Sectorale industriële technologiën
- 60 Chemische engineering en productie
  - 600 Agro-chemie
  - 601 Basischemie
  - 602/604 Fijnchemie en verven
  - 605 Petrochemische technologieën
- 61 Bouwtechnologie
  - 610 Architectuur
  - 612 Bouwmateriaal
  - 613 Burgerlijke engineering
  - 617 Isolatietechnologie
  - 619 Bodemmechanica
- 62 Elektrische Engineering & Productie
  - 620 Automatisatie
  - 621 Elektrische apparaten
  - 622 Elektrische machines
  - 623 Elektrische energie engineering
  - 624 Elektromechanica
- 63 Voedingstechnologie
  - 630 Kleur- en smaakbewerking
  - 631 Melkverwerking
  - 632 Brouwerij/stokerij
  - 633 Voedselbewaring
  - 634 Voedselbereiding
  - 635 Fruit- en groentenbehandeling
  - 636/637 Vlees- en visverwerking
  - 638 Soft Drinks
- 65 Industriële Engineering en Productie
  - 650 Industriële design
  - 651 Industriële uitrusting en machinebouw
  - 653 Prototyping
- 66 Mechanische Enginering & Productie
  - 660 Boiler Technologies
  - 661 Stromingsmechanica
  - 662 Smering
  - 663 Micromechanica
  - 664 Pompen, kleppen, perslucht
  - 665 Koeltechnologie
  - 666 Thermische technologieën
  - 667 Mecatronica
- 67 Drukkerij/Uitgeverij
  - 670/671 Foto- en reprografie
  - 672 Desk-Top Publishing
  - 674 Lithografie
- 68 Textiel
  - 680 Textielmachines
  - 681 Textielverwerking
- 69 Transport
  - 690 Lucht- en ruimtevaart
  - 691 Logistiek
  - 692 Motorvoertuigen
  - 694 Wegvervoer
  - 695 Scheepsbouw

7 Materiaaltechnologie en -productie
- 70 Basismaterialen
  - 701 Glas- en kristalverwerking
  - 704 Papierverwerking
  - 706 Steen- en kleiverwerking
  - 707 Stof- en vezelverwerking
  - 708 Houtverwerking
- 71 Nieuwe materialen
  - 710 Keramieken
  - 711 Composieten
  - 712 Plastics
  - 714 Legeringen
- 72 Metallurgie
  - 720 Adhesieve verbindingstechnologieën
  - 721 Gieten
  - 722 Metaalvorming
  - 723 Walsen
  - 724 Non-ferro metallurgie
  - 725 Plaatbewerking
  - 726 Oppervlakte behandeling
  - 727 Thermische behandeling
  - 728 Lassen
  - 729 Poedermetallurgie

NOTES

1 The author of this chapter is Roger Kalenga-Mpala, chargé de mission of the Federal Science Policy Office.

2 In Belgium, a permanent inventory of the scientific potential has been created in the framework of the cooperation agreement of 12 July 1994, executing article 6 bis, § 2, point 6 of the special law of 8 August 1980 of institutional reforms. This inventory is meant to give a coherent, multisectoral and multidisciplinary image of the R&D efforts, in compliance with the definitions and methodology of the OECD and Eurostat.

3 This Manual has been composed by and for national experts of the Member States that collect and diffuse data on R&D and provide answers to the OECD surveys on R&D. It deals exclusively with the measurement of human resources and financial means dedicated to the research and the experimental development, often called R&D "inputs".

4 According to the Oslo Manual (OECD, 1997a) the activities of technological innovation are all of the scientific, technological, organisational, financial and commercial steps, including investments in new knowledge, which actually, or are intended to, lead to the implementation of technologically new or improved products and processes.

5 The other institutional R&D sectors consist of government, higher education, private non-profit and abroad.

6 Data of 2001, Federal Commission of Cooperation, Concertation group CFS/STAT, calculations Federal Science Policy 2003.

7 The author of this part is Prof. Michele Cincera

8 "Inspanningen voor Onderzoek & Ontwikkeling door de Vlaamse bedrijven" in 1998 and 1999 and in 2000 and 2001.

9 The sample is obtained as the result of a stratification of the total population of firms in terms of the different size-classes of the firms and the industry in which they are active.

10 See Capron et al. (1999) and Kalenga (this IWT study) for a description of the procedures to intrapolate and extrapolate the R&D expenditures.

11 The short version only contains questions related to R&D expenditures and personnel.

12 The test procedures to identify errors and to correct them are described in a technical note (Cincera, 2003).

13 See the contribution of Kalenga (this IWT Study) for more details.

14 Capron and Duelz (2003) analyze the R&D current position of Belgium and its regions as well as the level of effort to be implemented to reach the 3% objective.

15 See Symeonidis (1996) for a review of empirical studies examining this question.

16 By average, we mean the average R&D intensity of the firms of a given sector or size class.

17 See Table A3 in the appendix.

18 This Table can be compared with Table A4 in the Appendix.

19 See Bond et al. (1999) for instance.

20 Indivisibilities and uncertainties (or high risks) associated with R&D activities are two other sources of market failure (Arrow, 1962).

21 Sources: own calculations, IWT R&D surveys 2000 and 2002.

22 It should be noted that there are 165 firms that answered to these questions and reported their R&D expenditures. These firms represent 27.1% of the total R&D of all the respondents to the R&D question. There are however 171 other companies that have answered the questions on collaboration. These firms did not report any R&D expenditures.

23 See Delanghe et al. (2003) for a presentation of first results of the third Community Innovation Survey (CIS-3) in Flanders.

24 It should be noted that there are 221 firms that answered to these questions and reported their R&D expenditures. These firms represent 27.7% of the total R&D of all the respondents to the R&D question. There are however 434 other companies that have answered the questions on innovation. These firms did not report any R&D expenditures.

25 The author of this part is Prof R. Veugelers. This note is a translation into English of the Document made by "Steunpunt O&O Statistieken"(advice centre R&D statistics) approved by the meeting of the Steering Group R&D Statistics of 4-11-2003, and published in Flemish on the website of the Steunpunt: www.steunpuntoos.be

26 Also see G. Vervliet, Speurgids 2003, Chapter III.8 and the Flemish Indicator Book, 2003, Steunpunt O&O.

27 All of the leading principles for measuring the financial R&D effort can be found in the OECD "Frascati Manual".

28 The 2002 data being an estimate will not be reported.

29 All of the leading principles for measuring the financial R&D effort can be found in the OECD "Frascati Manual".

30 This especially concerns the VUB and KUB as university institutions, the University institution for Judaism as Independent university research centre and for the Colleges: Erasmus, College for Science and Art and EHSAL

31 This MSTI deflator is specific for R&D expenditures, but not specific for Flanders, also see VRWB Study series 1, Developing a specific R&D deflator.

32 The category "others" (0.7%) consists mainly of foreign universities and is therefore attributed to the public sector (CFS-STAT).

REEDS VERSCHENEN BIJ HET IWT-OBSERVATORIUM

VTO-STUDIES:

1/ Het Vlaams Innovatiesysteem: een nieuw statistisch beleidskader
1annex/ Theoretische en empirische bouwstenen van het 'Vlaams Innovatie Systeem'

2/ Innovatiestrategieën bij Vlaamse industriële ondernemingen

3/ Octrooien in Vlaanderen: technologie bekeken vanuit een strategisch perspectief
Deel 1: Octrooien als indicator van het technologiesysteem

4/ De impact van technologische innovaties op jobcreatie en jobdestructie in Vlaanderen

5/ Strategische verschillen tussen innovatieve KMO's : Een kijkje in de zwarte doos

6/ Octrooien in Vlaanderen: technologie bekeken vanuit een strategisch perspectief
Deel 2: Analyse van het technologielandschap in Vlaanderen

7/ Diffusie van belichaamde technologie in Vlaanderen: een empirisch onderzoek op basis van input/outputgegevens
7 annex/ Methodologische achtergronden bij het empirisch onderzoek naar de Vlaamse technologiediffusie

8/ Schept het innovatiebeleid werkgelegenheid?

9/ Samenwerking in O&O tussen actoren van het "VINS"

10/ Octrooien in Vlaanderen: technologie bekeken vanuit een strategisch perspectief
Deel 3: De internationale technologiepositie van Vlaanderen aan de hand van octrooi posities
Deel 4: Sporadische en frequent octrooierende ondernemingen : profielen

11/ Technologiediffusie in Vlaanderen. Enquêteresultaten - Product- en diensteninnovatie: evolutie 1992-1994-1997

12/ Technologiediffusie in Vlaanderen. Enquêteresultaten - Hoogtechnologische producten: evolutie 1992-1994-1997

13/ Technologiediffusie in Vlaanderen. Enquêteresultaten - Procesautomatisering: evolutie 1992-1994-1997

14/ Technologiediffusie in Vlaanderen. Methodologie en vragenlijst

15/ Financiering van innovatie in Vlaanderen. Het aanbod van risicokapitaal.

16/ Product- en diensteninnovativiteit van Vlaamse ondernemingen. Enquêteresultaten 1997

17/ Adoptie van procesautomatisering en informatie- en communicatietechnologie in Vlaanderen. Enquêteresultaten 1997

18/ Performantieprofiel en typologie van innoverende bedrijven in Vlaanderen. Waarin verschillen innoverende bedrijven van niet-innoverende bedrijven. Enquêteresultaten 1997

19/ De werkgelegenheidsimpact van innovatie: is de aard van de innovatie-strategie belangrijk?

20/ Samenwerking in O&O tussen actoren van het "VINS"
Deel 2: Samenwerking in een aantal specifieke technologische disciplines

IWT-STUDIES:

21/ Clusterbeleid: Een innovatie instrument voor Vlaanderen? Reflecties op basis van een analyse van de automobielsector

22/ Benchmarken en meten van innovatie in KMO's

23/ Samenwerkingsverbanden in O&O en kennisdiffusie

24/ Financiering van innovatie in Vlaanderen. De venture capital sector in internationaal perspectief

25/ De O&O-inspanningen van de bedrijven in Vlaanderen - De regionale uitsplitsing van de O&O-uitgaven en O&O-tewerkstelling in België 1971-1989

26/ De O&O-inspanningen van de bedrijven in Vlaanderen - Een perspectief vanuit de enquête voor 1996-1997

27/ Identificatie van techno-economische clusters in Vlaanderen op basis van input-output-gegevens voor 1995

28/ The flemish innovation system : an external viewpoint

29/ Geïntegreerd innovatiebeleid naar KMO's toe. Casestudie: Nederland

30/ Clusterbeleid als hefboom tot innovatie

31/ Resultaten van de O&O-enquête bij de Vlaamse bedrijven

32/ 'Match-mismatch' in de O&O-bestedingen van Vlaamse en Belgische bedrijven in termen van de evolutie van sectoriële aandelen

33/ 'Additionaliteit'- versus 'substitutie'-effecten van overheidssteun aan O&O in bedrijven in Vlaanderen: een econometrische analyse aangevuld met de resultaten van een kwalitatieve bevraging

34/ Het innovatiebeleid in Ierland als geïntegreerd element van het ontwikkelingsbeleid: van buitenlandse investeringen naar 'home spun growth'

35/ ICT Clusters in Flanders: Co-operation in Innovation in the New Network Economy

36/ Het fenomeen spin-off in België

37/ KMO-innovatiebeleid levert toegevoegde waarde aan Vlaamse bedrijven

38/ Technology watch in Europa: een vergelijkende analyse

39/ ICT-Monitor Vlaanderen: Eindrapport van een haalbaarheidsstudie

40/ Innovation policy and sustainable development: can public innovation incentives make a difference?

41/ Spinning off new ventures: a typology of facilitating services

42/ Research mandates for technology transfer: International policy

43/ Subregionale O&O-inspanningen van de bedrijven in Vlaanderen

44/ De intelligente omgeving: de noodzaak van convergerende technologieën en een nieuw businessmodel.

45/ Innovatie-inspanningen van Vlaamse ondernemingen: een exploratie van de CIS-3-enquête

Biography

MICHELE CINCERA

Michele Cincera is affiliated with the Centre d'Economie Regionale et de la Technologie at the Department of Applied Economics of Université Libre de Bruxelles (DULBEA-ULB) since 1993. After his master degree in Econometrics at ULB in 1995, he has submitted his Ph.D. thesis entitled "Technological and Economic performances of International firms" presented at Université Libre de Bruxelles in 1998. He is currently Associate Professor of economics at ULB. His research interests embrace the quantitative assessment at the micro-level of innovative activities, their determinants and their socio-economic impacts, the analysis of National Innovation Systems, and the development of new S&T indicators.

ROGER KALENGA-MPALA

Roger Kalenga-Mpala obtained his Licence in economics and a Master in econometrics at the Université Libre de Bruxelles (1997 and 1999) Since 2000 he is Chargé de mission of Federal Science Policy Office, Unit for Production and Analysis of R&D indicators, Business Enterprise Sector.

REINHILDE VEUGELERS

Prof Dr. Reinhilde Veugelers has been with K.U.Leuven, Belgium since 1985, where she obtained her PhD in Economics in 1990 with a thesis on "Scope decisions of Multinational Enterprises". She is currently a full professor at the Department of Applied Economics, where she teaches managerial economics and international business economics and a CEPR Fellow (London). With her research concentrated in the fields of industrial organisation, international economics and strategy and innovation, she has authored numerous publications on multinationals, R&D cooperation and alliances, and market integration in leading international journals. She is currently co-promotor for the Flemish Government "Steunpunt" on R&D statistics.

DONALD CARCHON

Donald Carchon holds a licentiate degree in Economics and Applied Economics and a Baccalaureat in Applied Informatics. Since 1998, he is employed as Scientific Advisor at the IWT, the technology agency of the Flemish Government. In the field of the economics of innovation and R&D he is manager of the integrated innovation information system of IWT and innovation policy analyst.

JAN LAROSSE

Jan Larosse (1952) obtained an MA in Economics and a Baccalaureat in Philosophy at the Catholic University of Leuven. Since 1992 he is Scientific Advisor at IWT, the technology agency of the Flemish Government. In 1996 the Observatory unit was started where he took up the role of coordinator. His work is mainly directed to innovation monitoring, innovation studies covering themes such as the knowledge economy, cluster analysis and innovation systems, policy and additionality.

WHAT IS IWT-FLANDERS?

The Institute for the promotion of Innovation by Science and Technology in Flanders (IWT-Flanders) was established in 1991 by the Flemish government as a regional public institution to provide R&D and innovation support in Flanders. In order to execute this task IWT has several financial tools available and an annual budget of 235 million EUR (in 2004) available to support projects. In addition to **direct funding**, a variety of **services** is provided to the local industry in the field of technology transfer, partner search, information about international subsidy options, etc. IWT has also an important mission as co-ordinator, aiming for a strong co-operation between all organisations in Flanders offering technological innovation services to companies.

Over the years **IWT** has expanded into the **knowledge center** for R&D and innovation in Flanders.

WHAT IS THE IWT-OBSERVATORY?

The IWT-Observatory functions as an analytical unit, supporting the role of IWT as a **Knowledge Centre for R&D and Innovation** in the Flemish Innovation System.

The Observatory has a **supporting function** towards IWT's operational activities in evaluation and service support, supplying analytical information concerning aspects of innovation and company-specific data and developing systems for performance measurement.

Being a part of **Innovation-monitoring** by the Flemish Government, the IWT-Observatory analyses collects and analyses indicators on the R&D and innovation activities of companies and other actors in the Innovation System in Flanders.

The **analytical capacity** of the Observatory is built upon a multitude of internal and external sources, the results of innovation studies and IWT specific data about companies, and recombined into knowledge components for stimulating innovation and innovation policy in Flanders.

As an **information provider**, frequent demands for information by policy-makers and interested third parties are being answered about benchmarks from foreign (policy) experiences, introduction of new policy concepts within the innovation theory, and other matters in the field of innovation. Results are published in periodic reports and IWT-Studies.