ISBN 92-894-0173-7

2000 EDITION

Statistics on Innovation in Europe

Data 1996-1997

9

EUROPEAN COMMISSION

eurostat

THEME 9
Science
and technology

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu.int).

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 2001

ISBN 92-894-0173-7

Printed in France

PRINTED ON WHITE CHLORINE-FREE PAPER

Table of Contents

INDEX

List of tables

INDEX

List of figures

INDEX

Foreword

The European Council Summit in Lisbon in March 2000 set a clear strategic objective for Europe in the next decade: to make the European Union the most competitive and dynamic knowledge-based economy in the world. This ambitious goal has also to be supported by reliable and relevant statistical information.

The aim of the Innovation survey is to serve as a good information source for monitoring and assessment of the Community and national policy to strengthen the scientific and technological basis of the European businesses to be more innovative and competitive, both by providing the users with a number of indicators on the innovation activity and by providing data for analytical studies to have a better understanding of the innovation process.

The Community Innovation Survey (CIS) is a coordinated action of the European Commission, the OECD and EEA Member States designed to obtain information on technological innovation. A large pilot survey, the first CIS developed between 1991 and 1993, was jointly initiated and implemented by Eurostat and the Innovation Programme (now under Enterprise DG). The survey aims at facilitating the accurate measurement of innovation activities at the enterprise level.

Based on the experience gained during the first CIS, Eurostat, Enterprise DG and EEA Member States decided to launch a second round, CIS2, in 1997/1998. All the participants agreed on a common set of methodology aimed at providing comparable, harmonised and representative data on a pan-European scale. This exercise is based on the revised version of the Eurostat/OECD Proposed guidelines for collecting and interpreting technological innovation data: the 'Oslo manual'. In CIS firm-level data on inputs to, and outputs of, the innovation process across a wide range of industries and regions in EEA Member States are collected and disseminated as indicators on aggregated level. The data have also been used in analytical studies.

The present publication provides, in Part 1, a general introduction to the role of the promotion and measurement of innovation within the general framework of enterprise policy in the European Community. Part 2 presents an overview of the results of the different parts of the CIS2 questionnaire in some detail by country and size class. In Part 3, a comparison of the high-tech sector with other economic branches of the manufacturing activities is made. Finally, details concerning methodology are provided in Part 4.

The tables and figures presented in this panorama are based directly on CIS2. In the manufacturing sector, data for all EU countries, except Greece and partly Luxembourg, are available. Regarding the service sector, data for Spain and Italy are not available; in addition, the wholesale sector has not been surveyed in France. The EEA aggregates include the available EU countries plus Norway but excluding Iceland and Liechtenstein.

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Part 1
ENTERPRISE POLICY AND INNOVATION

Enterprise Policy and Innovation

by Enterprise DG

Today, on the eve of the 21st century, the European Union is facing the opportunities raised by globalisation and the new knowledge-driven economy. This challenge affects every facet of our lives and requires a radical transformation of Europe's policies having a bearing on enterprises.

Although the European Union is experiencing its best macro-economic outlook for a generation, with robust growth and job creation, these strengths should not distract attention from a number of weaknesses:

- More than 15 million European are still out of work. Long-term structural employment and marked regional imbalances remain endemic in parts of the Union.
- There is a widening skills gap, especially in application of new technologies and management methods, with, as a corollary, an increasing number of jobs remaining unfilled.

In the field of Innovation, the latest data collected and analysed in this Panorama-publication indicate that relatively few enterprises in the Union are able to build on innovative products, services and processes not only in order to remain competitive but also to gain new markets and become major in the marketplace.

The new agenda in Lisbon: definition of an Enterprise Policy

It is against this background that the European Union needs to shape and implement a policy for enterprises to build a dynamic and innovative economy. Political attention is well focussed on these issues: at the European Council Summit, held in Lisbon in March 2000, the Heads of State and Government of Member States set a strategic goal for the Union in the next decade:

'… make the European Union the most competitive and dynamic knowledge-based economy in the world'.

Since this ambitious goal can be achieved only by making Europe more entrepreneurial and innovative, the Commission was asked to define an enterprise policy contributing to achieve this goal. In addition, the Commission was requested to monitor progress through the launching of a benchmarking exercise on the most crucial aspects of entrepreneurship and innovation.

Policy objectives on Enterprise

The Commission in April 2000[1], set out policy objectives as well as a proposed instrumental programme (Multi-annual Programme for Enterprise and Entrepreneurship, 2001-2005) for the pursuit of such goals.

This Enterprise Policy needs to address the entire business environment to enable enterprises, whatever their size, legal form, sector or location, to grow and match the challenges of the knowledge driven economy.

Enterprise Policy charts a clearly defined course of action around six areas:

First, entrepreneurship is the key to the new economy. Enterprise Policy must encourage policy initiatives that reward those who take risks.

Second, promoting an innovative business environment is essential. Environment innovation is increasingly becoming the decisive source of competitiveness and wealth. Enterprise Policy will foster a framework conducive to innovation, linking research and innovation more effectively. In this respect, the Commission has broken new ground to address the duality of research and innovation.

Although innovation is an activity often inspired by research, it should not be confused with research. There is a great deal of innovation without any specific research effort, and research does not always lead to innovation. This duality has been addressed by the Commission placing innovation at the heart of this policy, just as the structure of the Fifth Research Framework Programme has placed it at the heart of the EU's Research Policy. This will promote the ability of Enterprise Policy to influence the orientation of Research and Development activities towards meeting the needs of the economy.

The third area of Enterprise Policy aims at stimulating the electronic economy, for example business to business commerce. Enterprise Policy will encourage best practice and the take-up of successful business models in this area.

The fourth area seeks to obtain more from benefits from the internal market, still to be completed in sectors such as gas, electricity, transport and postal services.

The fifth area will focus on cutting ‘red tape’. This means making both existing and future regulations as light and simple as possible.

Finally, the sixth area aims at setting a new method of co-ordination: ‘BEST procedures’ to ensure better integration of existing tools identifying best practices.

Coordination of Enterprise and Innovation policies

And, last but not least, the Enterprise Policy will build on a new open method of coordination agreed in Lisbon. This method will build on benchmarking and monitoring, as a means of spreading best practice and achieving greater convergence towards the main European Union goals. This exercise will concentrate on political issues, such as the time and cost involved in setting-up a company, access to risk capital for investment, the number of business and scientific graduates, innovating enterprise's outputs and markets, etc.

To launch this open method of co-ordination with Member States the Commission will set a scoreboard of indicators in the field of entrepreneurship and innovation by December 2000. It is expected that the findings presented in this Panorama-publication will contribute to the fulfilment of this endeavour. The reading and analysis of reported performance on innovation in enterprises should lead policy makers to learn form each other and identify the specific characteristics surrounding good practice.

[1] COM (2000) 256 final. Brussels 26.04.2000

Part 2

INNOVATORS IN EUROPE

Chapter 1
Innovators: who, how many?

- *On average, one out of two manufacturing enterprises is a technological innovator and two out of five service enterprises have successfully implemented a technologically new or improved service on the market.*
- *Every fifth manufacturer has introduced a product new to their market.*
- *The propensity to innovate increases with the size of the enterprise.*
- *About two thirds of manufacturing innovators are engaged in both product and process innovation.*
- *There are relatively more innovators among exporters than among non-exporters.*

How many firms innovate?

According to the second Community Innovation Survey more than half of the enterprises in manufacturing industries in Europe are technological innovators, i.e. they have introduced technologically new or improved products, processes or services during the three years surveyed, i.e. 1994-1996 (except in Portugal and Norway where the survey covered the years 1995-1997). In the service branches the share of innovating enterprises (40%) is lower than in the manufacturing sector. The concept of innovation includes all or part of successful implementation of such activities as R&D, acquisition of machinery, software or other external technology, training, preparation and market introduction.

'New' as used in this context does not necessarily mean new to the world, to the country or to the enterprise's market. The requirement is that the product, process or service must be new to the firm. As for 'improved', it is defined as an objective improvement in the performance of a product/service or in the way in which it is produced or delivered. The act that defines an enterprise as innovator is therefore the launching of a product or service different from those previously offered by the enterprise or the introduction of a new or modified production process. Consequently, innovators can be engaged in imitation or in the use of already known and applied technology. Enterprises were therefore, in this survey, considered to be innovators even if they pushed forward their own 'technology frontier' without necessarily changing that of the whole industry.

Innovation is being used in the broad sense in order to take into account the process of diffusion. An innovation may have little effect unless it is widely applied beyond its place of origin (first in the world) in other countries, industries and even firms in the same industry.

As illustrated in Table 2.1.1, the share of innovating enterprises varies considerably within the group of countries. In the manufacturing sector Ireland, Germany and Denmark exhibit a much larger share of innovators than Spain, Portugal or Belgium, the shares ranging from a minimum of 26% (Portugal) to a maximum of 74% (Ireland). As for the marketed services, the highest percentage of innovators is found in Ireland with 58% whereas Belgium has the lowest share of innovators.

Table 2.1.1: Number of innovators (%), 1996

	Manufacturing	Services[1]
EU-15	51	40
B	34	13
DK	71	30
D	69	46
E	29	:
F[2]	43	31
IRL	74	58
I	48	:
L	42	49
NL	62	36
A	67	55
P	26	28
FIN	36	24
S	54	32
UK	59	40
EEA	51	40
NO	48	22

1: Spain and Portugal are not included in the service sector.
2: Wholesale sector is not included.

Source : CIS2, Eurostat / Enterprise DG.

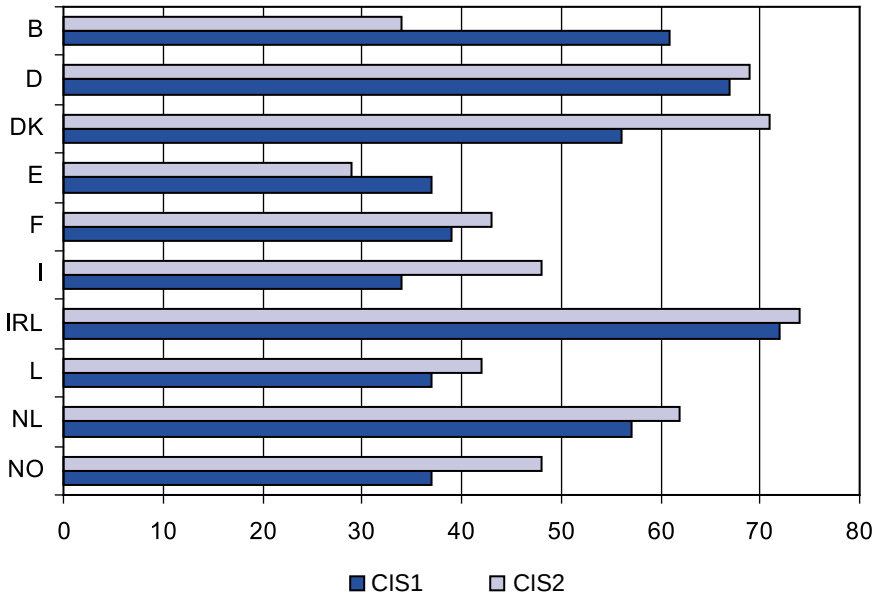
Technological innovation is in general carried out more frequently in manufacturing enterprises than in the marketed service sector. The same pattern is, as shown in Table 2.1.1, found in most of the participating countries, with the exception of Luxembourg and Portugal. In the latter, the two broad economic sectors show more or less similar shares of innovating enterprises. The most striking examples of this general trend are Belgium and Norway; the proportion of manufacturers having implemented an innovative product or process is more than two times higher than in services. However it would be misleading to conclude that service branches are technologically backward.

The percentage of innovating firms is a basic indicator of the innovation activity. This statistics provide a general idea of the propensity to innovate, but fails to measure the complexity of the innovation process. It answers to the question ‘how many have been innovating’ but does not give any indication of the intensity or quality of innovation. In particular, it does not indicate whether the innovation consists of a minor adjustment, a substantial improvement or a revolutionary product that is completely new.

CIS2 compared to CIS1

For most of the participating countries the share of innovating firms indicated in the second Community Innovation Survey is higher than in the first CIS which relates to years 1990-1992. For Belgium and Spain, nevertheless, the share of innovating firms according to CIS2 is somewhat below the level shown in CIS1. However, these results should not be taken as a representation of an evolution through time of the share of innovating firms. In fact, due to a number of technical differences, including large differences in sampling techniques, the results of the two surveys cannot be considered to be directly comparable. The results of CIS1 are, nevertheless, provided, for information, in Figure 2.1.1.

Figure 2.1.1: CIS2 compared to CIS1, number of innovators (%), manufacturing sector



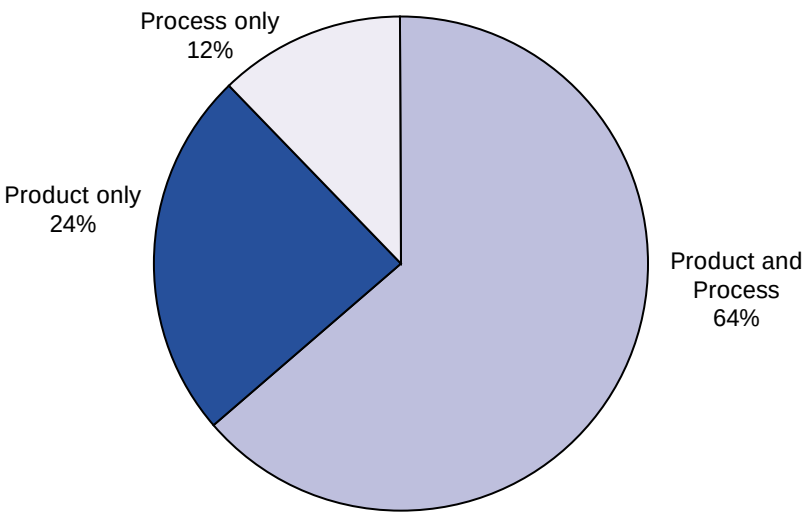
Source : CIS1 and CIS2, Eurostat / Enterprise DG.

Product or process innovation, how do manufacturers innovate?

An enterprise can innovate either by introducing a technologically new or improved product on the market (product innovator) or by adopting a new or improved process (process innovator). A new product is a product whose technological characteristics or intended uses differ significantly from those of previously produced ones, while an improved product is an existing one whose performance has significantly been enhanced or upgraded. By new or improved process is understood technologically new or improved production methods, including methods of product delivery. The distinction made between these two methods of innovating is central for both the understanding the mechanism of innovation and for helping in defining policies.

The pie chart below illustrates the distribution of product and/or process innovators among the innovators in the manufacturing sector. Data are not available for the service sector.

Figure 2.1.2: Relative distribution of product and/or process innovators, manufacturing sector, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

According to CIS2, 64% of innovators declared to be innovating both in products and processes. Indeed, these two types of innovation are often interrelated. The data available, however, do not permit the analysis of whether an innovation in a product is related to one in a process. An enterprise may, therefore, have introduced a new product on the market and developed a new process without any connection to the specific product. However the finding implies that the majority of firms having a capacity to innovate in the product field also tend to be innovative in the process field.

At the EEA-level purely product-innovating enterprises outnumber exclusively process innovating enterprises (Table 2.1.2). 13% of enterprises have been introducing on the market a new or improved product without adopting any new or significantly improved production method. Enterprises that have been innovating in the process field without product innovation, on the other hand, account for only 7% of the total number of enterprises.

Table 2.1.2: Number of product or process innovators as a percentage of enterprises in manufacturing sector, 1996

	All innovators	Product innovator	Process innovator	Product innovator only	Process innovator only
EU-15	51	44	39	13	7
B	34	31	22	12	4
DK	71	58	51	19	13
D	69	65	53	15	4
E	29	24	25	4	5
F	43	38	31	12	5
IRL	74	66	54	19	8
I	48	37	41	7	12
L	42	32	29	12	9
NL	62	56	46	16	6
A	67	60	49	19	7
P	26	15	23	3	11
FIN	36	30	25	11	7
S	54	48	38	17	6
UK	59	52	37	22	7
EEA	51	44	39	13	7
NO	48	35	40	8	13

Source : CIS2, Eurostat / Enterprise DG.

The country data for manufacturing provided in Table 2.1.2 indicate a tendency for four countries with low share of innovators (Italy, Portugal, Luxembourg and Spain) to rely proportionately more on process innovation than on product innovation. In contrast, higher intensity innovators (Denmark, Germany, Ireland, the Netherlands and Austria) all record proportionately high levels of product innovation, both in combination with a certain degree of process innovation and with only product innovation.

Innovation: inventive effort or adoption of external technology?

That process innovation to a larger extent relies more than product innovation on externally developed mechanisms is, in fact, confirmed by the data presented in Table 2.1.3, showing a breakdown of the number of innovators according to the origin of the product or the process. As seen, on average for all countries, 73% of product innovators reported to have implemented the innovation on the basis of own resources and own R&D, as against only 8% reporting to have relied on external sources (and 27% relying on a combination of the two sources). In the field of process innovation the share of firms having implemented the innovation on the basis of their own research was only 48% with 28% having relied on external support. In this respect, the innovation in the service branches (at least as understood in this survey) appears to be rather similar to the process innovation in manufacturing.

The share of enterprises relying mainly on internal research in the field of product innovation shows only modest variation according to the size of the firm: 74% of large firms relied on own resources or a figure not much higher than the 71% and 74% reported by small and medium-sized firms, respectively. The tendency for product innovation to rely more than process innovation on internal research is also broadly the same for all countries albeit with some striking outlying observations, such as, notably, the high reliance on external sources for process innovation in Germany (51%) contrasting with only 10% in Italy and 11% in Belgium. Since a high proportion of external contribution to process innovation is likely to be implemented by consulting firms, the data imply a very different structure of the market for business services in those countries.

Table 2.1.3: Number of innovators according to who developed the innovation (%), 1996

	Manufacturing product			Manufacturing process			Services[1]		
	Developed internally	Both internally and with others	Developed by others	Developed internally	Both internally and with others	Developed by others	Developed internally	Both internally and with others	Developed by others
EU-15	73	27	8	48	32	28	54	33	19
EEA	73	27	8	48	32	28	54	33	19
Small	74	24	9	52	27	28	53	30	22
Medium	71	29	8	46	34	27	56	37	12
Large	74	30	6	39	42	31	57	47	8
B	68	25	10	60	31	11	46	52	9
DK	68	32	9	51	37	25	59	46	8
D	65	27	7	12	37	51	51	35	15
E	:	:	:	:	:	:	:	:	:
F[2]	74	33	8	60	38	15	59	47	14
IRL	76	21	14	68	26	15	64	16	25
I	83	24	5	72	30	10	:	:	:
L	54	25	23	34	30	36	50	25	29
NL	70	28	12	36	38	34	43	37	29
A	78	39	10	64	43	24	49	53	34
P	80	16	8	59	28	16	47	30	26
FIN	66	34	8	45	41	20	49	40	14
S	70	26	7	51	33	16	59	30	12
UK	77	21	13	61	16	32	67	13	26
NO	61	34	10	47	33	22	55	32	17

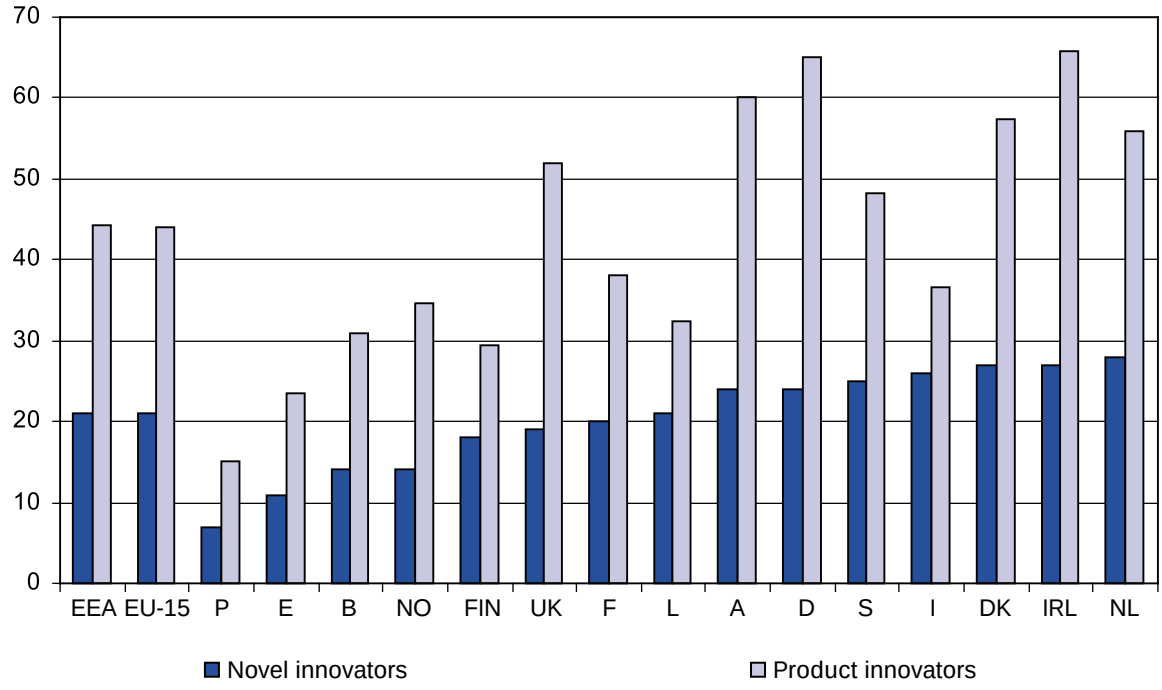
1: Italy and Spain are not included in the service sector.
2: Wholesale is not included.

Source : CIS2, Eurostat / Enterprise DG.

New to the firm, new to the market?

On average about half the enterprises in manufacturing are, in CIS2, classified as being product or process innovators and 44% as product innovators. Among these (product innovators) firms, slightly less than half were reported to be ‘novel innovators’, that is, to have introduced products which were new not only to the enterprise itself but also to its market. As mentioned above, new does not necessarily mean new to the world or country. ‘Novel innovators’ therefore can contribute to innovation through the diffusion of products which may have been designed and created outside their own market.

Figure 2.1.3: Number of product innovators, new to the firm compared to new to the market (%), manufacturing sector, 1996



Source : CIS2, Eurostat / Enterprise DG.

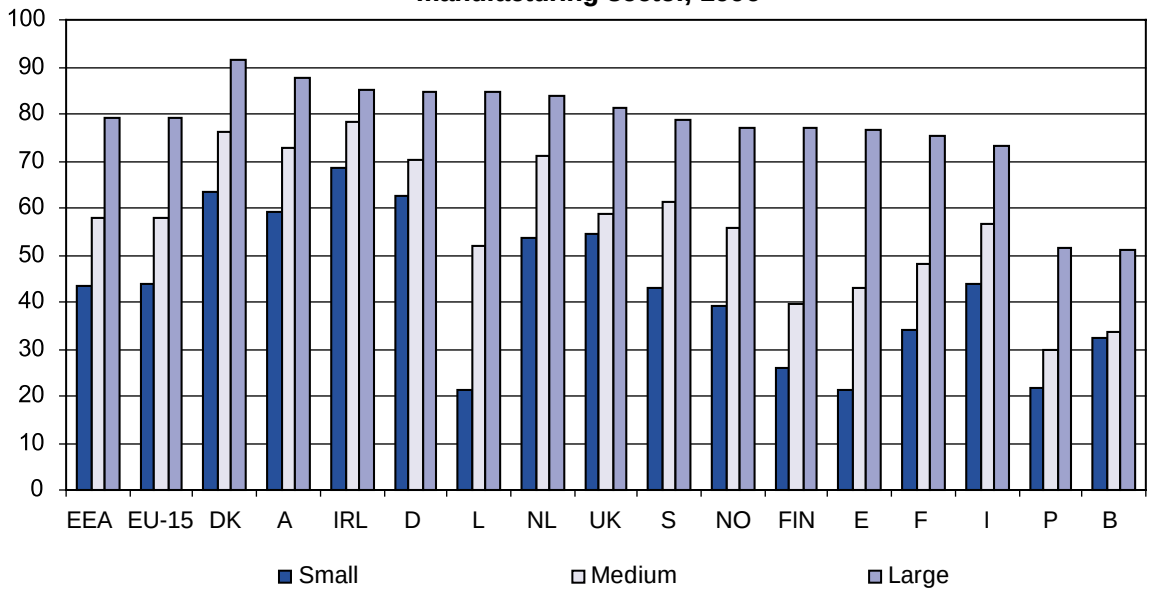
As illustrated in Figure 2.1.3, Italy, Denmark, Ireland and the Netherlands are the countries with the highest proportion of novel innovators; more than a quarter of the enterprises have been introducing on the market a product that is new to the enterprise's market. On the other hand, in Portugal, Spain, Belgium and Norway the share of novel innovators relative to the total number of enterprises is low. However, expressed in proportion to the (relatively low) number of product innovators as shown in Table 2.1.2, the number of novel innovators for Belgium and Spain is not much different from that of the European average. Among the four large EU Member States, Italy and France stand out as having a comparatively low share of innovators in products on average but with a high share of novel innovators. In Germany and the UK, in contrast, where the overall share of product innovators is on the high side, the share of novel innovators is comparatively low.

Does the propensity to innovate increase with size?

The propensity to innovate is higher in large firms than in small ones. As illustrated in Figure 2.1.4, the proportion of large firms that reported to be innovating on average, at 79% for the 15 EEA countries, is almost twice as high as that of the small enterprises, with the medium-sized enterprises on average half way between the large and the small ones.

The fact that large-size enterprises are more likely to innovate than small-sized enterprises has been amply demonstrated by all surveys of innovation in the business sector. Large enterprises, on average, have a higher level of research and development, broader production programmes and are more likely than small ones to have changed or newly introduced at least one product or process during the reference period of 1994 to 1996. Large enterprises in industries characterised by economies of scale, high capital intensity and technological intensity, may also have a greater likelihood to engage in risky projects as well as economies of scope.

Figure 2.1.4: Number of innovators by size class and country (%), manufacturing sector, 1996



Source : CIS2, Eurostat / Enterprise DG.

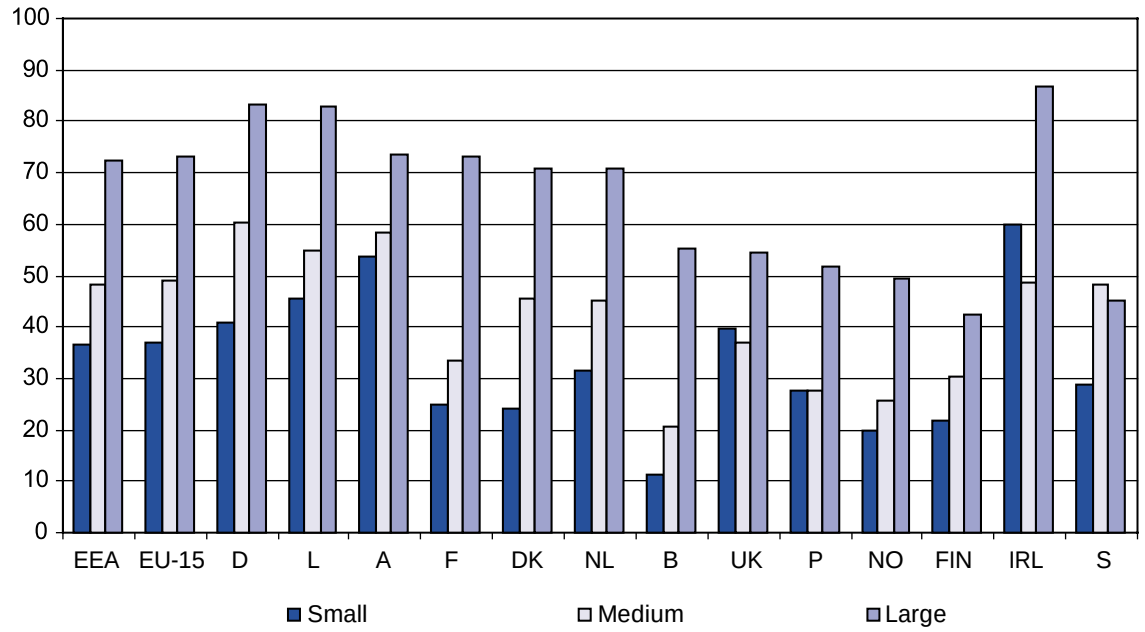
In some sectors though, small enterprises can have more scope for competing technologically with larger firms, particularly in branches where technology is not so sophisticated and capital intensive. Small enterprises can succeed in those markets for more or less tailor-made products if they concentrate on their strengths, i.e. flexibility, responsiveness to customers' needs, etc. This may, indeed, be one important explanation for the fact that in some of the smaller countries the share of small firms reported to be innovators is high as compared to the larger countries where more of the innovation is concentrated in large firms.

Whereas large firms show a high propensity to innovate in all countries, the share of innovating firms among small or medium-sized firms consequently shows rather large differences within the 15 countries participating in CIS2. As illustrated in Figure 2.1.4, the share of large innovating firms in manufacturing for practically all countries (the exception being Portugal and Belgium), lies within the range of 70% to 90% for national averages of large enterprises. For small-size firms the share of innovating manufacturing enterprises ranges from a low of some 20% in Luxembourg, Spain and Portugal to a high of some 60-70% in Denmark, Austria, Germany and Ireland.

In broad terms the fact that the share of innovating firms is higher for large than for small firms also holds true for the branches of services covered by CIS2. As shown in Figure 2.1.5, the share of innovating firms in the service sector on average for the 15 countries ranges from 36% for the smallest size class and 48% for medium-sized firms to 73% for the large firms. As an exception to the general size pattern, the share of innovators for medium-sized Irish companies is lower than that of smaller ones. In Portugal, the UK and Austria, small and medium-sized enterprises have a percentage of innovators that are quite close to one another. In Sweden there is only little difference between large and medium-sized enterprises in this respect.

Figure 2.1.5, however, also shows somewhat larger discrepancies between the countries surveyed, both as regards the comparison between countries within a given size class and a comparison between size classes for a given country. In fact, as seen, among large-sized service enterprises the share of innovators vary between some 45% in Finland and Sweden and more than 80% in Germany, Luxembourg and, notably, Ireland.

Figure 2.1.5: Number of innovators by size class and country (%), service sector[1,2], 1996

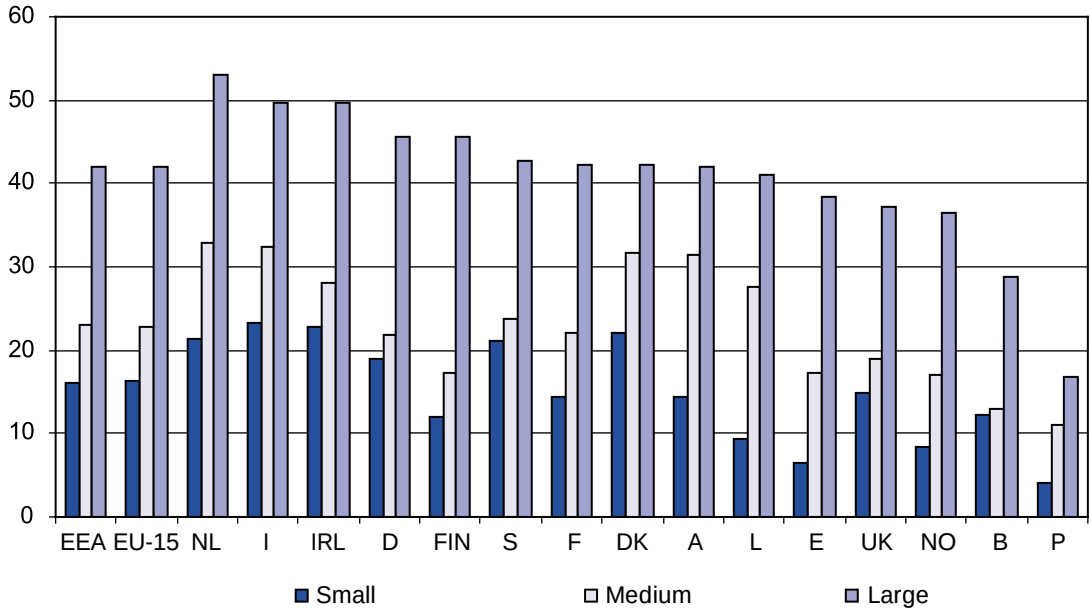


1: Spain and Italy are not included.
2: France: wholesale is not included.

Source : CIS2, Eurostat / Enterprise DG.

This general relation between size of the enterprise and propensity to innovate may be explained for both sectors, at least in part, by the scale of activities: large firms are more likely to report that they have introduced innovations as they typically have a broader range of products and lines of business. During the 3-year reference period, these firms are more likely to have introduced a change in at least one of their products or methods of production. They are therefore considered as innovators. Smaller companies may also improve technologically, continuously or intermittently but if this is carried out beyond the reference period, they are considered to be non-innovators.

Figure 2.1.6: Number of novel innovators by size class and country(%), manufacturing sector, 1996



Source : CIS2, Eurostat / Enterprise DG.

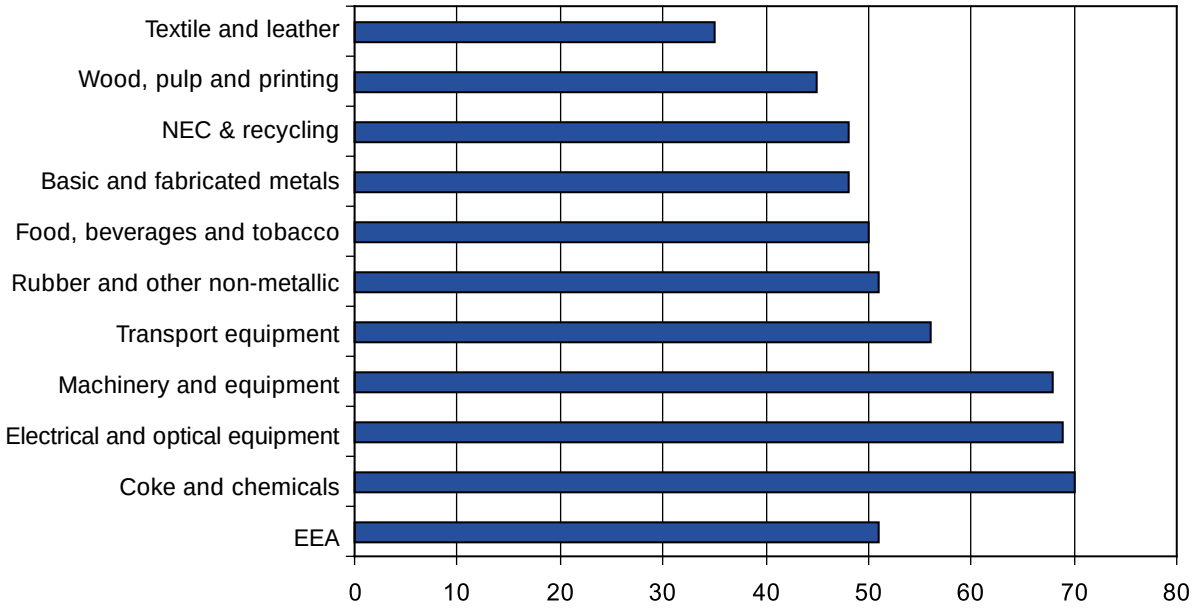
Size structure of novel innovators

As shown in Figure 2.1.6, among large firms in the manufacturing sector, the share of novel innovators is more than twice as high as that of small firms, 16% for the small-sized enterprises as compared to 42% for large ones. The pattern is the same for all countries in the survey and, like for the overall share of innovators, the largest relative difference between the size bands is found in Luxembourg, the Netherlands, Finland and Spain (in the order of 30 percentage points or more).

What is the propensity to innovate for different economic activities?

As could be expected, the share of innovating firms is, generally higher in the 'knowledge-based' industries than in the more traditional classes of manufacturing industries. As shown in Figure 2.1.7, the share of innovators for all countries by economic sector, following the structure of the European nomenclature of economic activities (NACE), ranges, on average, from 35% for the textile and leather industry to 70% for coke and chemicals. The latter is closely followed by electrical and optical equipment (69%) and machinery and equipment (68%). The group of industries with a relatively low share of innovators include, in addition to manufacturing of textile and leather products, notably wood, pulp and paper (45%), basic and fabricated metals (48%), the economic activities not-elsewhere classified (NEC) and recycling (also 48%).

Figure 2.1.7: Number of innovators by economic activity (%), manufacturing sector, 1996



Source : CIS2, Eurostat / Enterprise DG.

However, data for the individual countries presented in Table 2.1.4, show large variations in the share of innovators for a given industry. In transport equipment, for example, the share of innovating firms amounts to 19% in Portugal compared to 88% in Ireland. In a ranking of the shares of innovators in the individual countries for the different branches the pattern is approximately the same as for manufacturing as a whole. Enterprises in coke and chemical, in machinery and equipment and in electrical and optical equipment very often rank among the sectors with relatively high numbers of innovators in all countries. Textile and leather, together with wood, pulp and paper are, in most countries, among the sectors with the lowest percentage of innovators

Within the group of service branches surveyed in CIS2, the share of innovating firms shows even larger discrepancies than for manufacturing. As seen in Table 2.1.5, the share of innovators ranges from a low of 24% in transport to 68% for computer and related service activities, only slightly ahead of telecommunications with 64%.

Table 2.1.4: Number of innovators by economic activity (NACE) (%), manufacturing sector, 1996

	Manufacturing	Food, beverages and tobacco	Textile and leather	Wood, pulp and printing	Coke and chemicals	Rubber and other non-metallic	Basic and fabricated metals	Machinery and equipment	Electrical and optical equipment	Transport equipment	NEC & recycling
EU-15	51	50	35	45	70	51	48	68	69	57	48
B	34	27	28	30	46	34	39	44	51	41	25
DK	71	73	55	70	93	63	58	80	88	85	60
D	69	68	62	59	75	67	59	84	78	72	69
E	29	22	18	21	62	31	25	46	55	46	23
F	43	45	30	32	68	49	31	63	61	49	38
IRL	74	65	58	68	79	79	68	89	88	88	71
I	48	59	32	45	61	44	54	61	56	47	53
L	42	15	:	43	53	51	44	70	50	:	:
NL	62	58	49	53	85	67	53	80	74	60	57
A	67	67	55	62	71	45	68	80	88	78	82
P	26	25	19	24	77	36	19	36	80	19	17
FIN	36	25	37	30	61	44	31	41	51	36	22
S	54	38	45	45	61	57	41	73	75	58	59
UK	59	58	56	51	81	53	56	63	76	63	44
EEA	51	50	35	45	70	51	48	68	69	56	48
NO	48	48	45	36	76	54	43	64	65	44	51

Source : CIS2, Eurostat / Enterprise DG.

Table 2.1.5: Number of innovators by economic activity (NACE) (%), service sector, 1996

	Services[1]	Wholesale	Transport	Telecom-munications	Financial intermediation	Computer & related activities	Engineering services
EU-15	40	34	24	65	54	68	55
B	13	10	9	27	13	41	43
DK	30	27	13	100	48	89	36
D	46	39	26	100	70	71	61
F[2]	31	:	11	52	45	52	39
IRL	58	52	33	86	67	73	78
L	49	37	58	43	43	88	77
NL	36	36	21	74	40	68	52
A	55	58	54	81	55	69	21
P	28	26	28	45	43	53	30
FIN	24	15	16	79	28	64	31
S	32	29	19	51	56	55	47
UK	40	33	34	60	49	81	38
EEA	40	34	24	64	54	68	55
NO	22	18	5	56	44	50	38

1: Spain and Italy are not included.
2: Wholesale sector not included.

Source : CIS2, Eurostat / Enterprise DG.

Like for manufacturing, the data for individual countries show large discrepancies, possibly due to some extent to different size class distribution. While only 27% of Belgium enterprises with their main economic activity in the telecommunication sector declare themselves as innovators, the share of German and Danish innovators in this sector is very high. In transport only 5% of the Norwegian enterprises are considered as innovators whereas in Austria the share is 54%.

Large cross-country differences are also found for the wholesale branch, where, like for transport, Belgium shows the lowest and Austria among the highest share of innovating firms.

Are exporters more likely to be innovators?

There is an increasing recognition that innovation is one of the most important factors determining competitiveness and, notably, the capacity of a firm to compete efficiently in the world market. Innovators, in this section, are analysed in the light of their export intensity, i.e. their share of export sales in total turnover.

Table 2.1.6: Number of innovators according to export intensity, as a percentage of total number of enterprises, 1996

	Manufacturing sector				Service sector[2]			
	No exports	Low	Medium	High	No exports	Low	Medium	High
EU-15[1]	40	52	58	61	40	53	46	44
B	18	31	27	45	17	30	14	19
DK	61	50	63	89	27	30	73	14
D	61	67	73	79	42	69	54	53
E	18	35	44	44	:	:	:	:
F[3]	26	42	53	62	31	24	24	36
IRL	46	70	73	83	71	47	45	54
I	36	52	53	57	:	:	:	:
NL	45	55	70	79	38	25	31	27
A	49	67	64	76	24	100	56	28
P	16	26	32	26	16	34	45	36
FIN	15	35	40	59	26	42	53	36
S	34	51	56	68	32	39	42	22
UK	53	60	64	72	40	68	63	72
EEA[1]	40	52	58	61	39	53	46	44
NO	37	49	60	65	17	66	46	54

1: Luxembourg not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector not included.

Source : CIS2, Eurostat / Enterprise DG.

The survey, indeed, shows that there are relatively more innovators among exporters than among non-exporters. On average, 57% of enterprises with sales on foreign markets are innovators compared to 40% for non-exporters in manufacturing. In the manufacturing sector, the share of innovators is higher, the higher the firm's dependence upon exports. For the individual countries the share of innovators again shows rather large variations, reflecting mainly the differences already presented above for the economy as a whole and for the single industries and size classes. Therefore, among the manufacturing enterprises catering for the domestic market (non exporters), the share of innovators ranges from a low of 15-18% in Finland, Belgium, Portugal and Spain (the four countries with the lowest overall share of innovators, as shown in Table 2.1.1) to a high of 61% in Denmark and Germany. In the class of non-exporting enterprises the share of innovators is, however, only in the medium range in Ireland, where, on the other hand, the share of innovators among exporters is among the highest.

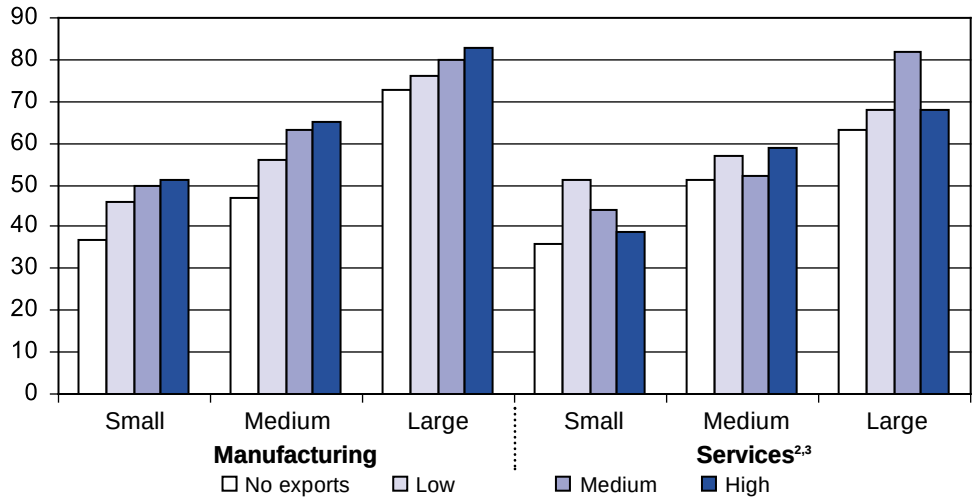
On the whole, as already suggested, the share of innovators in the manufacturing sector for most countries is higher the higher the export dependence of the firm with nevertheless some exceptions. In Belgium, Spain and Portugal (low innovators in general), the tendency for the share of innovators to rise as a function of the export intensity is not pronounced (for Belgium and Spain) or absent (Portugal).

For the service sector there are also more innovators among exporters, but at the more detailed level certain differences show up. The share of innovating firms catering mainly for the domestic market is lower than in manufacturing, except in Ireland, France and Finland. On average, the share of innovators decreases as the export intensity increases, decreasing from 53% down to 44%. Furthermore, the country-by-country details show a less clear picture than for manufacturing. There is a sharp decrease in level of innovators as the export intensity increases in Austria and to a much lesser extent in Germany.

The overall tendency for the share of innovators to rise as a function of the export intensity is found also in a breakdown of these data by size class within manufacturing. As shown in Figure 2.1.8 the share of innovating firms for small, medium-sized and large enterprises is the lowest among the non-exporters and the highest among firms with a high export intensity.

For service branches included in this survey the results of a breakdown by size class and export intensity are less homogeneous.

Figure 2.1.8: Number of innovators by export intensity (%), breakdown by size class, EEA[1], 1996



1: Luxembourg is not included.
2: Wholesale sector and financial intermediation are not included.
3: Italy and Spain are not included in the service sector.

Source : CIS2, Eurostat / Enterprise DG.

The share of innovators among exporting firms is much higher in small countries, than in medium-sized and large countries. In the breakdown of innovators according to their export intensity presented in Table 2.1.7, high-intensity exporters in manufacturing account for some 40-60% of innovators in Belgium, Denmark, Ireland, Austria, Portugal, Finland and Sweden but for 20% or less in Germany, Spain, France and the UK. At the other end of the scale, non-exporting innovators account for only a small part of innovating firms in Belgium, Ireland, Austria and Portugal but for a higher part in the larger countries. Nevertheless, there are exceptions to the general rule, possibly reflecting specific local factors.

In the service branches more than sixty per cent of innovating firms are, on average for all countries, catering only for the domestic market or are classified as low-intensity exporters and this general picture is found in all countries, although with a higher proportion of innovating firms classified as low-intensity exporters in Finland and Portugal. Conversely, on average for the countries included in this survey, only fifteen per cent of firms in the service branches are classified as high-intensity exporters, with this proportion even as low as three per cent in Germany.

Table 2.1.7: Distribution of innovators by export intensity (%), by country, 1996

	Manufacturing				Service sector[2,3]			
	No exports	Low	Medium	High	No exports	Low	Medium	High
EU-15[1]	26	25	25	25	66	17	11	6
B	8	13	20	58	36	21	24	19
DK	27	9	16	47	70	8	16	6
D	27	29	28	16	70	17	10	3
E	31	25	25	19	:	:	:	:
F	18	34	29	19	52	25	13	11
IRL	9	13	21	57	52	6	13	29
I	25	21	23	31	:	:	:	:
NL	18	24	25	33	:	:	:	:
A	7	26	28	38	79	4	6	11
P	8	27	24	41	12	22	60	6
FIN	12	24	22	42	9	76	9	7
S	13	22	26	40	56	17	17	9
UK	42	21	19	18	68	18	10	4
EEA[1]	26	25	24	25	66	17	11	6
NO	37	19	20	25	69	13	7	11

1: Luxembourg is not included.
2: Wholesale sector and financial intermediation are not included.
3: Spain and Italy are not included in the service sector.

Source : CIS2, Eurostat / Enterprise DG.

Chapter 2
Output of innovation

♦ *A third of European manufacturing sales is due to new or improved (innovative) products for the enterprise.*
♦ *Innovative products new to the market represent 7% of all manufacturing sales.*
♦ *Large enterprises have been introducing relatively more innovative products than smaller ones, but if we turn to product innovators only, the picture is less clear-cut.*

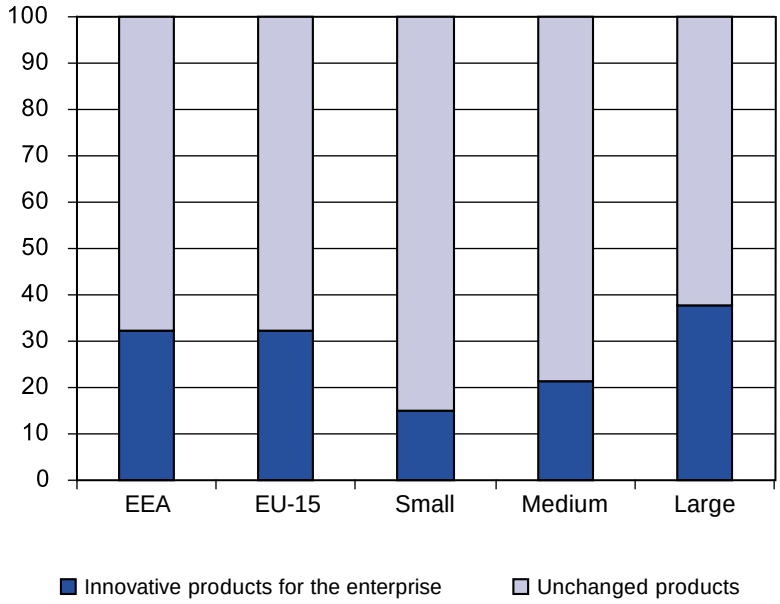
The present chapter will present the indicators on the outputs of innovation activities. The principal indicator in this field is the proportion of improved or new products (to the firm) in total sales (innovative products). A further breakdown by products also new to the enterprise market will be made. These statistics, however, focus only on product innovation, leaving out other aspects such as process innovation. This is mainly due to the fact that product innovation is more easily identified and measured. However, this does not necessarily imply that product innovation is more important than the other categories of innovations.

Composition of sales

In 1996, a third of European sales consisted of products new or improved to the enterprise (introduced between 1994 and 1996). Although innovation is an essential precondition for growth and competitiveness, European enterprises still realise the major part of their turnover with products which have remained unchanged during a three-year period.

The proportion of innovative (new or improved) products in turnover increases with the size of the enterprise as shown in Figure 2.2.1. The share of these products in total turnover increases from 15% for small enterprises, to 21% for medium-sized and 38% for large ones. The largest part of sales from small firms is, therefore, attributable to products that have not been changed during the three years covered by the survey. Innovating products hence represent a small proportion of the total turnover of those enterprises. It is recalled that, as indicated in Chapter 2.1, only 44% of small firms have been engaged in innovation activities between 1994 and 1996.

Figure 2.2.1: Composition of sales in the manufacturing sector, total population, EEA[1], 1996

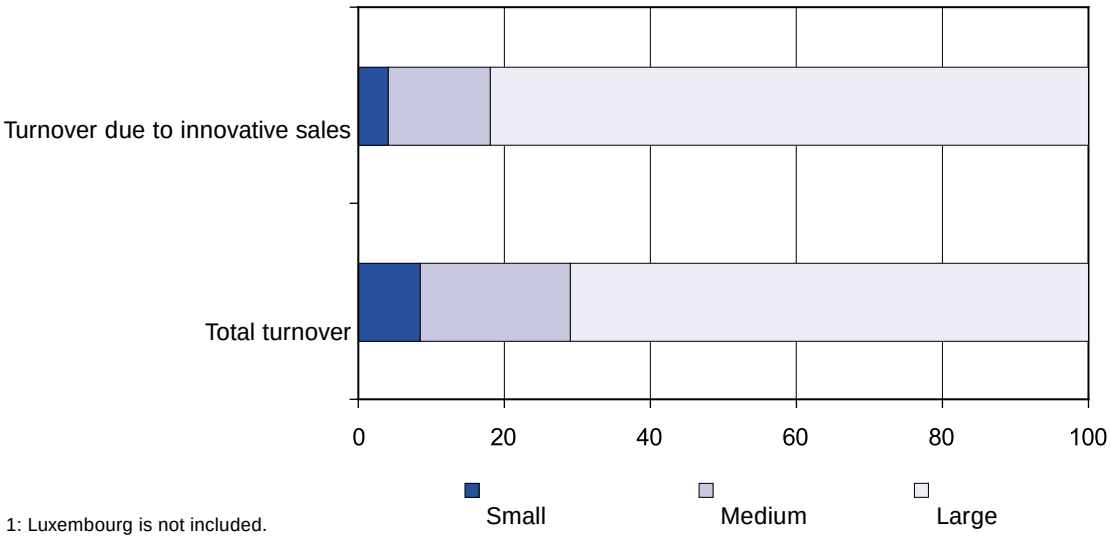


1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Figure 2.2.2 shows that large enterprises account for 71% of the total turnover while medium and small-sized represent respectively 21% and 9%. Compared to the sales of innovative products, large enterprises have a much higher share and consequently the two other size bands have lower shares. Small enterprises account for only 4% of the innovative sales while large enterprises contribute to 82% of the total sales due to innovative products.

Figure 2.2.2: Comparison of the share of innovative products and total sales by size class, manufacturing sector, EEA[1], 1996

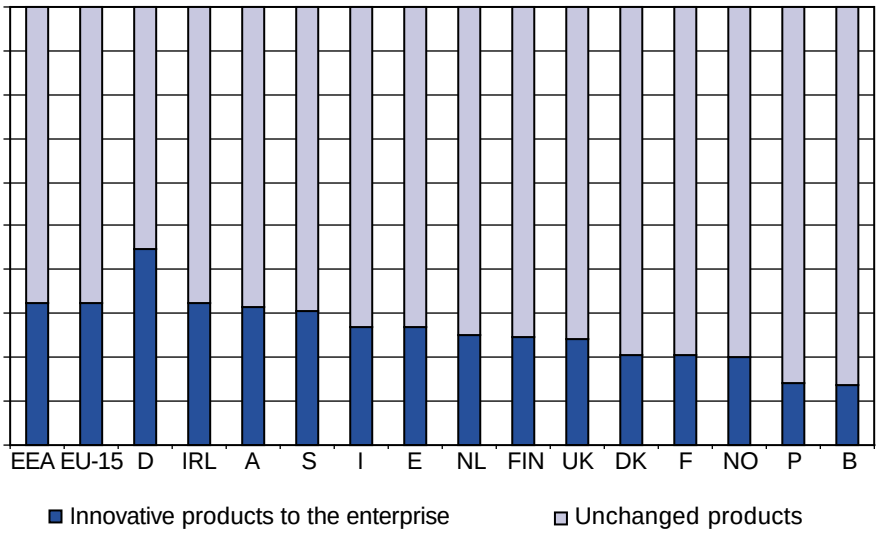


1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

In general, countries with a large number of innovating firms also report a comparatively high share of new or significantly improved products in their sales. This is the case for Germany, Ireland, and Austria. In this respect, Germany has the highest share of turnover due to innovative products, with almost 45% of the value of turnover consisting of new or improved products. Correspondingly, in countries with a relatively small number of innovating firms, notably Belgium and Portugal, new and significantly improved products account for only a small share of sales, see Figure 2.2.3.

Figure 2.2.3: Composition of sales, manufacturing sector[1], by country, total population, 1996



1: Luxembourg is not included.

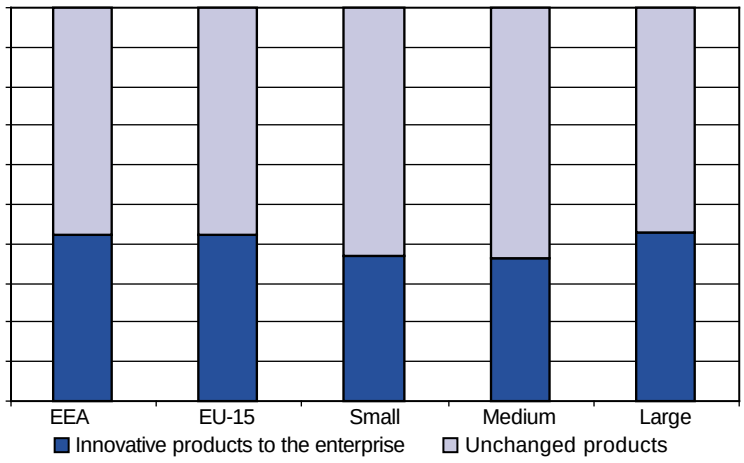
Source : CIS2, Eurostat / Enterprise DG.

However this general picture is not true for all countries. Spain, which has the second lowest number of innovators, is found in the middle range of countries ranked according to the share of innovative products in turnover. Denmark, on the other hand, where the number of innovating firms is the second highest, is somewhat below Spain in the ranking according to the share of innovative products in total sales.

Sales for innovating enterprises

Focusing on innovators only, unchanged products account for almost 60% of turnover, as shown in Figure 2.2.4. The most important finding is that the overall share in turnover of innovative products does not show significant disparities as between small, medium-sized and large firms. In this context, it should be mentioned, however, that small enterprises, on average, are spending more on innovation in proportion to their turnover than large firms (see chapter 2.3). The finding that the proportion of new products in turnover is not significantly different from that of large firms may be attributable to the fact that large enterprises may benefit from economy of scales.

Figure 2.2.4: Composition of sales, manufacturing sector[1], by size, innovators only, 1996



1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

The ranking of countries according to the share in turnover of new or improved products is slightly modified when the analysis is carried out focusing only on innovators. Germany is also, in this comparison, the country with the highest level of innovative products but Denmark ranks last, rather than Belgium as in Figure 2.2.3. The most important differences is seen for new products in Portugal, which is among the top three countries with the highest level of turnover due to new products compared to the ninth country in the previous ranking (Table 2.2.1).

CIS2 compared to CIS1: sales of innovative products

As stated previously, CIS1 is not directly comparable with CIS2. Differences between the findings of the two surveys, consequently, are likely to result more from changes in survey technique and/or changes in the questionnaire rather than changes in the underlying reality. A rough comparison of the results of the two surveys with respect to the distribution of sales for innovating enterprises shows an appreciably lower share of new or improved products in CIS2 than in CIS1 for Belgium, Denmark, Spain and to a lower extent for the Netherlands. However, in France, Ireland and notably Italy and Portugal, there is an increase in the share of sales due to innovative products.

Table 2.2.1: Comparison of the composition of sales, manufacturing sector, innovators only, CIS2 and CIS1 (%)

	CIS2		CIS1	
	New or improved	Unchanged	New or improved	Unchanged
EU-15[1]	42	58	:	:
B	28	72	40	60
DK	29	71	44	56
D	50	50	50	50
E	44	56	52	48
F	29	71	27	73
IRL	41	59	36	64
I	43	57	29	71
NL	33	67	36	64
A	40	60	:	:
P	40	60	29	71
FIN	32	67	:	:
S	37	63	:	:
UK	31	69	:	:
EEA[1]	42	58	:	:
NO	33	67	32	68

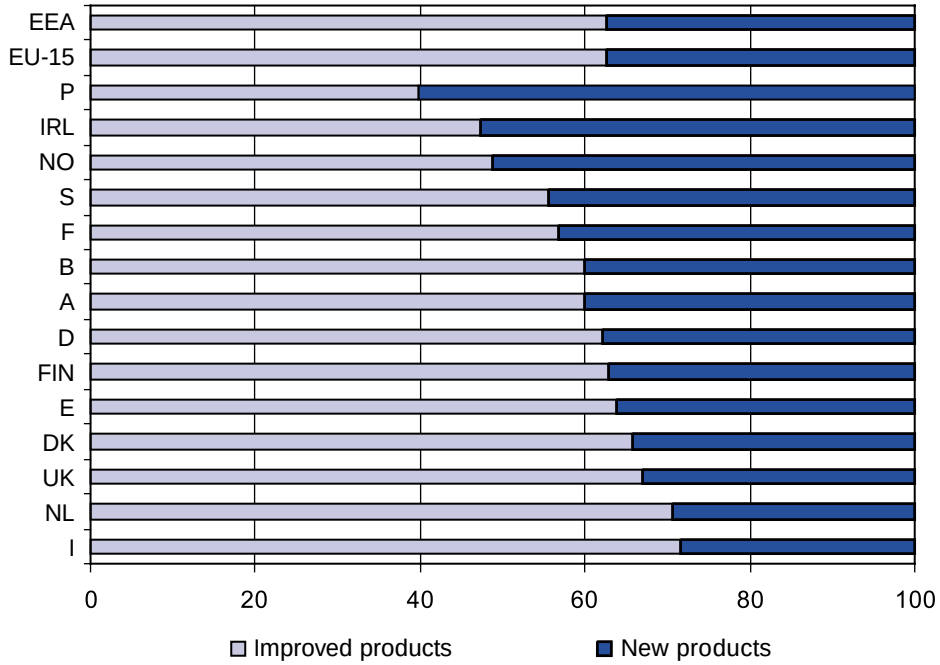
1: Luxembourg is not included.

Source : CIS1&CIS2, Eurostat / Enterprise DG.

Structure of product innovation: new or only improved to the enterprise?

Whereas the launching of completely new products can be considered to be the most visible and important part of the process of innovation, there is broad agreement that also significant improvement of existing products should be taken into account as innovation. In fact, products which are completely new to the enterprise, on average for the 14 countries considered, account for only about a third of turnover of innovative products. The remaining two thirds therefore consist of turnover in improved, but already existing, products.

Figure 2.2.5: Breakdown of turnover due to products new or improved to the enterprise, manufacturing sector, EEA[1], 1996



1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

A breakdown of the sales of innovative products on new and improved products shows that the share in sales of improved versions of existing products varies from more than 70% in Italy to only some 40% in Portugal. Emerging from Figure 2.2.5 is also the finding that the share of new products in sales due to innovative products is not directly related to the relative number of innovating firms or to the share of innovative products in the total turnover of manufacturing. In Ireland, for example, where the number of innovators is high and where innovative products account for a high overall share of manufacturing turnover, new products are relatively important for innovators. In Denmark, on the other hand, which is also a country with a high number of innovators, improved products represent almost 70% of the total turnover of innovative products.

As it seems, on average for the 14 countries, the reliance upon new products appears to be somewhat greater among small, than among medium-sized and large, firms, suggesting that small- and medium-sized firms rely more on a narrow range of newly created industrial goods. Large firms, with a broader and more heterogeneous structure of production, depend somewhat more on the improvement of existing products (Table 2.2.2).

However, in this latter respect the relative importance of new products for the different size classes of enterprises is not the same in all countries. In fact, the relative importance of new products appears to run counter to the general picture in particular in Ireland and Portugal and to a lesser extent in Belgium and Austria. Some further light on this issue is, nevertheless, shed by the analysis of the response to the questions as to whether new products are new to the market or only to the enterprise.

Table 2.2.2: Share of new products in innovative products, manufacturing sector, EEA[1], 1996				
	All	Small	Medium	Large
EU-15	37	43	39	37
B	40	39	36	42
DK	38	59	46	36
D	34	40	29	35
E	36	41	43	34
F	43	47	43	43
IRL	53	41	49	57
I	28	35	32	26
NL	29	29	27	30
A	40	30	40	41
P	60	23	47	66
FIN	37	42	32	38
S	44	43	43	45
UK	33	27	24	36
EEA	37	43	39	37
NO	51	60	50	51

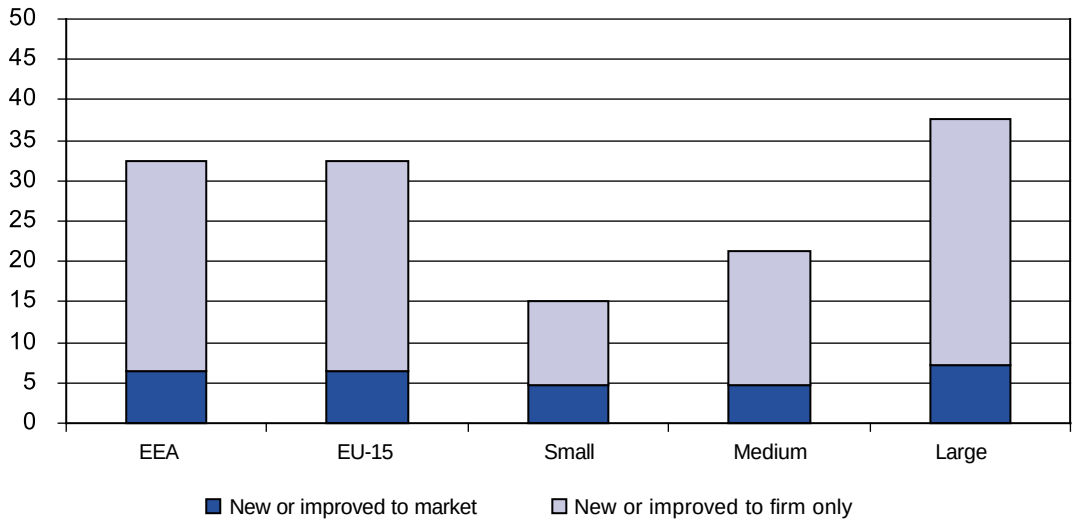
1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Sales new to the firm or new to the market?

In order to track the full path of innovation, the definition of innovation applied in the survey is a relatively broad one (new to the enterprise). Innovative products may not only be new to the enterprise but also new to the enterprise's market (novel products). As shown in Figure 2.2.6, on average a third of turnover in manufacturing is due to new or improved products but only some 7% are in fact new or improved to the market. The remaining 26%, therefore, consists of innovative products for the enterprise but not for the market. Products new to the enterprise market make up less than 5% of total turnover for small- and medium-sized enterprises and 7% for large ones.

Figure 2.2.6: Composition of sales, new to the market/firm by size, total population, manufacturing, EEA[1], 1996

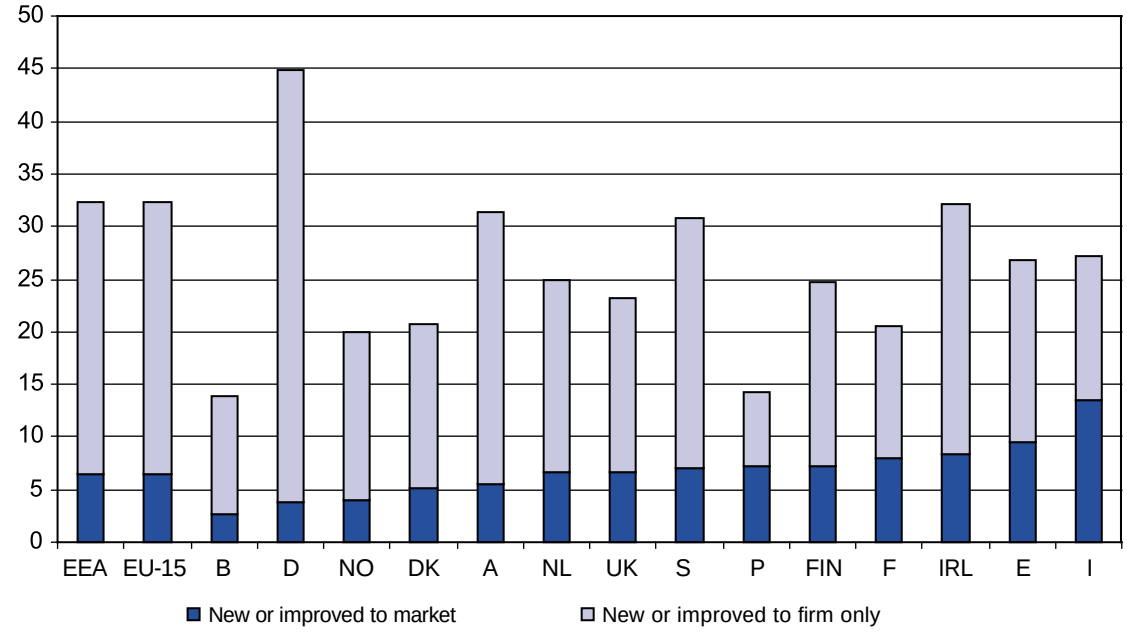


1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

An analysis at the country level shows that Spain and Italy have the highest percentage of turnover of products new to the market, respectively about 9 and 13%. In contrast, Belgium, Germany and Norway are at the low end of the range. Belgian enterprises record less than 3% of sales for novel products, German and Norwegian enterprises around 4%.

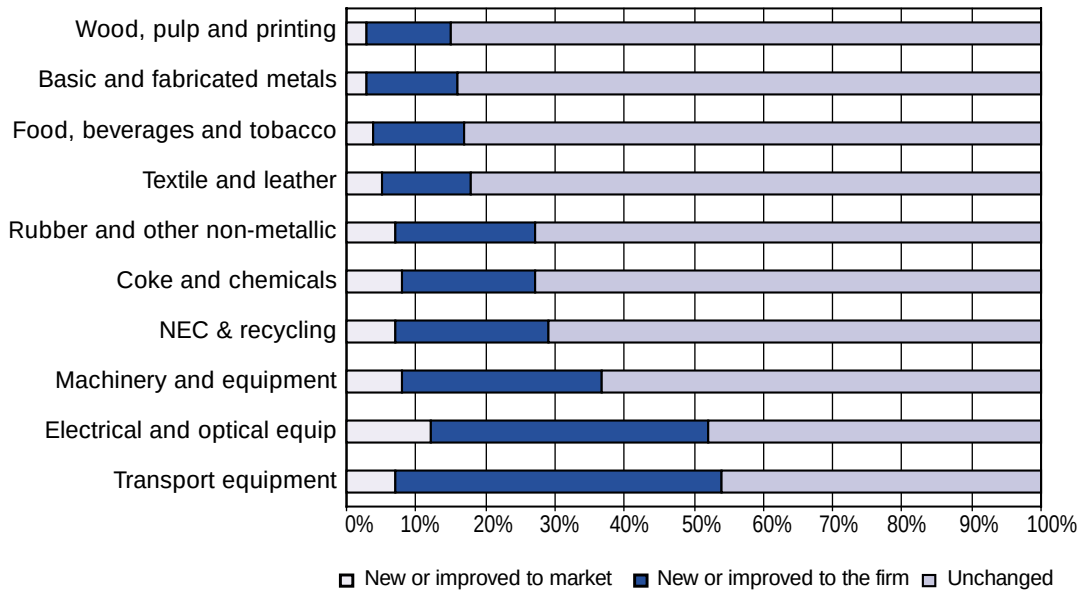
Figure 2.2.7: Composition of sales, new to the market/firm and by country, total population, manufacturing, EEA[1], 1996



1: Luxembourg is not included; Source : CIS2, Eurostat / Enterprise DG.

As seen in Figure 2.2.8 the share in innovators' turnover of products which are new or improved to the market or new or improved to the firm differs considerably among the different economic activities. Manufacturing of transport equipment or electrical and optical equipment have the largest share of turnover due to new or improved products; more than half of their sales. At the opposite end is found the sector of wood, pulp and printing, closely followed by basic and fabricated metals and the agro-industries with 15% of their turnover from innovative products.

Figure 2.2.8: Composition of sales, new to the market/firm and unchanged by economic activity, total population, manufacturing, EEA[1], 1996



1: Luxembourg is not included; Source : CIS2, Eurostat / Enterprise DG.

Manufacturers of electrical and optical instruments are by far those, which report the highest share of turnover due to novel products; 12% of their turnover on average, or four times as much as for wood, pulp and paper for instance.

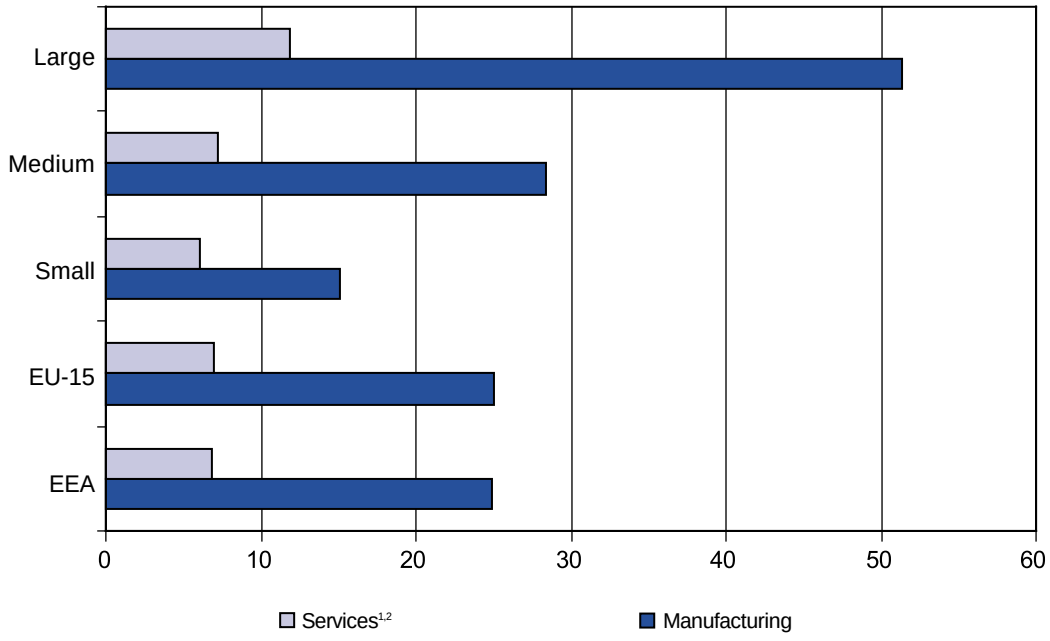
Focusing on the share of novel products in innovative sales, the lowest share of sales due to novel products is found in transport equipment: 7% of sales due to products new to the market compared to 54% of innovative sales. It is followed by basic fabricated metals. For the other sectors, novel products represent between 20% and 30% of innovative products, coke and chemicals being the economic activity with the largest share of novel products.

Patents: a measure of output

For a long time, patents have been used as the main output measurement of innovation activity. In the CIS2 survey, enterprises have been asked whether they have applied for at least one patent in any country. The results show that the propensity to apply for patents in the manufacturing sector is considerably larger than in the service sector. This could be due to the fact that the patenting of certain categories of output of the service branches is a relatively new phenomenon. On average only 7% of innovators in the service sector have, during the three years covered by the survey, applied to at least one patent against a quarter for the industrial sector.

The larger the enterprises are, the higher the share of innovators with a patent application is. This trend is common in both sectors though the gap is much smaller in the service branches. In the manufacturing sector 15% of small and 28% of medium-sized innovators have applied for patents against 51% for large ones.

Figure 2.2.9: Number of innovators having applied for at least one patent as a share of innovators by size, EEA, 1996



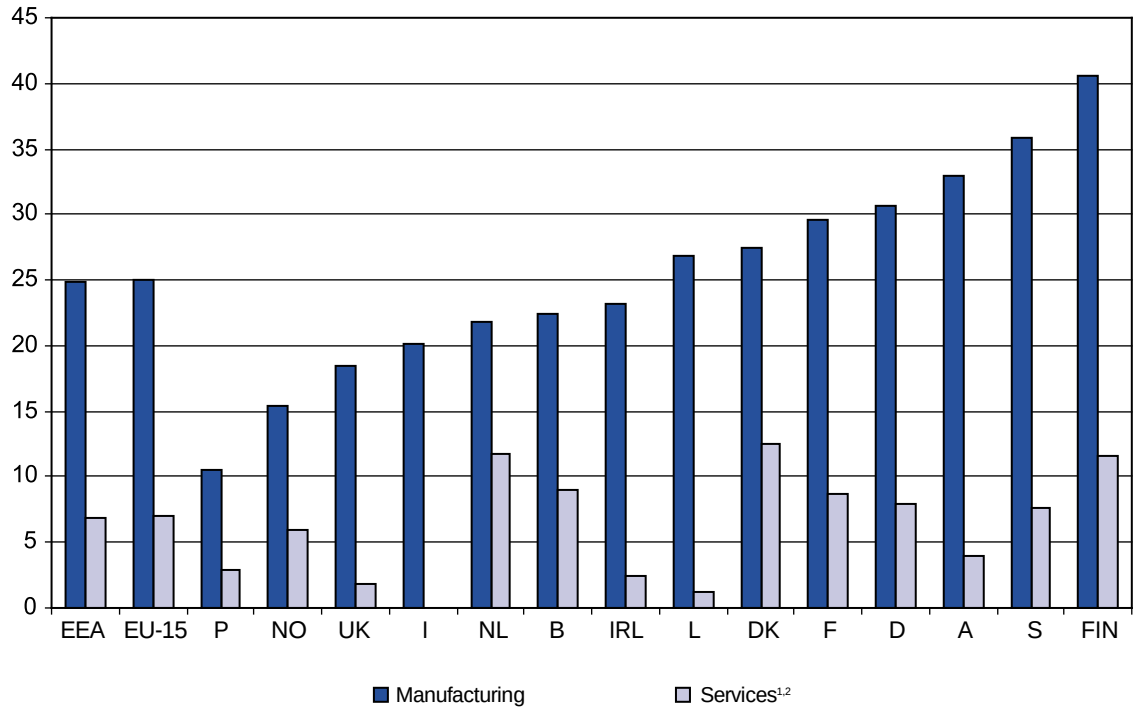
1: Spain and Italy are not included.
2: Wholesale is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Patent application by country

In the manufacturing sector, Finnish innovators have the highest propensity to apply for patents (41%) followed by Sweden and Austria (above a third of innovators). In contrast, Portugal and Norway have the lowest share of innovators applying for patents, respectively 11% and 15%.

Figure 2.2.10: Number of innovators having applied for at least one patent as a share of innovators by country, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included.

Source : CIS2, Eurostat / Enterprise DG.

Regarding the service sector, the shares are much lower and the ranking of the countries differs. Danish and Dutch innovators rank as the first two countries, while in Ireland, Portugal, Luxembourg and the UK less than 4% of service firms have applied for patents.

Chapter 3
Innovation activities and expenditure

- *Manufacturing enterprises in 1996 devoted 4% of their turnover to innovation expenditure, service firms only 3%.*
- *Electrical and optical equipment has the highest innovation intensity in the manufacturing sector; the same stands for computer and related activities in the service branches.*
- *In-house R&D represents the most important component of innovation expenditure.*
- *58% of manufacturing and 40% of service innovators have not been engaged in intra-mural R&D activities.*
- *There is a stronger tendency for large manufacturing innovators to be engaged in R&D than smaller ones.*

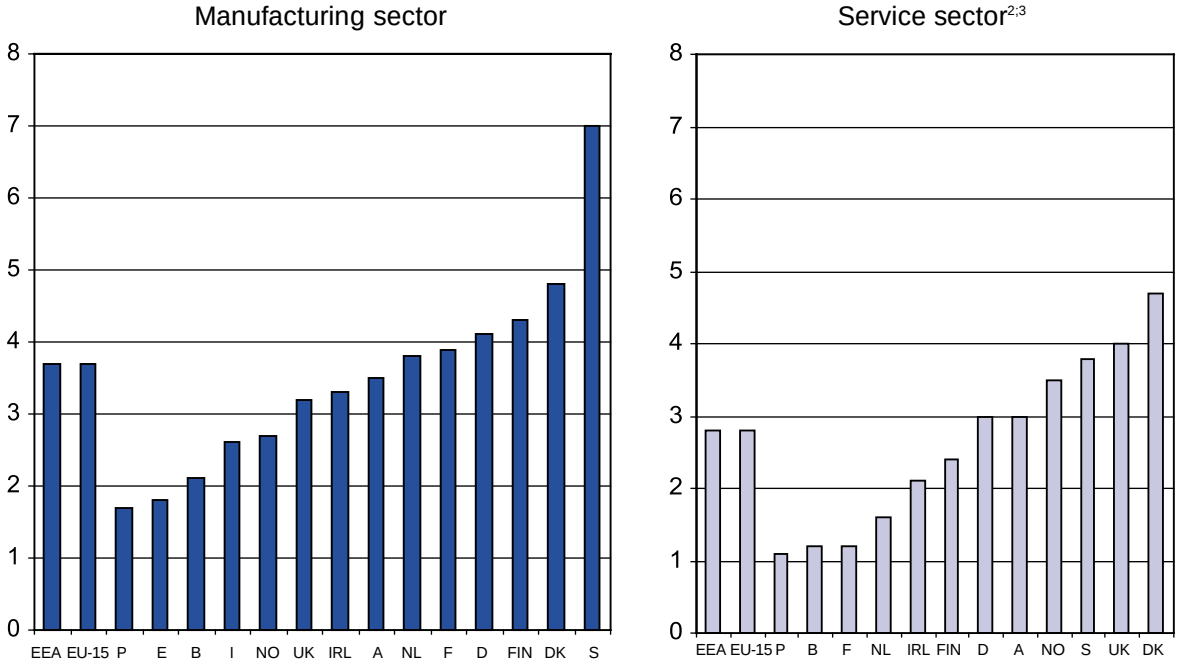
The process of innovation encompasses a wide range of activities: research and technological development, knowledge creation, diffusion, absorption and use of technology. When a firm innovates, it is involved in a complex process of learning, developing and marketing new products and improving production processes. The activities involved can broadly be divided into two classes. The first class mainly constitutes the creation and maintenance of intangible assets such as organisational and human capital, skills, exploration and creation of markets, etc. The second class consists in the acquisition of fixed capital and intermediate goods, embodying new technologies.

Innovation activities: how much?

Innovation is a complex process and the scale of activity required may vary considerably, involving both technical and commercial activities. These activities may be carried out within the firm or may involve the acquisition of goods, services or knowledge from outside sources, including consulting services. Therefore a firm may acquire external technology in a disembodied or embodied form.

In the Community Innovation Surveys, expenditure on technological product, process or service innovation includes all spending related to those scientific, technological, commercial, financial and organisational steps which are intended to, or actually lead to, the implementation of technologically new or improved products, processes or services. In order to analyse the level of innovation expenditure, the innovation intensity is used, i.e. the ratio between total spending on innovation over total turnover.

Figure 2.3.1: Innovation intensity by country (%), total population of enterprises[1], 1996



1: Luxembourg is not included
2: Wholesale sector and financial intermediation are not included
3: Spain and Italy are not included in the service sector

Source : CIS2, Eurostat / Enterprise DG

On average for the fourteen countries included (Luxembourg is excluded), the amount of expenditure allocated to product and process innovation corresponded to close to 3.7% of total turnover in the manufacturing industries and to some 2.8% of total turnover in the service branches, excluding wholesale trade and financial intermediation as well as Spain and Italy where data are not available for services (see Figure 2.3.1).

Data for the individual countries show for manufacturing that Portugal, Spain and Belgium, with the lowest share of innovating enterprises, also report the lowest level of innovation expenditure in proportion to turnover, in all three cases at or below 2% of turnover. However, at the other end of the range, in Sweden, which has only a middle-range share of innovating firms, innovation expenditure for manufacturing as a whole amounted to as much as 7% of turnover in the manufacturing sector, two percentage points more than Denmark, as the second highest. This particular position of Sweden seems to suggest that in this country the innovative activities are concentrated on a relatively small number of highly innovation-intensive firms. The position of Sweden, therefore, contrasts to that of Ireland where the innovation intensity is only in the medium range despite the fact that the proportion of innovating firms is the highest among the participating countries.

A breakdown of the data on innovation intensity by size class of enterprises (Table 2.3.1) underpins the observation that in Sweden innovation expenditure is high and concentrated in large manufacturing firms. The latter, in fact, reported innovation expenditure amounting, on average, to more than 8% of turnover. In small and medium-sized firms, on the other hand, the level of innovation expenditure is not significantly different from the average. A significant difference between large and small firms in this respect is also reported in Finland and France, albeit less pronounced than in Sweden. The findings for these three countries contrast with those of most other countries where the difference between the three size classes is much less pronounced and even, in some cases, reversed. In Denmark and Austria, in particular, small firms report on average a higher level of innovation expenditure in proportion to turnover than medium-sized and large firms.

With respect to the service branches, the size class breakdown in Table 2.3.1 reveals, in particular, only a weak link between size and innovation intensity. On average for all countries, the innovation intensity is actually very close for small and large firms and somewhat lower for medium-sized firms. For certain countries (Ireland, Finland and the UK), furthermore, the innovation intensity is considerably higher for small, than for large, firms.

Table 2.3.1: Innovation intensity by size, total population[1], 1996

	Manufacturing sector				Service sector[2,3]			
	All	Small	Medium	Large	All	Small	Medium	Large
EU-15	3.7	2.5	2.3	4.2	2.8	2.9	2.4	2.8
B	2.1	2.1	1.4	2.3	1.2	0.9	2.7	1.1
DK	4.8	10.4	3.5	4.5	4.7	2.6	1.5	6.3
D	4.1	3.3	2.4	4.4	3.0	3.1	2.5	3.0
E	1.8	1.0	1.6	2.2	:	:	:	:
F	3.9	1.4	2.2	4.9	1.2	0.8	1.0	1.5
IRL	3.3	2.8	3.2	3.7	2.1	6.0	1.2	2.9
I	2.6	2.4	2.2	3.1	:	:	:	:
NL	3.8	3.0	1.8	4.6	1.6	2.4	2.4	1.3
A	3.5	4.4	3.1	3.5	3.0	2.8	3.9	2.7
P	1.7	1.8	1.9	1.6	1.1	2.1	1.6	0.7
FIN	4.3	1.6	1.6	5.1	2.4	3.6	3.0	1.8
S	7.0	2.6	2.7	8.2	3.8	1.1	6.1	5.0
UK	3.2	3.3	2.9	3.2	4	6.9	2.7	3.7
EEA	3.7	2.5	2.3	4.2	2.8	2.9	2.3	2.9
NO	2.7	2.2	2.8	2.8	3.5	2.2	1.2	5.4

1: Luxembourg is not included.
2: Wholesale sector and financial intermediation are not included.
3: Spain and Italy are not included in the service sector.

Source : CIS2, Eurostat / Enterprise DG.

When considering only innovators (the turnover of non-innovators being excluded) the innovation intensity is higher, as shown in Table 2.3.2 compared to Table 2.3.1. Most strikingly, however, is the fact that when comparison is made only between the firms categorised as innovators, small firms in fact, on average, report a higher innovation intensity (5.1%) than large firms (4.7%), and this both in manufacturing and services. This is attributable to the fact that innovation within small firms is concentrated in a small number of highly innovating firms, whereas the innovation process is less concentrated among the large firms in general. This pattern is found not only at the level of the overall sample but for practically all participating countries, with the exception of, notably, Sweden, where the innovation intensity is high among large firms, even disregarding the non-innovators.

Table 2.3.2: Innovation intensity, by country and size, innovating enterprises only, 1996

	Manufacturing sector				Service sector[1, 2,3]			
	All	Small	Medium	Large	All	Small	Medium	Large
EU-15	4.5	5.1	3.6	4.7	3.9	10.2	4.5	3.1
B	3.8	5.4	3.7	3.6	2.6	9.2	13.0	1.5
DK	5.4	14.8	4.2	4.7	6.3	5.0	3.6	6.9
D	4.5	5.4	3.2	4.6	4.0	12.0	4.4	3.1
E	2.8	3.7	3.3	2.5	:	:	:	:
F	5.2	3.5	4.0	5.6	2.0	2.6	2.5	1.8
IRL	4.0	3.2	4.4	4.1	2.6	9.2	1.4	3.3
I	3.7	4.8	3.5	3.5	:	:	:	:
NL	4.7	5.2	2.4	5.4	2.1	6.3	4.4	1.6
A	4.1	6.5	4.1	3.9	4.2	4.9	5.5	3.3
P	3.3	3.7	4.5	2.8	1.6	6.5	4.8	0.8
FIN	5.5	4.7	3.4	5.7	3.6	10.6	6.8	2.3
S	8.2	5.8	3.8	9.0	7.4	4.3	10.6	7.2
UK	4.0	6.3	4.2	3.8	6.2	13.8	6.0	5.0
EEA	4.5	5.1	3.6	4.7	4.0	10.2	4.5	3.2
NO	3.8	6.0	4.4	3.2	6.9	9.1	4.9	7.1

1: Wholesale sector and financial intermediation are not included.
2: Spain and Italy are not included in the service sector.
3: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

In the service branches, the innovation intensity is equally comparatively high among small-sized innovators in most countries, with the notable exceptions of Sweden and Denmark.

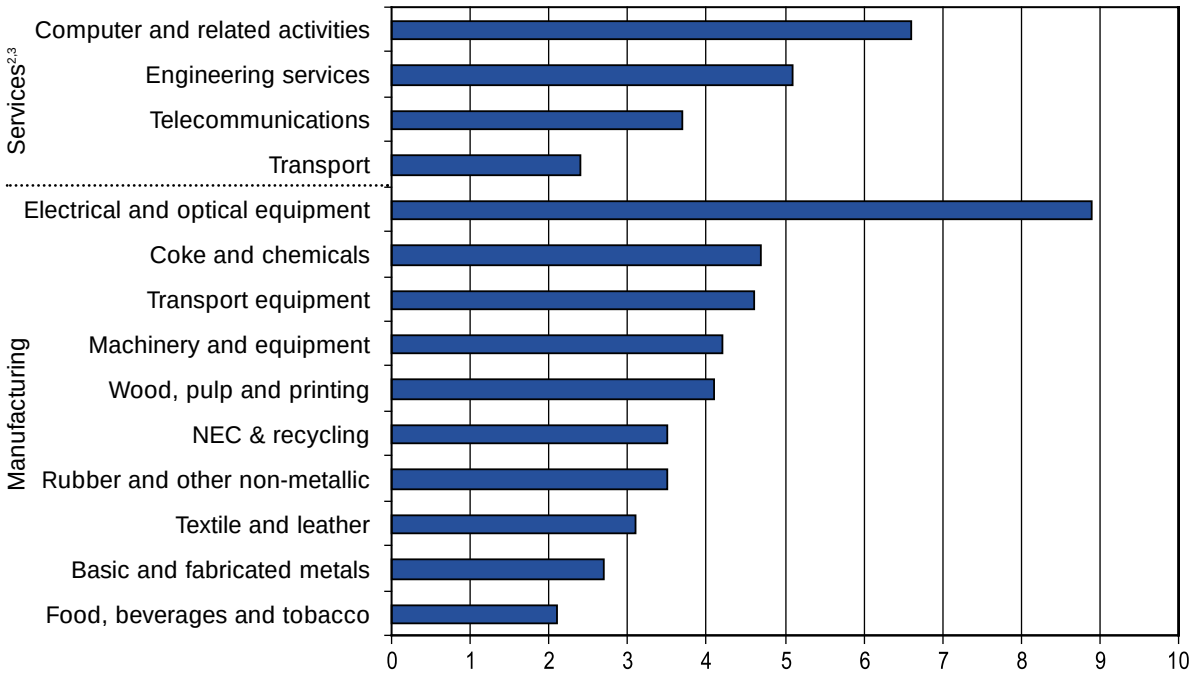
Although the number of innovating firms increases with size, in most EU countries there is, strong empirical evidence indicating that innovating SMEs, measured by innovation intensity, are as much involved in innovation efforts as large innovators.

Innovation intensity by economic activity

The innovation intensity varies widely across the different economic sectors. Figure 2.3.2 gives details of the innovation intensity for innovators in the different economic activities surveyed in CIS2, with the exception of the wholesale and financial intermediation sectors for which this statistics cannot be meaningfully calculated. As seen, the innovation intensity ranges from around 2% of turnover in transport and manufacturing of food, beverages and tobacco compared to a little less than 9% of turnover in the manufacturing of electrical and optical equipment.

The second highest innovation intensity, at some 7%, is found in the service branch, computer and related activities. This branch of services is followed closely by engineering services, which to an increasing extent is delivering input to process innovation in manufacturing firms through sub-contracting or outsourcing. Both these service branches, therefore, work closely with large parts of the manufacturing industries and are part and parcel of the complex dynamics of design and diffusion of innovation.

Figure 2.3.2: Innovation intensity by economic activity, innovators only, EEA[1] ,1996



1: Luxembourg is not included.
2: Wholesale sector and financial intermediation are not included.
3: Spain and Italy are not included in the service sector.

Source : CIS2, Eurostat / Enterprise DG.

It should be mentioned that innovation intensity is a quantitative measure of the input (expenditure) into the innovation process. A high intensity can be a positive feature since high levels of investments are being made and reasonable returns on investments can be expected. However, in some cases the innovation project might not run smoothly and a large amount of resources have to be invested before reaching the final goal.

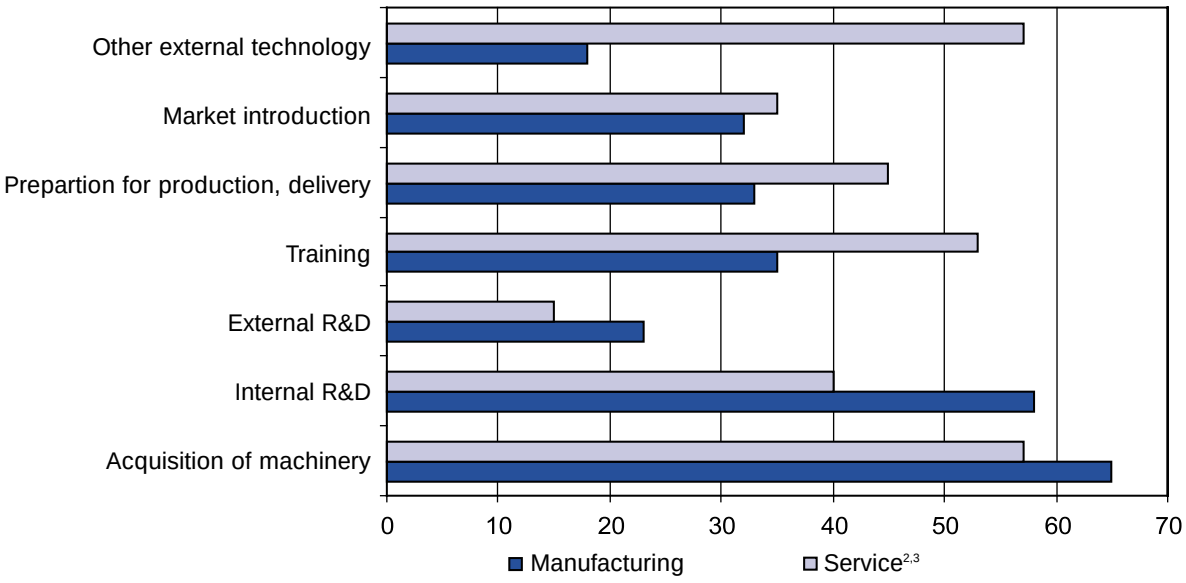
Furthermore, there is no direct link between the financial resources invested in innovation in 1996 to develop innovative products or processes and the turnover of the enterprise in the same year.

Particularly in small or medium-sized firms, where the launching of a new product or a new service may be the main objective of the enterprise, the effects of innovation on turnover may be felt in the years following the launching of innovations.

Engagement of firms in innovation activities

The technical performance capabilities of an enterprise are not solely determined by its R&D activities involved. No less crucial is its ability to launch new or improved processes on the market, and/or to design and implement new or improved production processes. This part of innovation activity, therefore, requires successful implementation of activities above and beyond pure and simple internal creative research, e.g. for market analyses or staff training in connection with new product launches. The Community Innovation Survey, in order to elucidate these aspects of the innovation process, has introduced a distinction between seven types of activity in which enterprises might be involved during their innovation process. The list includes tangible and intangible investments which are complementary in the sense that investments in embodied technology requires investments in intangible resources in order to integrate, test and develop a new technology for the firm.

Figure 2.3.3: Number of innovators according to types of innovation activities (%), EEA[1], 1996



1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector is not included in France.

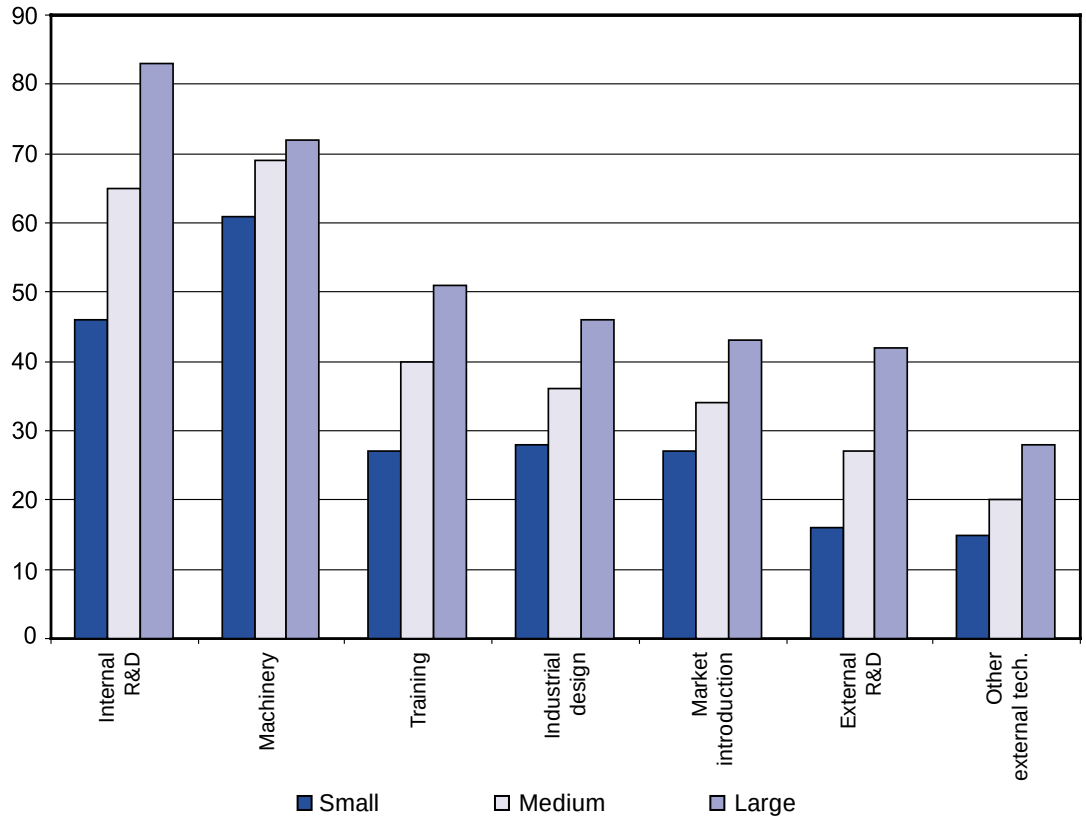
Source : CIS2, Eurostat / Enterprise DG.

For more than 65% of innovators in manufacturing and close to 60% of innovators in services the acquisition of new machinery has been an important aspect of the innovation process. When it comes to other aspects, however, proportionately more innovators in manufacturing have relied on internal or external R&D. The innovators in service branches, on their side, appear to rely relatively more on investment in intangible assets, such as, notably training, preparation for production or delivery, market introduction and, notably, other external technology. Again, this observation confirms the strong position of the service branches in the diffusion of innovation, for example through the introduction of new telecommunication services depending upon the new products developed in the information, communication and technology industry. Indeed, in the service sector disembodied technology such as non-patented inventions, licenses, know-how, trademarks, consultancy services other than R&D, etc. are at least as important as embodied technology.

Engagement of firm in innovation activities by size class

A breakdown by size classes of innovators, however, indicates that reliance on the different aspects of the innovation process is not necessarily the same for firms of all sizes. In fact, as shown in Figure 2.3.4, in more than 80% of large firms in-house R&D is an important aspect of innovation against 65% among medium-sized, and only slightly more than 45% among small firms. Between the two latter categories acquisition of machinery and equipment appears to be a more important aspects in so far as 69% of medium-sized firms and more than 60% of small-sized firms mention this aspect as being part of their innovation process.

Figure 2.3.4: Number of innovators engaged in different innovation activities by size (%), EEA[1], manufacturing, 1996



1: Luxembourg is not included.

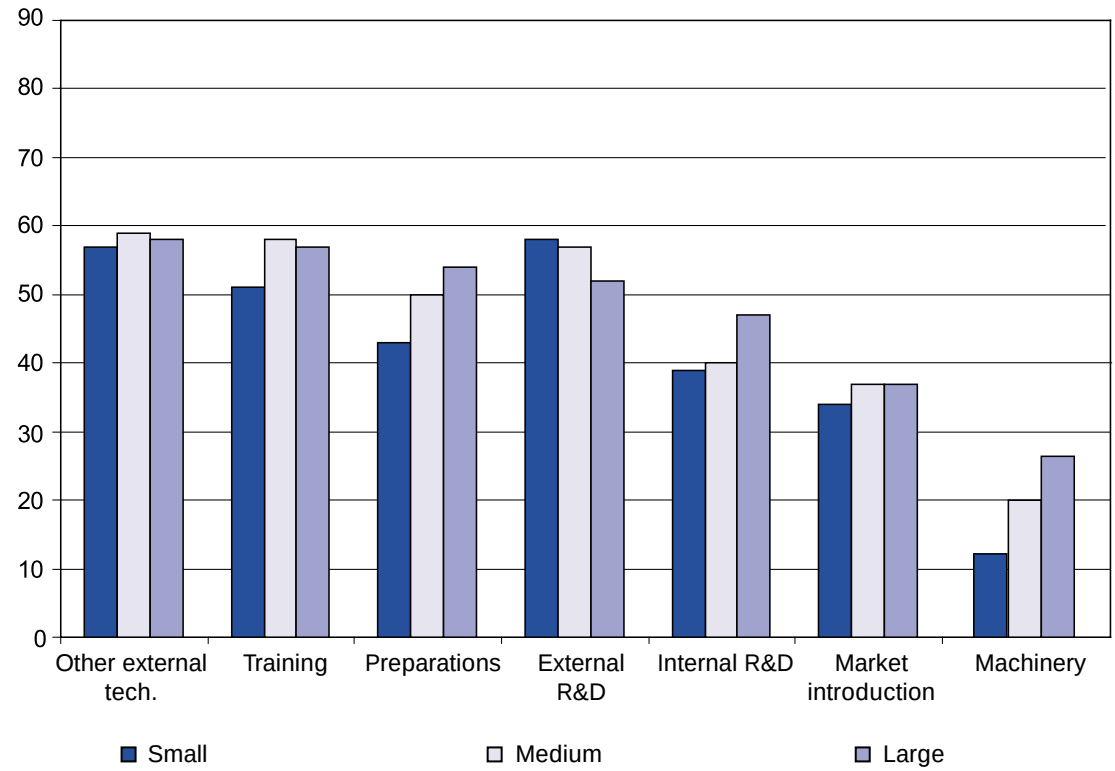
Source : CIS2, Eurostat / Enterprise DG.

Within the services branches the different size classes of firms do not show major differences with respect to the implication of the different aspects of the innovation process. The share of firms reporting reliance upon acquisition of machinery and external technology is high in all size classes as is the number of firms relying upon training as an important aspect of innovation. This observation therefore would indicate that within the service branches included here, firms of all size classes participate in more or less the same manner in the design, and discussion, of new services and new intangible products.

Distribution of innovation expenditure

On average, in-house R&D is the main item of resources devoted to innovation activities. Roughly half of the innovation expenditure is allocated to internal research and experimental development. The acquisition of machinery and equipment represents the second most important item: 22% of total innovation expenditure in the manufacturing sector and 16% in the service sector. Outlays on disembodied technology such as patents, non-patented inventions, licenses, know-how, trademarks, are higher for service firms than for industrial enterprises, 15% for the former compared to 4% for the latter, confirm-

Figure 2.3.5: Number of innovators engaged in different innovation activities by size (%), EEA[1], Service sector[2,3], 1996

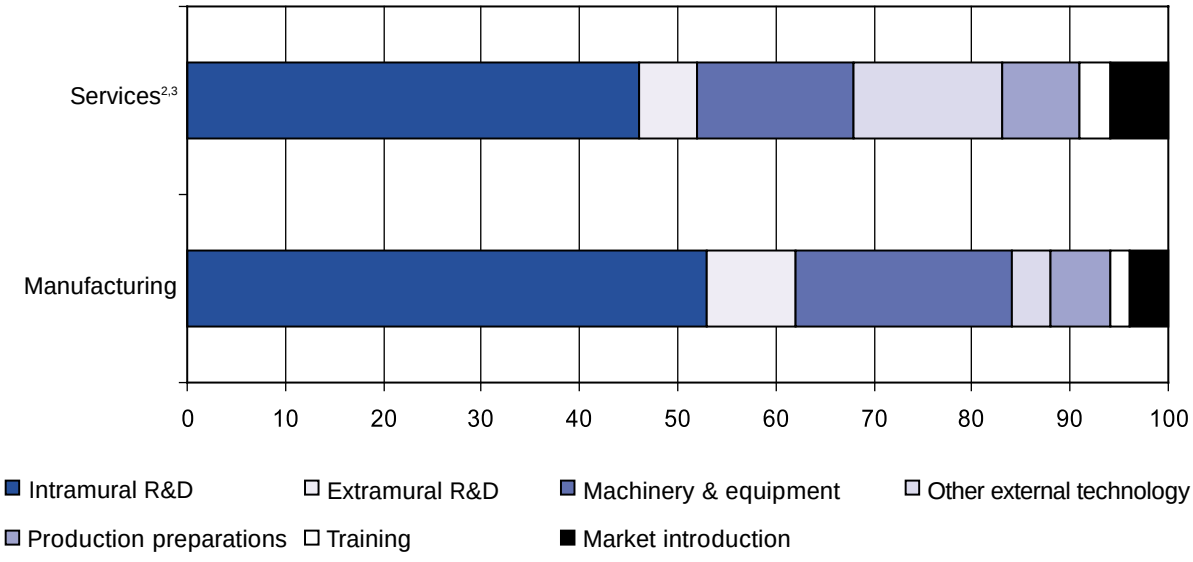


1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

ing once again the strong position of the service branches in the diffusion of technology. The remaining innovation activities, i.e. extra-mural R&D, market introduction and training directly linked to innovation, each accounts for less than 10% of the total spending.

Figure 2.3.6: Structure of innovation expenditure, EEA[1],1996



1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector is not included in France.

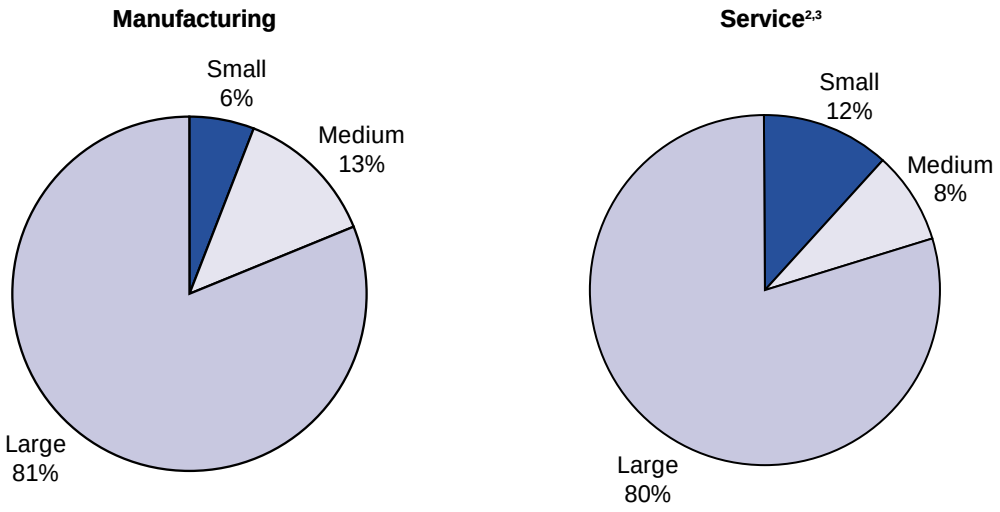
Source : CIS2, Eurostat / Enterprise DG.

It should be underlined that the quantification of the expenditure is simply an indicator of the expenditure, and that these percentages do not necessarily reflect on a one-to-one basis the relative importance of the single activities within an integrated process. A case in point is training linked to innovation which weighs less than 2% in the manufacturing sector and a little more than 3% in the service sector; this does not mean that it has only a marginal importance. As already indicated above, a proportionately large part of innovating enterprises are engaged in training as part of the overall strategic innovation process even though its unit expenditure is low.

Distribution of Innovation expenditure by size classes

As shown in Table 2.3.2, among innovating enterprises the expenditure on innovation in proportion to turnover is actually, on average for the 14 countries included, somewhat higher for the small enterprises (manufacturing) or even considerably higher (services) than that of large firms. Nevertheless, as a result of their sheer size, large innovating firms account for approximately 80% of total innovation expenditure in both manufacturing and services (Figure 2.3.7).

Figure 2.3.7: Distribution of innovation expenditure by size, EEA[1], 1996



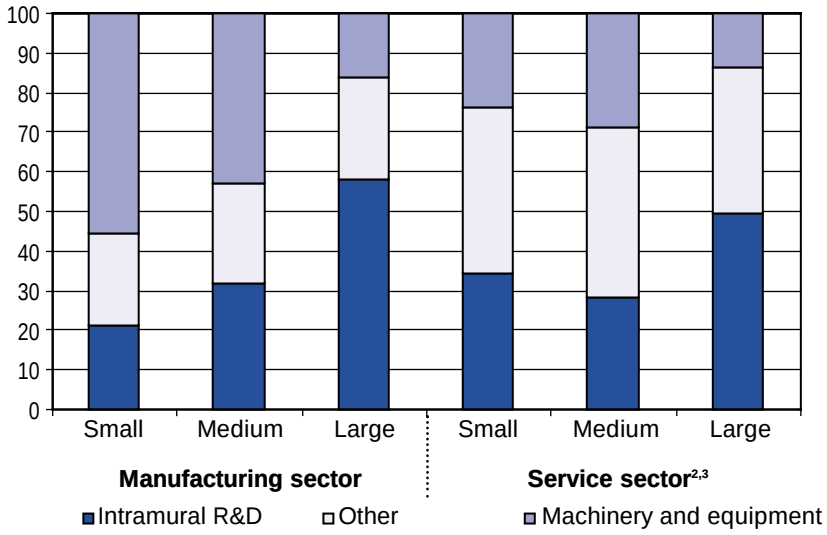
1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

In manufacturing, large enterprises allocate a large share of their innovation budget to intra-mural R&D to develop their innovations while small enterprises rely more on the acquisition of machinery and equipment. It is quite clear from Figure 2.3.8 that the larger the enterprise the higher the share of intra-mural R&D expenditure is in the total expenditure for innovation. With respect to the acquisition of machinery and equipment, the situation is the opposite: the smaller the enterprise is the higher, in general, the share is of embodied technology in the total spending.

In the service sector the different activities of innovation is less strongly influenced by firm size as in the manufacturing sector. The prevailing tendency for small firms to innovate by acquiring machinery and equipment, against the greater propensity of larger firms to generate internally new technologies is much less marked. In fact, large service enterprises have proportionally a larger share of intra-mural R&D and a lower share of expenditures on machinery and equipment than small-sized firms. However medium-sized innovators spend proportionally less on intra-mural R&D and more on acquisition of machinery than small enterprises.

Figure 2.3.8: Structures of innovation expenditure by size bands, EEA[1], 1996



1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Distribution of innovation expenditure by country

Manufacturing sector

An approach by country shows that in-house R&D is not the dominating expenditure in all countries. In France and Germany, more than 60% of the spending covers internal research, around 50% in Sweden, the Netherlands and Austria. However R&D activities absorb a lower share of investment in Italy (28%), the UK and Norway (31%) and only 7% in Portugal.

Table 2.3.3: Distribution of innovation expenditures by country, manufacturing sector, EEA[1], 1996

	Intra-mural R&D	Extra-mural R&D	Machinery & equipment	Other external technology	Preparation process	Training	Market introduction
EU-15	53	9	22	4	6	2	4
B	42	6	35	4	9	1	2
DK	35	5	44	6	7	5	4
D	63	11	13	2	6	1	3
E	37	8	32	7	12	1	3
F	65	10	12	1	7	1	4
IRL	33	5	44	4	6	3	4
I	27	7	45	5	9	2	4
NL	46	6	33	1	3	7	5
A	47	5	33	2	3	3	6
P	7	4	68	8	9	2	1
FIN	43	10	27	2	2	1	14
S	50	9	17	11	6	1	7
UK	31	2	41	7	7	4	7
EEA	53	9	22	4	6	2	4
NO	31	15	39	4	4	3	4

1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Among the 14 countries presented in the above table, 6 have been devoting more financial resources to the acquisition of machinery and equipment than to intra-mural research. Embodied technology accounts for 39% or more of total innovation expenditure in Denmark, Italy, Ireland, the UK, and Norway; in Portugal the share reaches 68%. On the other hand, France and Germany, and to a lesser extent Sweden, allocate relatively less spending to machinery and equipment.

Extra-mural R&D represents a relatively important financial post for Germany, France, Finland and Norway, 10% or more of the total innovation expenditure. If we consider both in-house and acquisition of external R&D services, research and development constitutes three quarter of innovation expenditure in Germany and France. These two countries represent more than a half of European spending and therefore strongly affect the overall average.

Expenditure on industrial design and preparation of processes to introduce or deliver technologically new products is the highest for Spain where it accounts for 12% of the innovation budget. In Finland this type of innovation expenditure represents only 2% of the spending.

Service sector

In the service sector the share of intra-mural R&D expenditure in total innovation spending varies considerably, from only 5% in Portugal to a high of 66% in Ireland.

Table 2.3.4: Distribution of innovation expenditure by country, service sector, EEA[1,2], 1996

	Intra-mural R&D	Extra-mural R&D	Machinery & equipment	Other external technology	Preparation process	Training	Market introduction
EU-15	46	6	16	15	8	3	6
B	23	6	25	8	16	5	18
DK	35	3	19	6	11	3	23
D	57	8	13	13	4	2	3
F[3]	51	7	9	24	5	2	2
IRL	66	4	8	3	9	3	7
NL	21	7	39	8	11	6	7
A	10	5	32	27	9	6	11
P	5	3	35	45	5	4	3
FIN	51	8	21	8	5	3	4
S	19	4	9	9	17	6	36
UK	15	:	25	24	21	8	7
EEA	46	7	16	15	8	3	6
NO	27	10	32	11	8	6	6

1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale sector not included.

Source : CIS2, Eurostat / Enterprise DG.

Half of the countries where data are available, not necessarily the same as for the industrial sector, invest more on the acquisition of machinery and technology to develop their innovation than on in-house research. The Netherlands devote 39% of their expenditure to embodied technology, Austria, Portugal and Norway around a third, Belgium and the UK a quarter of their total innovation expenditure.

As shown above, disembodied technology is an important component of innovation for service firms. On average, 15% of total spending is used for the acquisition of software and other external technology other than machinery and equipment. At the national level, there is a great variation: from 3% in Ireland to 45% for Portugal. In the latter country, embodied and disembodied technology in fact accounts for 80% of total investment on innovation activities. France, Austria and the United Kingdom devote a quarter of their spending to the acquisition of other external technology.

Preparations to introduce new or significantly improved services or methods to deliver them occupies an important share of the innovation budget in Belgium, Sweden and the United Kingdom, where they account for respectively 16%, 17% and 21% of the total expenditure.

The market introduction of technological innovation represents for respectively 36%, 23% and 18% for Sweden, Belgium and Denmark. This is particularly high compared to an overall average of 6%.

Does innovation mean R&D?

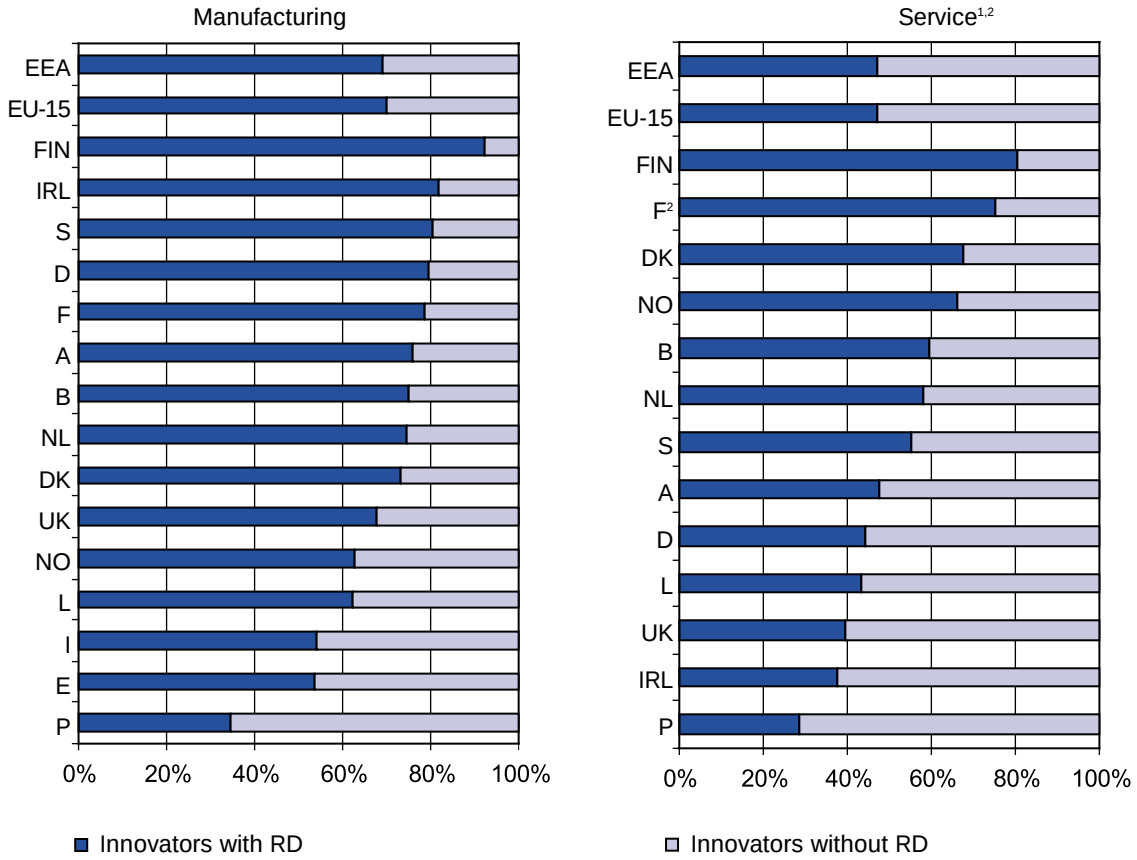
For a long time innovation has been practically synonymous with ‘creative research’. Innovation tended to be considered as a roughly linear process progressing from research to invention, then to innovation and finally to the diffusion of new products or techniques. Within the research process a similar pattern was assumed to occur, starting from the building up of basic scientific knowledge and moving forth to technological knowledge and further to practical engineering. Hence, research and experimental development (R&D) has been considered as the main indicator to measure innovation and innovating firms were most often identified through the reporting resulting from the legal requirements to declare R&D.

It is now commonly admitted that innovation is a more complex phenomenon going beyond R&D. It is often conceptualised in terms of interaction between market opportunities and the firm's knowledge base and capabilities. The innovation process is henceforth considered as an interactive procedure where the different phases and sub-processes involved are recursively interwoven with each other. It should not be understood as a pure and simple transfer of know-how and technology transfer in which knowledge, production, application and utilisation can be separated.

The Community Innovation Surveys, in fact, confirms that the link between R&D and innovation is less clear-cut and less linear than had been earlier assumed. Enterprises can be engaged in the innovation process without performing R&D; they participate in the innovation process through diffusion or implementation of new techniques or processes.

On average, 69% of innovators in the industrial sector and some 47% of innovators in the service branches have declared to carry out R&D on a systematic basis or occasional basis. As shown in Figure 2.3.9 the proportion of innovators, which reported upstream R&D activities, varies considerably from one country to another. Therefore within manufacturing the share of innovators reporting R&D activities ranges from only 35% in Portugal to almost 90% in Finland. Correspondingly, within the service branches the share varies between some 30% in Portugal to some 80% in Finland.

Figure 2.3.9 Number of innovators with or without R&D activities (%), 1996



1: Italy and Spain are not included in the service sector.
2: Wholesale not included .

Source : CIS2, Eurostat / Enterprise DG.

Somewhat surprisingly no clear pattern emerges as concerns a correlation between the overall share of innovators among the enterprises and the proportion of these innovators reporting R&D. In Portugal and Spain, where the proportion of innovating enterprises in manufacturing is relatively low, the share of innovators reporting in-house R&D is also among the lowest in the range. At the other end of the range, some countries with a high proportion of innovating enterprises report a high proportion of innovating enterprises with R&D. This is the case, in particular, for the Netherlands and Sweden. But in some of the countries with a high proportion of innovating enterprises, such as Denmark in the manufacturing sector, the number of innovators with R&D is only in the middle range, indicating that a comparatively large number of firms are mainly concerned with diffusion or application of external R&D. Similarly, Finland has a low share of innovators but a very high percentage of innovators performing R&D.

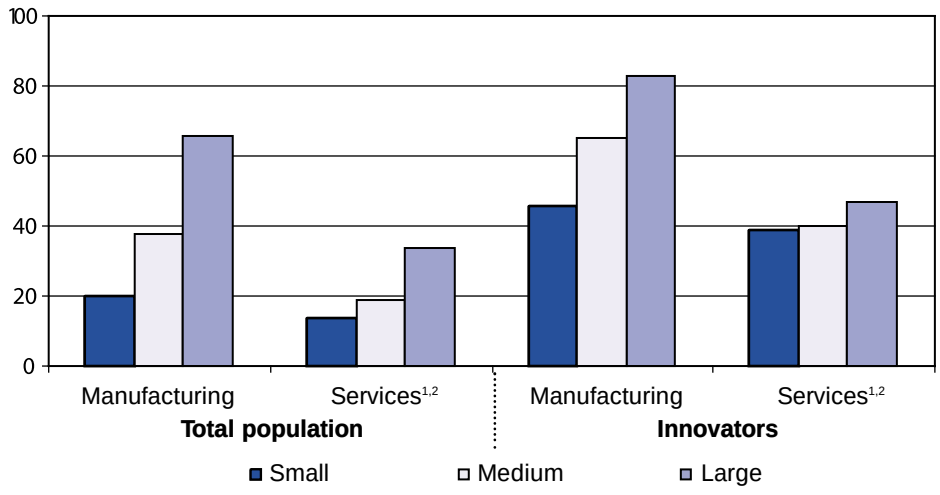
It is striking, however that in Finland, with a relatively low level of 'novel innovators' (see Figure 2.1.3), the share of innovators with in house R&D is in the upper end of the range, together with Ireland.

In-house R&D, any size pattern?

As shown in Figure 2.3.10, the proportion of firms performing in-house R&D among large manufacturing enterprises, at 66%, is more than three times as high as for small firms and also considerably higher than in medium-sized firms. In the service branches the disparities between the size classes are smaller but still appreciable.

Looking only at the R&D in innovating firms the differences between large and small firms are maintained in the manufacturing sector. However for the service branches, the gap between size bands is much less marked.

Figure 2.3.10: Number of enterprises engaged in intra-mural R&D, as a share of total population and of innovators, EEA, 1996



1: Italy and Spain are not included in the service sector.
2: Wholesale is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

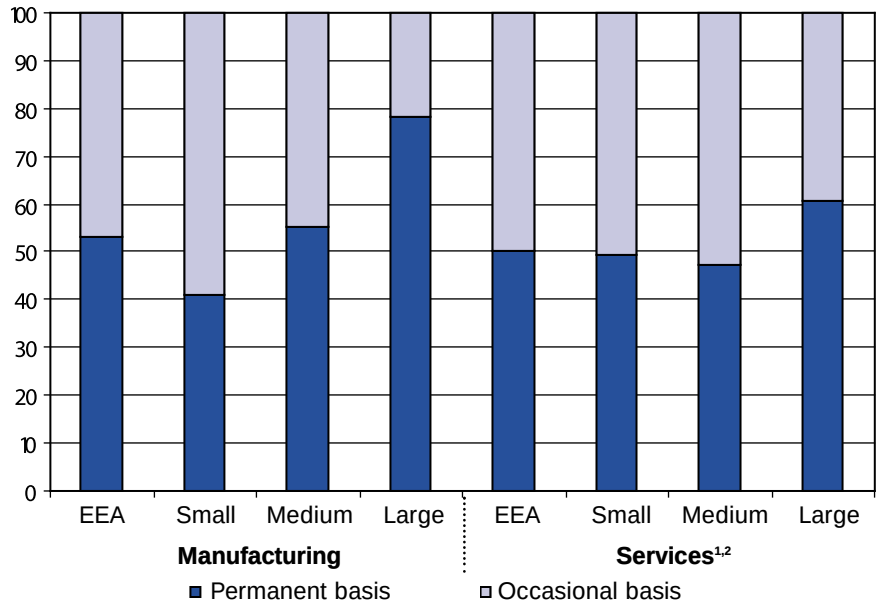
This picture confirms that large firms generally have more resources available for R&D, and are able to cover the costs from a larger volume of sales. In addition, large enterprises often operate on more than one product line, allowing for potential economies of scale and scope in utilising the results from R&D.

R&D, occasional or permanent basis?

Normally research and experimental development involve sunk costs committed to building up R&D capacity, hiring researchers, and generally building up competencies in the areas relevant for, and often at the core of, the firms' operation. In addition it is frequently argued that knowledge builds up in

a cumulative way, which might indicate that continuous R&D would confer benefits on firms in terms of a higher rate of innovation and market performance. However, as seen from Figure 2.3.11, the aggregate data available show that, on average, only about half of the innovating enterprises performing R&D carry out R&D on a permanent basis, whether in manufacturing or in services. In manufacturing, a breakdown of these data by size class shows that the share of firms performing R&D on a permanent basis is relatively low among small-sized innovators, somewhat higher among medium-sized and the highest among the large innovators. In this respect, however, the service branches again (possibly due to different size class structure of the branches) prove to be in a different position with only small differences between the three size classes as far as the share of innovating firms with a permanent R&D capacity is concerned.

Figure 2.3.11: Number of innovators performing R&D, permanent and occasional basis (%), EEA, 1996



1: Italy and Spain are not included in the service sector.
2: Wholesale is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

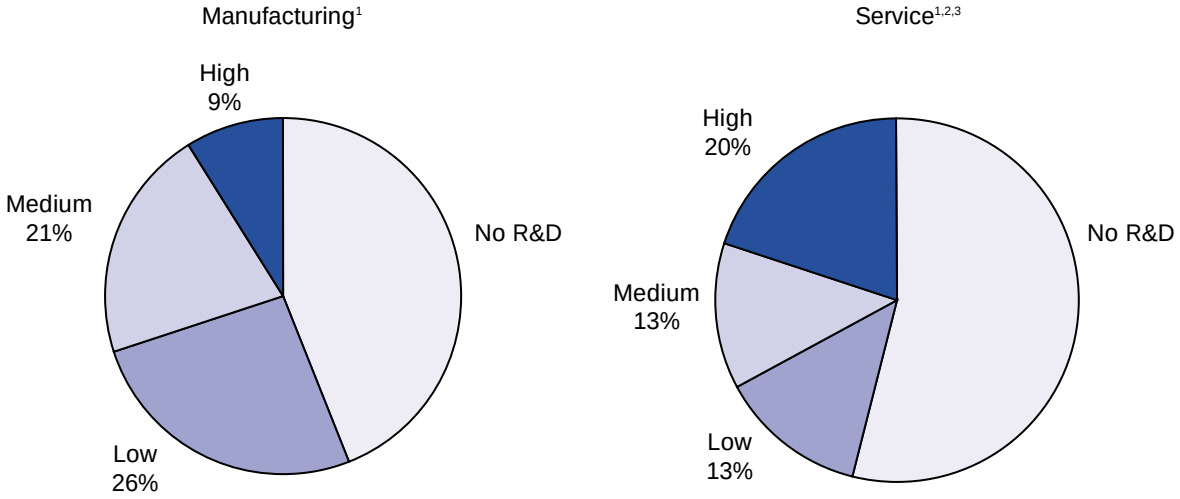
Level of R&D expenditure

As already shown in Figure 2.3.9, about 50-70% of the firms categorised as innovators have actually been backing up their innovation with in-house R&D. Among these innovators the level of R&D expenditure may, however, show large disparities, depending, in particular, upon the nature of the innovation process and the nature of the products in the branch concerned.

As illustrated in Figure 2.3.12, among the innovators in manufacturing only 9% of the firms committed resources for in-house R&D in excess of 4% of their turnover, whereas the number of innovators with a medium-range level of R&D (between 1% and 4% of turnover) amounted to 21% of the total. Finally 26% of innovators were recorded as having only small in-house R&D (less than 1% of turnover).

On average for the service branches, innovators with a high R&D intensity account for more than twice the share in manufacturing. However, in this special case only transport, telecommunication, computer and related activities and engineering services have been included while wholesale trade and financial intermediation have been excluded. The former four service branches all have a relatively high R&D intensity, explaining therefore the rather surprising result. A breakdown by the main branches of manufacturing would equally show large differences from one branch to another with respect to the proportion of innovators reporting a high R&D intensity.

Figure 2.3.12: Distribution of innovators by level of R&D intensity, EEA, 1996



1: Luxembourg is not included; 2: Spain and Italy are not included in the service sector; 3: Wholesale is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Differences between countries with respect to the relative importance of the different branches and size classes of manufacturing and services may to some extent explain the differences between countries as far as the R&D intensity among innovating firms is concerned. Data for the individual countries provided in Table 2.3.5, show that, for manufacturing, the share of innovators with a high R&D intensity is the highest in Ireland, which on average has the highest proportion of innovators. The R&D intensity among innovators is also particularly low in Portugal where the overall proportion of innovators is the lowest. Between these two extremes, however, the pattern is more diversified. Table 2.3.5 shows a high number of firms with a high R&D intensity in, for example, Finland, where the overall share of innovating firms is comparatively low. There are a small number of firms with a high R&D intensity in Denmark, where the number of innovators is high. As regards the service branches, the highest proportion of innovators with a high R&D intensity are found in the countries where telecommunication (Finland), computer and related services (Ireland) or transport are highly research intensive.

Table 2.3.5: Share of innovators according to R&D intensity, 1996

	Manufacturing				Services[2]			
	No R&D	Low	Medium	High	No R&D	Low	Medium	High
EU-15[1]	44	27	21	9	54	13	13	20
B	46	25	21	8	54	9	25	11
DK	45	18	32	5	62	22	9	7
D	31	35	22	12	55	11	13	21
E	46	25	21	8	:	:	:	:
F[3]	51	13	20	16	44	34	11	10
IRL	30	23	28	19	58	4	8	31
I	59	22	16	3	:	:	:	:
NL	27	42	25	6	36	29	26	8
A	41	25	27	7	57	23	6	14
P	65	22	10	2	73	10	5	12
FIN	16	39	31	15	20	23	24	33
S	29	28	28	15	52	20	13	15
UK	45	25	21	9	60	7	8	26
EEA[1]	44	26	21	9	54	13	13	20
NO	54	25	13	8	31	14	20	34

1: Luxembourg is not included.
2: Spain and Italy are not included in the service sector.
3: Wholesale is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Chapter 4
Why do firms innovate?

- *Enterprises innovate mainly to improve product quality and to open up new markets or increase market share.*
- *On average, 'reducing labour costs' is the most important process-oriented objective.*
- *In general, large enterprises do not differ significantly from SMEs as far as goals for innovation are concerned.*

In the second Community Innovation Survey, enterprises have been invited to rate a number of goals that innovation can help to achieve. The main reasons for developing and introducing innovation were classified in the following three main groups:

Product oriented objectives:

- replace products being phased out;
- improve product quality;
- extend product range and
- open up new markets or increase market share.

Process related objectives:

- improve production flexibility;
- reduce labour costs;
- reduce materials consumption and
- reduce energy consumption.

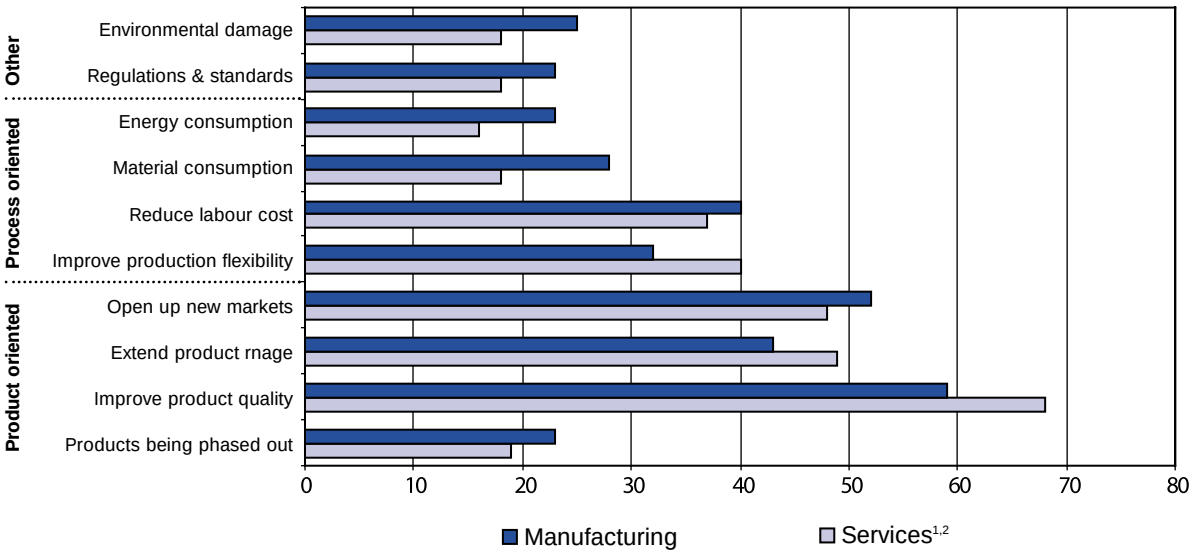
Other objectives:

- fulfil regulations, standards and
- reduce environmental damage.

Objectives of innovation, what are the most important ones?

Improving the quality of products or services is by a comparatively large margin, as shown in Figure 2.4.1, the most frequently quoted very important objective (59% for manufacturing and 68% for services). Among the product-oriented objectives, also the extension of the product range (that is launching new products) and the opening up of new markets are considered as important goals for a large number of innovating enterprises. Replacement of products being phased out, on the other hand, is mentioned as an important aim by only a relatively small proportion of innovators, notably in the service sector.

Figure 2.4.1: Number of innovators with very important objectives of innovation (%), EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Considering the process-oriented objectives, the most important one is the reduction of labour costs, indicated as an important objective by 40% of manufacturing innovators and by a marginally smaller share of innovators in services. In the ranking, the reduction of labour costs is, as shown, followed by two other process-related objectives: the improvement of production flexibility and reduction of the consumption of materials. Energy consumption is, on the other hand, stated as the least important objective both in manufacturing and in services.

Finally, objectives of a more legal and regulatory nature appear to be very important for only a minority of firms in both manufacturing and services. As seen, compliance with regulations and standards is indicated by only some 23% of innovators in manufacturing and some 18% in services. Reduction of environmental damage is indicated as an important objective by about the same number of service innovators as compliance with other regulations and standards but by some 25% of innovators in manufacturing.

Across the different industries the indication of the most important objectives shows some degree of variability (Table 2.4.1). Whereas replacement of phased out products overall is relatively unimportant, it is mentioned as very important by over a third of innovators in manufacturing of electrical and optical equipment. The extension of the product range and the development of new markets are also particularly important in this branch. The latter objective (development of new markets) is in fact quoted as very important by more than 60% of innovators in the chemical industry as against an average of some 52% for manufacturing as a whole.

Among the four process-related objectives, the wood, pulp and paper industry scores the highest share of very important objectives for 3 of them while the chemical industry ranks last. The search for production flexibility is one of the least important objectives in the chemical industry (mentioned by 22%) but much more important in the woodworking and pulp and paper industry. In the latter industry the search for reduction of labour costs is also mentioned by almost half of innovating enterprises against only a quarter in the chemical industry. Reduction of the consumption of materials is also an important objective for the wood processing industry (35%) but much less so in the chemical industry (23%), in the agro-food industry or the production of machinery and equipment. In contrast, the reduction of energy consumption is mentioned as an important objective by a third of innovating enterprises in the agro-food industry but by less than 20% of enterprises in the manufacturing of machinery and equipment, electrical and optical equipment and NEC and recycling.

As could perhaps be expected, compliance with regulations and standards is quoted as very important in the agro-food industry and manufacturing of transport equipment but by only few innovators in wood processing and most other industries. Reduction of environmental damage is, on the other hand, considered a very important objective by more than 40% of enterprises in the chemical industry, only slightly less than the three main product-related objectives.

Table 2.4.1: Number of innovators with very important objectives of innovation by economic activity (%), manufacturing sector, EEA, 1996

	Food, beverages and tobacco	Textile and leather	Wood, pulp and printing	Coke and chemicals	Rubber and other non-metallic	Basic and fabricated metals	Machinery and equipment	Electrical and optical equipment	Transport equipment	NEC & recycling
Product oriented objectives										
Replace products phased out	15	22	18	28	22	15	24	37	31	23
Product quality	59	62	62	59	60	59	58	56	57	59
Extend product range	43	42	31	49	45	42	47	53	39	39
New markets	55	50	44	62	53	49	53	61	52	44
Process related objectives										
Production flexibility	31	33	38	22	32	35	29	27	27	35
Labour costs	40	42	48	25	43	42	37	38	39	45
Material consumption	24	30	35	23	31	27	24	29	31	27
Energy consumption	33	22	29	20	30	21	18	17	20	15
Other objectives										
Regulations and standards	31	22	14	27	21	21	22	29	34	18
Environmental damage	25	23	27	41	30	23	22	18	27	22

Source : CIS2, Eurostat / Enterprise DG.

Due to the highly different character of the various service branches included in the survey, diversity with respect to the important objective of innovation in this sector is somewhat larger than in manufacturing. Table 2.4.2 shows that the replacement of phased out products on average for the service branches is less important than in manufacturing. However, it is mentioned as an important objective by almost 30% of innovators in the telecommunication branch and in the computer and related activities, as against less than 20% in the four other service branches included. Improvement of product quality, as in manufacturing is by far the most important objective for all service branches (68% on average) but is even more important in the field of telecommunications, where more than 80% of innovators indicate this as very important, the highest score of any objective in all the branches of manufacturing and services taken together.

Extending the product range is also by the service branches, in general, mentioned by a higher proportion of innovators than in manufacturing, notably in computer and related activities and engineering where this objective ranks almost as high as product quality. The search for new markets is also highly important in telecommunications and computers and related activities but much less so in transport.

Within the group of process related objectives the diversity is even greater, probably due, to a considerable extent, to the diversity of the characteristics of the branches concerned. An increase in production flexibility, therefore, is mentioned as an important objective by only 15% of innovators in telecommunication but by almost 50% in engineering and 46% in financial intermediation. Reduction of labour costs, equally, is of minor importance in telecommunications (12%) but very important for 50% of innovating enterprises in transport and 46% in engineering. Unsurprisingly, reduction of energy consumption is also an important objective of innovation in transport (41%) but of negligible importance in telecommunication, financial intermediation and computer and related activities.

Finally, compliance with regulations and standards is an important concern for innovation in transport and financial institutions but much less so in wholesale trade and the other service branches. The same picture emerges as far as reduction of environmental damage is concerned, which is an important objective for as many as 39% of innovators in transport but, unsurprisingly, for only 3% of innovators in telecommunication.

By and large the indications of the relative importance of the various objectives by the different branches therefore tend to confirm the close link with the general competitive conditions, the technological state of production and distribution, the interaction of the production with the environment and the general regulatory framework for operations.

Table 2.4.2: Number of innovators with very important objectives of innovation by economic activity (%), service sector, EEA[1], 1996

	Wholesale[2]	Transport	Telecom munication	Financial interme diation	Computer & related activities	Engineering services
Product related objectives						
Replace products phased out	19	16	28	19	28	14
Product quality	62	62	74	82	70	72
Extend product range	39	39	55	44	63	64
New markets	50	37	55	46	58	48
Process related objectives						
Production flexibility	35	40	15	46	29	49
Labour costs	31	50	12	41	22	46
Material consumption	16	36	22	8	6	21
Energy consumption	18	41	1	4	3	13
Other objectives						
Regulations and standards	16	29	6	23	13	14
Environmental damage	20	39	3	5	5	16

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Does size influence the objectives of innovation?

Given the high degree of diversity of the size class structure of the different branches a breakdown of the indications of objectives for small, medium-sized and large firms, to some extent, reflect the underlying branch structure of the three size classes. Considering the objectives mentioned as being very important, the enhancement of product quality remains the most popular, being mentioned by approximately 60% of firms in all three size classes, closely followed by the development of new markets. Only one objective in the manufacturing sector, compliance with regulations and standards, is quoted as very important by a higher proportion of small than large firms, suggesting that, as frequently supposed, the compliance with regulations is considered a heavier burden for SMEs.

In the service branches, the reduction of environmental damage, extension of the product range and the development of new markets is also more frequently mentioned as an important objective for small firms than for large ones. This may, however, be due, as already mentioned earlier, to the fact that the size class structure of the service branches included varies strongly from one branch to another. The differences recorded here between size classes may, consequently, be a reflection of the underlying preferences of the different branches.

Table 2.4.3: Number of innovators with very important objectives of innovation by size (%), EEA, 1996

	Manufacturing sector			Service sector[1,2]		
	Small	Medium	Large	Small	Medium	Large
Product related objectives						
Product range	44	42	45	50	48	48
Product quality	58	60	61	67	71	77
Products phased out	20	23	32	17	23	19
New markets	52	52	57	49	48	45
Process related objectives						
Production flexibility	31	32	32	36	46	52
Labour costs	40	40	43	36	39	44
Material consumption	26	28	34	19	15	13
Energy consumption	23	22	25	17	17	10
Other objectives						
Regulations and standards	25	24	28	19	18	12
Environmental damage	25	21	20	16	22	20

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Do European countries share the same objectives of innovation?

Replacing products phased out, as shown in Table 2.4.4, is reported as a very important objective by some 40% of manufacturing innovators in Ireland and Sweden, but by less than 20% in Belgium, Denmark, Spain, Italy, the Netherlands and Portugal. In the latter countries, therefore, product cycles appear to be longer with less need for rapid renewal of designs and technology. Extension of the product range and improvement of product quality, on the other hand, in most of these countries (but also in Ireland) is mentioned as a very important objective by a large proportion of innovators. In Spain, in particular, more than 80% of innovators consider improvement of product quality as a very important objective while it is mentioned as such by less than 50% of innovators in Denmark, the Netherlands, Austria and Finland. 76% of Spanish innovators consider that developing new markets is an important objective contrasting with the 47% of innovators in Italy, and less in Germany, the Netherlands, Portugal and Finland.

Spanish firms have the highest share of innovators looking for enhancement of production flexibility, at 44%. The fact that German and Norwegian innovators are looking for new processes and new systems is underpinned by the fact that in this country half of innovators mention the reduction of labour costs as a very important objective. This is also the case in high-cost countries like Austria, whereas only 19% of Dutch and 20% of Finnish innovators mention the reduction of labour costs as an important target for innovation.

With respect to material consumption and energy consumption, cross-country differences exist but are less striking, with the sole exception of the Netherlands, where these two objectives are quoted by, respectively, only 11% and 9% of innovators, as against an average of 28% and 23% for all countries. However, the rather low Dutch figure in this respect may also be due to a systematic bias in the Dutch reporting: possibly the Dutch innovators have been more restrictive in their selection of very important objective than innovators in other participating countries.

Table 2.4.4: Number of innovators with very important objectives of innovation by country (%), manufacturing sector, 1996

	Product oriented objectives				Process oriented objectives				Other	
	Products phased out	Product quality	Product range	New markets	Production flexibility	Labour costs	Material consumption	Energy consumption	Standards & regulations	Environmental damage
EU-15	23	59	43	52	32	40	28	22	23	25
B	19	52	50	61	25	37	27	14	18	25
DK	17	37	27	46	24	30	19	22	11	25
D	25	62	50	45	39	50	34	25	15	25
E	18	81	50	76	44	30	30	30	:	45
F	23	53	52	60	21	25	19	18	27	13
IRL	40	59	55	71	30	37	30	20	28	22
I	14	58	37	47	28	42	20	21	27	25
L	33	55	59	67	32	46	19	25	22	28
NL	17	31	28	26	19	19	11	9	14	12
A	21	49	33	50	26	47	25	22	14	23
P	16	70	34	47	32	39	22	22	25	27
FIN	25	34	25	33	22	20	16	6	12	10
S	41	58	33	55	26	38	32	18	29	29
UK	30	66	43	63	34	45	39	26	34	28
EEA	23	59	43	52	32	40	28	22	23	25
NO	20	60	41	59	37	51	28	16	25	21

Source : CIS2, Eurostat / Enterprise DG.

Two groups of countries can be distinguished. Germany, Spain, Ireland and the United Kingdom score high percentages compared to the Netherlands and Finland which have relatively low shares for most of the objectives. The importance of objectives of innovation has to be rated on an ordinal scale of 3 categories: slightly, moderately and very important. These were subjective questions which result in problems of comparability between respondents. For instance, 25% of innovators in Finland have declared that innovation was very important to replace products being phased out, compared to 30% in the UK. However in Finland, this objective is among the most important while in the UK it is among the least important. An alternative is to rank the different objectives within a country.

Ranking of objectives among countries

Ranking the various objectives by importance within each country confirms the indication of the most important objectives presented above. As seen from Table 2.4.5 in manufacturing, the improvement of product quality is ranked in the first or second place in all countries. However, in countries such as Ireland, Finland and Sweden, innovators have also ranked highly the replacement of products phased out whereas this is the least important objective in Italy and Portugal.

The reduction of labour costs is ranked 2nd, just after the improvement of product quality, by German innovators and in the 3rd place by Norwegian innovators but only in the 6th place by Spanish innovators. Reduction of environmental damage, on the other hand, is ranked 4th by Spanish innovators but in the range of 6th to 10th place in most other countries. The compliance with standards and regulations, which is ranked as a low priority objective in most countries, is indicated as the fourth most important objective by French innovators.

Table 2.4.5: Ranking of very important objectives of innovation, by country, manufacturing sector, 1996

	EU-15	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EEA	NO
Product oriented objectives																	
Products phased out	8	8	9	7	9	6	4	10	5	6	9	10	3	3	8	8	9
Product quality	1	2	2	1	1	2	2	1	3	1	2	1	1	1	1	1	1
Product range	3	3	4	2	3	3	3	4	2	2	4	4	3	5	4	3	4
New markets	2	1	1	4	2	1	1	2	1	3	1	2	2	2	2	2	2
Process oriented objectives																	
Production flexibility	5	6	6	5	5	7	6	5	6	4	5	5	5	9	6	5	5
Labour costs	4	4	3	2	6	5	5	3	4	4	3	3	6	4	3	4	3
Material consumption	6	5	8	6	6	8	6	9	10	9	6	8	7	6	5	6	6
Energy consumption	10	10	7	7	6	9	10	8	8	10	8	8	10	10	10	10	10
Other objectives																	
Standards & regulations	8	9	10	10	:	4	8	6	9	7	10	7	8	7	6	8	7
Environmental damage	7	6	5	7	4	10	9	7	7	8	7	6	9	7	9	7	8

Source : CIS2, Eurostat / Enterprise DG.

In services, the product-related objectives, like in manufacturing, are generally ranked highly, with the improvement of product quality in first or second place. The exception is Denmark, where the extension of the product range and the development of new markets are ranked in the first and second place, respectively. The replacement of products phased out, which, on average for all countries, ranks 6th, climbs as high as to the 3rd place in Finland, and to the 4th place in France. On the contrary, it ranks only in the range of 8th to 10th place in Belgium, Germany and Portugal.

The ranking of reduction of labour costs again confirms the German position as the country where innovators are the most concerned with cost reductions and with production flexibility. The reduction of environmental damage is also ranked rather differently across countries; in the medium-range for Sweden and Portugal but among the lowest in all the other countries, except Germany, the Netherlands and Finland. Finally, as already suggested by the indication of the most important objectives above, compliance with standards and regulations, which is the lowest priority in Germany, is ranked fourth in Sweden. However, this objective is also ranked in rather high position in Belgium, France, Portugal and the United Kingdom.

Table 2.4.6: Ranking of very important objectives of innovation, by country, service sector[1], 1996

	EU-15	B	DK	D	E	F[2]	IRL	I	L	NL	A	P	FIN	S	UK	EEA	NO
Product oriented objectives																	
Products phased out	6	8	5	9	:	4	7	:	6	5	4	10	3	5	7	6	4
Product quality	1	1	3	1	:	1	1	:	1	1	1	1	1	2	2	1	1
Product range	2	3	1	2	:	3	4	:	2	3	6	3	4	3	3	2	3
New markets	3	2	1	5	:	2	2	:	3	2	3	2	2	1	1	3	2
Process oriented objectives																	
Production flexibility	4	4	4	3	:	6	3	:	5	4	5	8	5	8	6	4	6
Labour costs	5	6	7	4	:	7	5	:	7	6	2	4	6	5	4	5	5
Material consumption	6	8	8	6	:	8	8	:	10	10	8	7	10	10	9	7	8
Energy consumption	10	7	9	8	:	8	10	:	9	9	9	9	9	9	8	10	10
Other objectives																	
Standards & regulations	6	5	6	10	:	5	6	:	4	8	7	5	8	4	5	7	7
Environmental damage	6	10	9	7	:	10	9	:	8	7	10	6	7	5	9	7	9

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included.

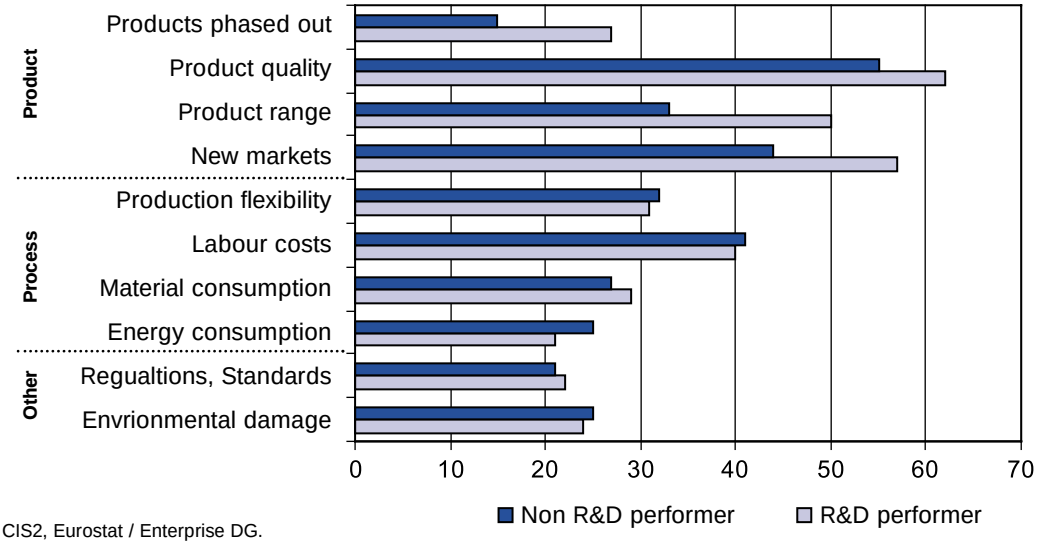
Source : CIS2, Eurostat / Enterprise DG.

R&D and objectives of innovation: any links?

As shown in Figure 2.4.2, R&D performing innovators in general do not rank objectives of innovation in the same manner as innovators that are not involved in internal creative research.

There is, in particular, a large gap between R&D performers and non-R&D performers for product related objectives. Indeed, in the manufacturing sector, the highest difference between the two groups of innovators is found in extending the product range, opening up new markets or increasing market share, increasing product quality and replacing products phased out. These objectives, which were mostly regarded as very important for all the innovators, are quoted by more innovators engaged in R&D than non-R&D innovators. In the manufacturing sector, replacing products phased out was considered by 23% of innovators as being a very important goal. This aim was ticked by 27% of innovators carrying out R&D but by only 15% of non-R&D innovators.

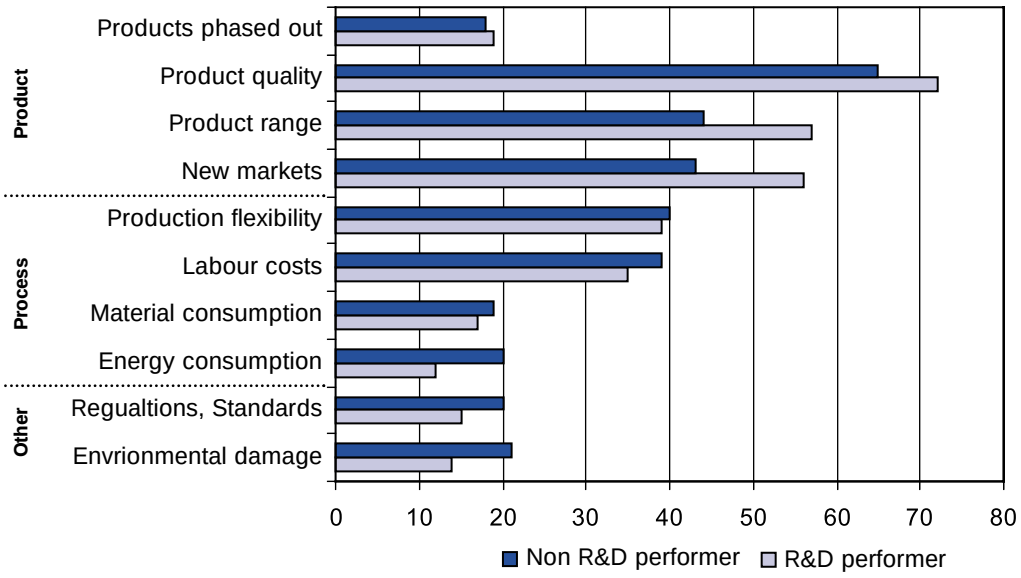
Figure 2.4.2: Very important objectives of innovation broken down by R&D and non-R&D performer, manufacturing sector, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

The picture is very much the same in the service sector except that the difference for products being phased out is merely inexistent. However, there is a wider gap for process related objectives. R&D does not seem to play a very important role in the field of reducing environmental damage and energy consumption. 20% of non-R&D innovators claim they innovate in order to reduce their consumption of energy while there are only 12% of innovators involved in R&D which do. For environmental damage, the corresponding figures are 14% and 21%.

Figure 2.4.3: Very important objectives of innovation broken down by R&D and non-R&D performer, service sector[1,2], EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Chapter 5
Sources of information for innovation

- *Information from within enterprises is the main source of information for innovation; every second innovator claimed that it was a very important source used.*
- *Clients and customers ranks highest among the market sources of information; it was considered to be very valuable by roughly 40% of innovators.*
- *Less than 5% of innovating enterprises have been actively using education-related, government or private non-profit institutes and patents as sources of information for innovation.*

Access to a particular information source is one of the key elements in the complex innovation process. There may be country differences due to the national system of innovation; innovation performance depends on the way in which the different components of the 'innovation system' - businesses, universities, other research bodies, financial and legal institutions - interact with one another at the local, national and international levels.

As it has already been pointed out, research and experimental development is no more considered as being the only source of information for innovation. As it has been shown, a large number of enterprises use external sources to back their innovations. Innovation can be the output of scientific endeavours but also the result of market demand. In other words some new products are downstream manifestations of technological potential, others constitute a response to market opportunities or are a combination of the two.

A considerable amount of emphasis has been put on learning and innovation, as important features of the knowledge-based economy. Learning is regarded as an activity that takes place in connection with the routine of activities of production, procurement, marketing and consumption. Consequently most firms have a wide range of potential sources of technical information to develop their innovation activities, whether of internal or external, private or public nature.

The Community Innovation Survey identified twelve main sources of information needed for designing new innovation projects or contributing to the completion of existing ones. The list included both internal and external sources. Among the former were own R&D, but also encompasses management, production, sales and marketing functions. The latter comprised different actors on the market, external advisers and publicly available information. Therefore the CIS2 has defined the following sources of information:

Internal sources:

- within the enterprise and
- other enterprises within the enterprise group.

Market information:

- competitors
- clients or customers
- consultancy enterprises and
- suppliers of equipment, materials, components and software.

Publicly available information:

- patent disclosures
- professional conferences, meetings and journals
- computer based information networks and
- fairs and exhibitions.

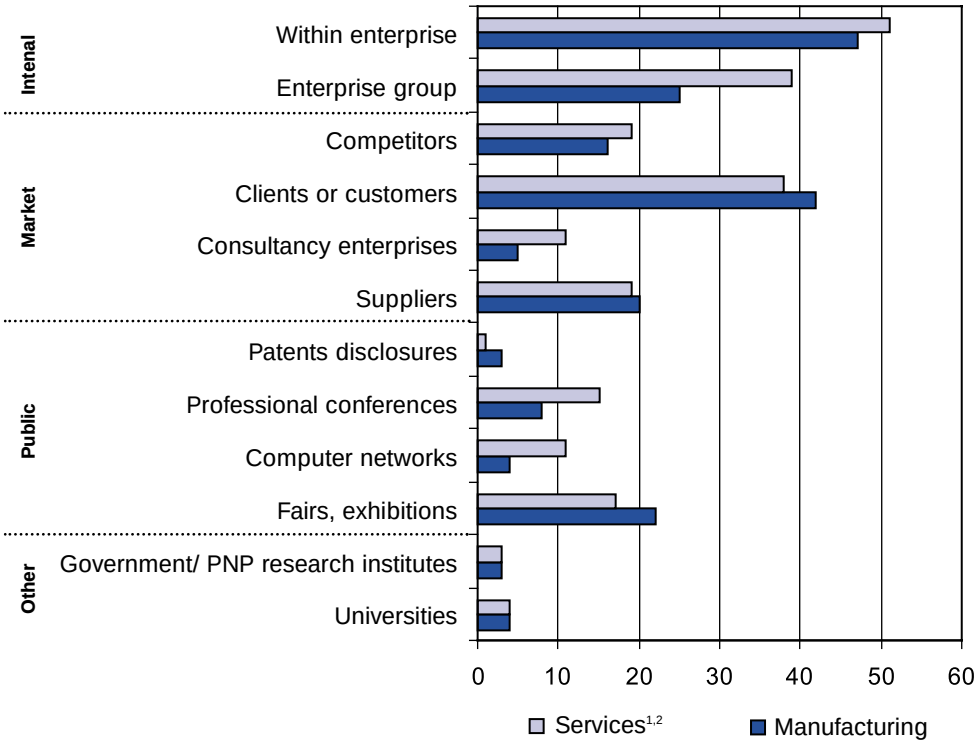
Other:

- universities or other higher education institutes
- government or private non-profit (PNP) research institutes.

Information for innovation

The two most important information sources for the firms are, as seen from Figure 2.5.1, found within the enterprise and their customers, a result that suggests the importance of user-producer relationships between firms and industry. Innovators also often call on other enterprises belonging to the same group for the innovation process. Therefore, the information available internally is the dominant source, but it is closely followed by clients or customers which represent a very important source for approximately 40% of innovators.

Figure 2.5.1: Number of innovators with very important sources of information for innovation used (%), EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

A second group of relevant sources comprises generally available information such as fairs and exhibitions and two complementary external market sources representing an important component of diffusion of sources of information for innovation: competitors and suppliers. It is by developing its internal capacity and by being embedded in the market that a firm reinforces its innovation capacity.

Education related and public research sources are ranked very low. Less than 5% of innovators considered information from government or private non-profit research institutes and from universities or other higher educational establishments as being a very important source of information. Similarly, patents are claimed to be very important by a marginal number of innovators, respectively 3% and 1% in the manufacturing and service sector. A reason could be that it is far from containing codified, i.e. generally available information. Their study may require a considerable amount of absorptive capacity demanding strong background competencies in the field.

When the manufacturing firms are compared to their service counterparts, the ranking of the different sources is quite alike but the level of the percentages is different. Service firms turn more to enterprises within the same group or to consultancy enterprises, have a wider use of computer based information networks and to consultancy firms than those in the traditional industrial sector. The manufacturing enterprises however seek more information in fairs and exhibitions than the service ones.

Does size affect information sources?

The survey shows that there are more large innovators than small ones considering information within the enterprise as very important and this picture holds for both sectors: 60% of large innovators compared to 43% of small manufacturing enterprises and in the service branches 60% against 51%. This is reasonable since the internal human base information is higher in large enterprises.

This trend is also found in the manufacturing sector for market information such as competitors, clients or customers and enterprises within the same group. The situation in the service sector is different: there is no particular size effect for competitors and the trend is opposite regarding the latter two sources of information mentioned. As for enterprise group, there are more small than large sized-service firms viewing enterprises within the same group as a very important source of information, 43% against 36% respectively.

In contrast to the general picture, small enterprises, on average, rely more on fairs and exhibitions than large ones. This is particularly true for the service sector where 19% of small innovators declares this publicly available information as very important compared to 9% of large ones. On the other hand, consultancy enterprises represent a more important source of information for large innovating service firms. This source is, for large firms, ranked fourth in order of importance while on average it is the eighth most relevant source.

Table 2.5.1: Number of innovators with very important sources of information used (%), by size, EEA, 1996

	Manufacturing			Services[1,2]		
	Small	Medium	Large	Small	Medium	Large
Internal information						
Within enterprise	43	48	60	51	47	60
Enterprise group	20	25	32	41	39	36
Market information						
Competitors	15	16	20	18	22	22
Clients or customers	40	42	48	38	39	33
Consultancy enterprises	5	5	5	9	11	22
Suppliers	19	20	19	20	17	13
Publicly available information						
Patents disclosures	3	3	6	0	1	1
Professional conferences	7	8	9	15	18	12
Computer based information networks	3	4	5	12	10	9
Fairs, exhibitions	23	21	17	19	12	9
Other						
Government/ PNP research institutes	2	3	5	3	3	2
Universities	3	5	8	5	2	5

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

The data in Table 2.5.1 also show that large firms, in general, use more diverse sources of information than SMEs. This is, however, due to obvious reasons: a large firm is more likely to have introduced several innovations and different products or processes are likely to require different information sources. It then follows naturally that the more innovations are introduced, the more sources of information are needed.

Sources of information across countries

Comparing cross-country differences in the share of manufacturing innovators having declared each source of information used as very important, the dominating source is either information from within the enterprise, ranging from 29% in Denmark to 73% in Spain or clients and customers between 14% in the Netherlands and 58% in Ireland.

Table 2.5.2: Number of innovators with very important sources of information for innovation by country (%), manufacturing sector, 1996

	EU-15	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EEA	NO
Internal information																	
Within enterprise	47	44	29	57	73	48	56	36	57	42	34	34	40	56	43	47	51
Enterprise group	25	23	11	38	:	24	46	25	59	14	22	42	18	17	19	25	27
Market information																	
Competitors	16	23	17	22	22	9	29	9	19	5	17	12	8	17	17	16	19
Clients or customers	42	54	44	45	53	32	58	28	38	14	57	29	44	69	54	42	54
Consultancy enterprises	5	3	4	5	7	1	9	8	6	1	1	15	3	2	2	5	5
Suppliers	19	15	11	22	14	18	24	21	28	7	7	28	13	11	23	20	27
Publicly available information																	
Patents disclosures	3	2	8	4	3	2	7	2	3	2	2	3	1	3	4	3	1
Professional conferences	8	5	2	11	8	4	14	7	18	5	12	10	5	4	5	8	8
Computer based information networks	4	3	3	5	:	4	8	4	7	1	5	1	3	2	3	4	4
Fairs, exhibitions	22	20	10	29	26	10	29	26	31	8	31	29	11	16	15	22	16
Other																	
Government/ PNP research institutes	3	5	4	3	5	2	7	2	2	2	1	6	5	:	2	3	6
Universities	4	7	6	7	3	3	5	2	3	1	5	7	7	5	4	4	5

Source : CIS2, Eurostat / Enterprise DG.

The review of country specifics in terms of access to sources of information (Table 2.5.2) shows that other members of an enterprise group is the most widely used source in Ireland (56%), closely followed by Germany where 38% of innovators in the manufacturing sector declared that it was very important. At the lower end are Denmark and the Netherlands with respectively 11% and 14% of innovators.

Irish firms are more widely involved in professional conferences for their innovation process than firms in other countries while, on average, there are more Italian and Portuguese innovators that have backed their project using information from consultancy enterprises.

The ranking of the sources or information within a country (Table 2.5.3) shows that the first two sources of information are found within the enterprise or with clients/customers for all countries except Portugal where 'clients/customers' is ranked third. In Portugal enterprises within the same group constitute the main source of information. However, this source is not directly comparable with the other ones because the data refers only to those firms which actually belong to a group.

Table 2.5.3 reveals a large number of disparities among the EEA countries. For instance, suppliers of equipment, materials, components or software constitute the third main source of innovation for UK and Norway but this source is ranked only at the seventh position in Italy and Austria. In addition, competitors are relatively more used in Belgium, Denmark and Sweden where it ranks third, than in Portugal where this source comes in the seventh position.

Table 2.5.3: Ranking of very important sources of information used, by country, manufacturing sector, 1996

	EU-15	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EEA	NO
Internal information																	
Within enterprise	1	2	2	1	1	1	2	1	2	1	2	2	2	2	2	1	2
Enterprise group	3	3	4	3	11	3	3	4	1	2	4	1	3	3	4	3	3
Market information																	
Competitors	6	3	3	5	4	6	4	6	6	6	5	7	6	3	5	6	5
Clients or customers	2	1	1	2	2	2	1	2	3	2	1	3	1	1	1	2	1
Consultancy enterprises	8	10	9	9	7	12	8	7	9	10	11	6	10	10	11	8	9
Suppliers	5	6	4	5	5	4	6	5	5	5	7	5	4	6	3	5	3
Publicly available information																	
Patents disclosures	11	12	7	11	9	10	10	10	10	8	10	11	12	9	8	11	12
Professional conferences	7	8	12	7	6	7	7	8	7	6	6	8	8	8	7	7	7
Computer based information networks	9	10	11	9	11	7	9	9	8	10	8	12	10	10	10	9	11
Fairs, exhibitions	4	5	6	4	3	5	4	3	4	4	3	3	5	5	6	4	6
Other																	
Government/ PNP research institutes	11	8	9	12	8	10	10	10	12	8	11	10	8	:	11	11	8
Universities	9	7	8	8	9	9	12	10	10	10	8	9	7	7	8	9	9

Source : CIS2, Eurostat / Enterprise DG.

In Denmark, professional conferences are not widely used as an important source of innovation. Among all the sources of information, it is the one with the lowest percentage while on average for all the countries it ranks 7th. As highlighted before, many Italian and Portuguese innovators have backed their project using information from consultancy enterprises; this source ranks respectively at the 5th and 6th position, while in France it is the source considered as the one that is the least used.

In the service sector (Table 2.5.4) like in manufacturing sector, internal information and clients or customers are the main providers of information for innovation; for most countries, these are part of the top three very important sources of information used. On the other hand, universities, government and private non-profit institutes as well as patent disclosures constitute sources of information that are not widely used - they generally rank last in most of the countries. Two exceptions are the Netherlands for government/PNP research institutes (7th) and Finland for universities (8th).

Table 2.5.4: Ranking of very important sources of information used, by country, service sector[1], 1996

	EU-15	B	DK	D	E	F[2]	IRL	I	L	NL	A	P	FIN	S	UK	EEA	NO
Internal information																	
Within enterprise	1	2	2	1	:	1	3	:	2	1	2	2	1	2	2	1	1
Enterprise group	2	3	5	2	:	4	1	:	1	2	4	1	3	3	3	2	3
Market information																	
Competitors	4	5	3	5	:	5	5	:	5	7	3	6	5	5	5	4	5
Clients or customers	3	1	1	3	:	2	2	:	3	3	1	3	2	1	1	3	2
Consultancy enterprises	8	7	7	8	:	8	8	:	9	10	10	8	9	7	7	8	9
Suppliers	4	4	3	7	:	3	4	:	4	4	8	4	4	4	4	4	4
Publicly available information																	
Patents disclosures	12	12	11	12	:	12	12	:	12	11	9	12	12	11	12	12	12
Professional conferences	7	5	9	4	:	6	9	:	6	5	7	6	7	10	9	7	7
Computer based information networks	8	7	6	8	:	6	6	:	8	8	6	9	5	6	8	8	6
Fairs, exhibitions	6	9	7	6	:	9	7	:	7	6	5	4	9	8	6	6	8
Other																	
Government/ PNP research institutes	11	10	10	11	:	10	11	:	11	8	10	11	11	:	10	11	11
Universities	10	11	11	10	:	10	10	:	10	11	10	10	7	9	11	10	10

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included.

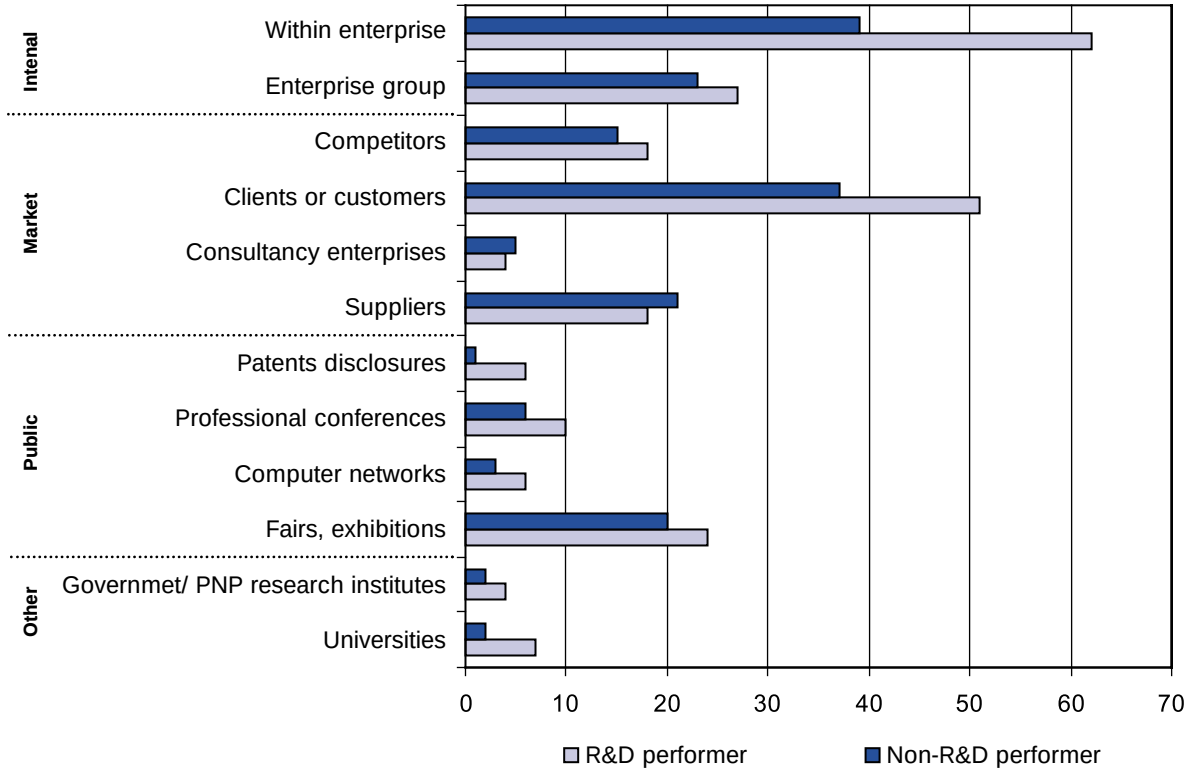
Source : CIS2, Eurostat / Enterprise DG.

Other sources are only moderately used as a significant information base, with a small number of exceptions among countries. For example, fairs and exhibitions play a more prominent role in Portugal than in other EEA Member States. Suppliers of equipment, as diffusers of innovation information are ranked respectively 7th and 8th in Germany and Austria while in other countries this source is ranked at least 4th. German firms, however, turn more to professional conferences for sources of innovation, while Austrian, as well as Danish firms, seek ideas with competitors more frequently than other European countries.

Sources of information for innovation with regards to R&D

The kind of information source and its importance does not indicate the 'value' of the source. Naturally, market-related sources are easier to obtain and a customer or supplier will know the requirements that a product should satisfy and the quality of marketing. In contrast, the value of science-based information will influence the research activities and contribute to the development of a product. The knowledge push comes from the technology side and is sometimes the first step to a new product or process.

Figure 2.5.2: Very important sources of information for innovation broken down by R&D and non-R&D performer, manufacturing sector, EEA, 1996



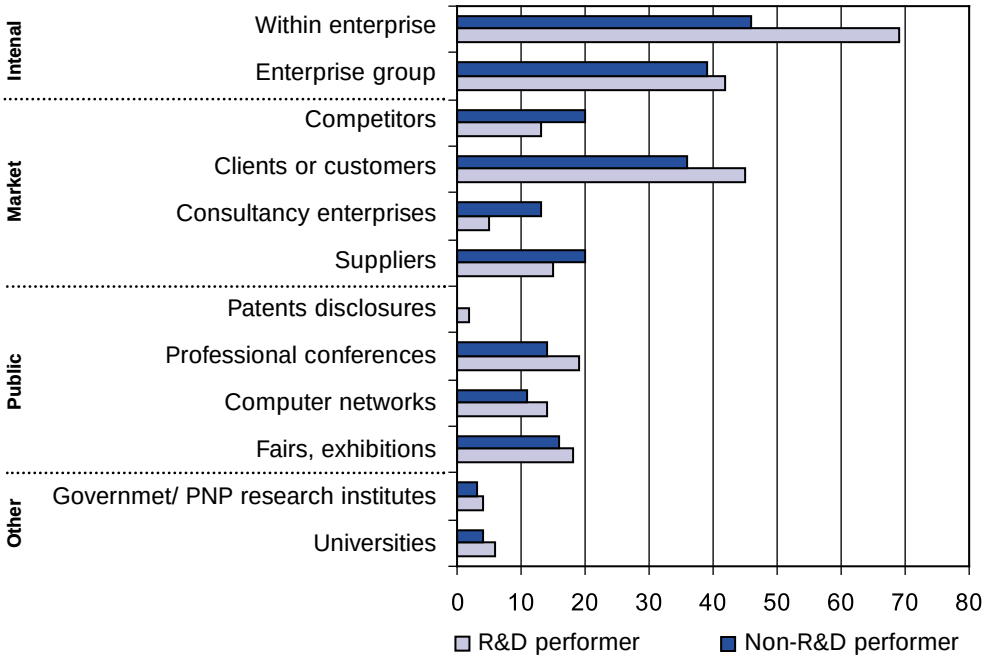
Source : CIS2, Eurostat / Enterprise DG.

As shown in Figure 2.5.2, firms with in-house R&D rely considerably more on internal sources of information than firms that are not engaged in internal creative research. In the manufacturing sector, there are more R&D performing than non-R&D performing innovators that have internal sources of information, respectively 62% and 39%. The situation is the same for clients or customers, albeit with a smaller gap.

For other sources than in-house and client based, the difference in percentages is not very large in the manufacturing sector. However R&D performers have a slightly larger use of education related and public research sources, including patents, than non-R&D performers. This tends to confirm that firms which are in a position to exploit these sources also rely more on research-oriented ones; it may thus be argued that a special competence is generally required to fully exploit this information.

In the service sector the picture still holds; there are much more R&D performers that call upon information within the enterprises and clients or customers compared to non-R&D performers. Innovators with in-house R&D use less information from competitors, suppliers of equipment and material and consultancy enterprises than non-R&D performers.

Figure 2.5.3: Very important sources of information for innovation broken down by R&D and non-R&D performer, service sector, EEA[1,2], 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Chapter 6
Innovation cooperation

- *Every forth innovator has established an innovation cooperation agreement with another enterprise or organisation.*
- *Enterprises within the same group represent the most common innovation partner; market-related partners (clients, suppliers, competitors), universities and government-based organisations also actively participate in innovation cooperation.*
- *National partners are the dominant innovation collaborators, but every second partner in the manufacturing sector is based in the EU; every third for the service sector.*
- *Nordic countries are relatively highly engaged in cooperation on innovation project (between 50 to 70% of innovators in the manufacturing sector).*
- *Every second innovator engaged in joint projects has been implementing a product new to the market.*

Firms and other economic actors may interact in many ways. The market place clearly constitutes the main field of interaction. However, interaction outside or at the margin of markets is common for innovating firms. A possible distinguishing characteristic of non-market interaction in the innovation process is the existence of collaborative arrangements. These can take many forms; they may be formal or informal (i.e. contractual or not), they may involve two or many more partners, involve one way or two ways relationship, have different geographical dimensions and involve different types of actors.

Cooperation between firms is in fact more frequent and the terms ‘networks’ or ‘clusters’ of enterprises are increasingly common in the daily vocabulary. Traditionally there are two types of inter-firm collaboration: horizontal and vertical. The former one relates to companies from the same or related branches, sometimes even direct competitors. The latter involves association along the supply chain between the suppliers and their customers. In that case, the major advantage to the participants lies in product tailoring for the buyer and reduced demand uncertainty for the supplier. A third type of cooperation in which firms are involved is university-industry or government-industry collaboration.

A number of reasons encourage enterprises to collaborate: the research process is more and more complex, costs and risks of developing an innovative product, process or service are rising, products are becoming increasingly sophisticated in response to the new and more complex problems and consumer demands. Many companies do not have the necessary scientific or financial resources to cope with these problems and associated additional burdens. Collaboration with different enterprises results in lowering the costs and risks of innovation as well as the sharing of scientific and technical knowledge. Collaborative arrangements may also exist if one of the participants is not a market actor. Thus universities, government laboratories and private non-profit research institutes may only be able to offer collaboration through such agreements.

This chapter investigates innovation cooperation regarding the type of partner and their location. By innovation cooperation is understood active participation in joint R&D and other innovation projects with other organisations. It does not necessarily imply that both partners derive immediate commercial benefit from the venture. It should be noted that purely contracting out of work, with no active participation, is not regarded as cooperation.

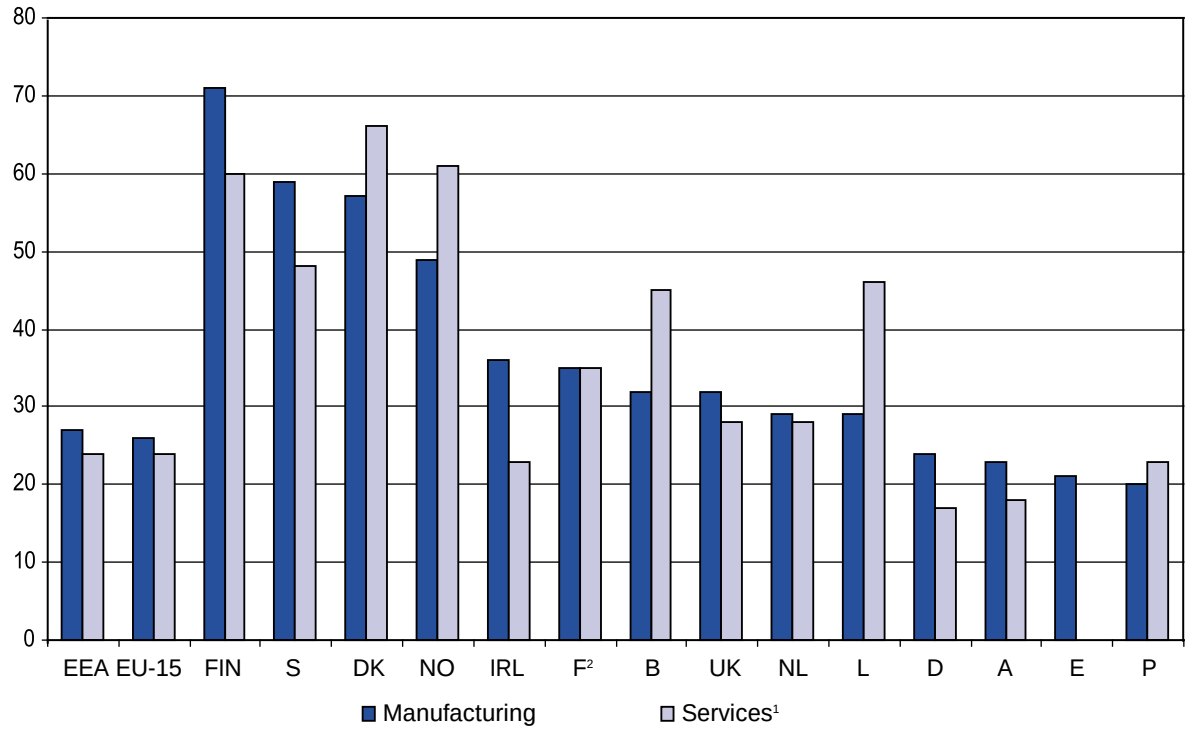
How many enterprises cooperate?

On average there are more than a quarter of innovators that have established cooperation agreement in innovation between 1994 and 1996, with slightly more in the manufacturing sector than in the service sector, 27% against 24%.

The country comparison in Figure 2.6.1 shows that the Nordic countries, namely Finland, Sweden, Denmark and Norway, are very active in innovation cooperation. In the manufacturing sector, over 71% of Finnish innovating enterprises have cooperated with other companies or organisations, while up to 59% of Swedish, 57% of Danish and 49% of Norwegian innovating enterprises have cooperation arrangements.

As opposed to their Nordic counterparts, southern countries are less involved in innovation cooperation. In Spain and Portugal, about a fifth of innovators in the manufacturing sector are involved in joint innovative projects; the proportion is as low as one-tenth for Italy. In Spain, however, the statistics relate to cooperation in R&D and as such are not directly comparable to other data on innovation cooperation for all the other Member States.

Figure 2.6.1: Number of innovators with innovation collaboration (%), by country, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included.

Source : CIS2, Eurostat / Enterprise DG.

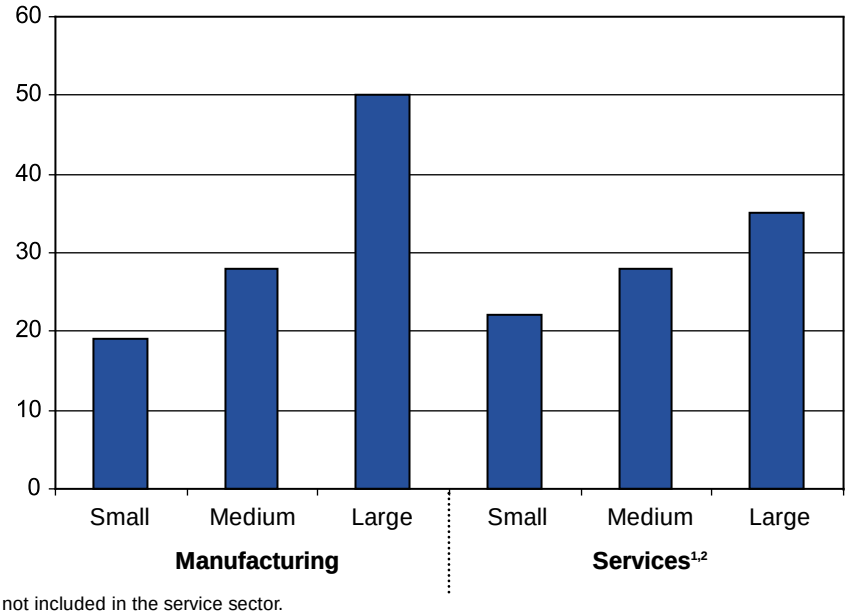
The breakdown of data by the two main economic sectors reveals that in Finland, Sweden, Ireland, Germany, Austria and the UK there are significantly more cooperation agreements among innovators in the manufacturing sector than in the service sector. The situation is however the opposite for Denmark, Norway, Belgium and Portugal. For France and the Netherlands, the proportions in both sectors are quite close.

How does size affect the propensity of enterprises to establish innovation cooperation?

Turning to the size distribution of cooperating firms, large enterprises are clearly the most involved in cooperation. As shown in Figure 2.6.2 half of the innovating large enterprises in manufacturing are actively participating in joint R&D and other innovation projects with other organisations compared to one fifth of small and less than a third of medium-sized enterprises. The same trend can be found in the service sector, though with a smaller gap across the size bands.

This trend makes sense since large enterprises have generally a wider mix of products, have to face larger investments on R&D, etc. and therefore have more incentives to carry out some cooperation in order to share the risks or technical knowledge.

Figure 2.6.2: Number of innovators with innovation collaboration (%), by size, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Although there are fewer small than large enterprises involved in innovation cooperation, their percentage is, nevertheless, significant. However, the statistics presented reflect the number of enterprises having declared any innovation cooperation, but does not measure their intensity, i.e. the extent of cooperation, number of projects, expenditure involved, etc.

Innovation agreements within countries, variation across size bands and by sector

At the country level, the general picture still holds true: the larger the innovator, the higher the probability for the firm to engage in innovation cooperation. Exceptions to this trend in the manufacturing sector nevertheless concern Germany, Denmark and Portugal where the shares of cooperating innovators are very close in the small- and medium-sized enterprises. In the service sector, the size differences are insignificant in Germany, Denmark, France, Finland and the UK. The picture is even the opposite in Finland where there are slightly more small than large innovators involved in cooperation.

Table 2.6.1: Number of innovators with innovation collaboration by country and size (%), 1996

	Manufacturing sector				Service sector[1]			
	All	Small	Medium	Large	All	Small	Medium	Large
EU-15	27	19	28	50	24	22	28	35
B	32	24	33	69	45	43	45	58
DK	57	55	54	76	66	71	51	72
D	24	22	22	37	17	14	22	22
E	21	11	25	50	:	:	:	:
F[2]	35	26	35	61	35	32	43	33
IRL	36	26	38	84	23	23	14	77
I	11	8	15	35	:	:	:	:
L	29	6	37	37	46	38	70	54
NL	29	20	30	59	28	23	33	55
A	23	14	27	42	18	16	21	37
P	20	19	18	35	23	22	30	35
FIN	71	57	72	93	60	61	59	57
S	59	43	63	85	48	42	62	70
UK	32	22	36	53	28	27	25	53
EEA	26	19	28	49	24	21	27	34
NO	49	35	56	81	61	57	67	80

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included.

Source : CIS2, Eurostat / Enterprise DG.

Table 2.6.1 also shows that the gap between large and small firms varies considerably among the different countries presented. For the industrial sector, it ranges from 15 percentage points in Germany to 58 in Ireland. Only 26% of small-sized Irish innovators in the manufacturing sector have arranged innovation cooperation against 84% for large ones. But on average, 36% of Irish innovators have joint projects; the average is highly influenced by SMEs which are relatively more numerous than large ones.

Finland has the highest share of innovation cooperation in the manufacturing sector and this is true regardless of the size of the enterprise. More than half of the small-sized Finnish innovators are engaged in cooperation, nearly three quarter for the medium-sized and 93% for large ones.

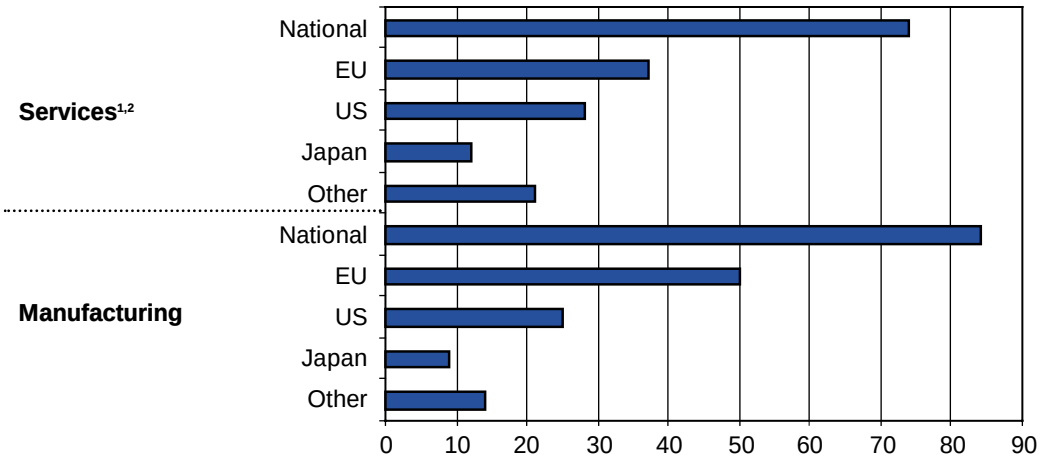
In contrast, in Italy, the available data show that the share of firms involved in innovation cooperation varies from 8% for innovating enterprises with less than 50 employees up to 35% for large manufacturing ones. The situation is rather much the same for Spain where the proportion ranges from 11% in small firms to 50% in large ones. These two countries show, albeit to a lesser extent in Spain, the lowest level of cooperation throughout the size bands.

Innovation cooperation, where?

An interesting aspect of innovation cooperation is the geographical location of partners broken down into five areas: national, EU, US, Japan and other countries. The results from CIS2 are summarised in Figure 2.6.3 below.

National partners are the dominant innovation collaborators. Three out of four enterprises with innovation cooperation are cooperating with a domestic partner; the percentage being higher in manufacturing than in services with a percentage difference of 10 points. But a number of European innovators undertake projects with collaborators from other countries; every second manufacturing innovator with a cooperation partnership has selected an enterprise from another EU Member State. In services approximately 4 out of 10 enterprises are involved in an agreement on innovation collaboration.

Figure 2.6.3: Number of innovators by location of partner as a share of innovation collaborators, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

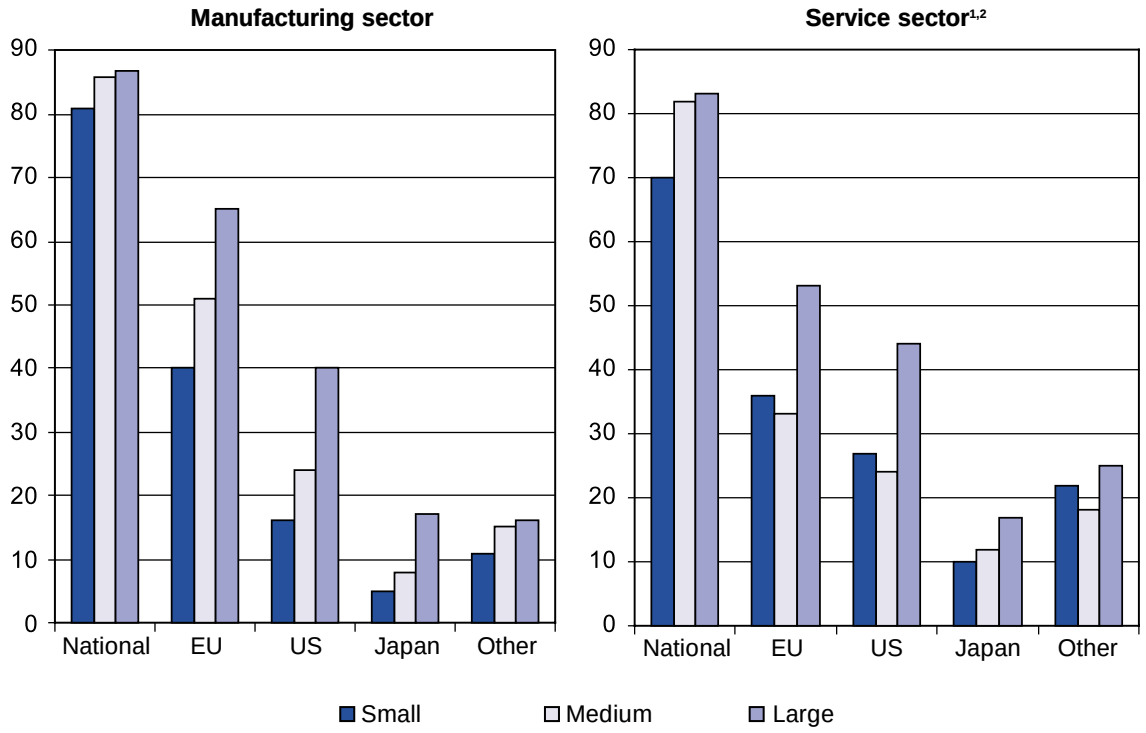
Source : CIS2, Eurostat / Enterprise DG.

The US also actively takes part in joint innovation projects. Depending upon the main economic sector, a quarter or more of innovation cooperation has been set up between EU and US enterprises. The share of arrangements with Japanese partners is lower, but not negligible: 14% for manufacturing enterprises against 12% for service enterprises.

Location of partner according to size

One would expect small enterprises to concentrate mainly on national partners for innovation cooperation. In fact, 81% of small manufacturing enterprises with innovation cooperation report joint projects within the national boundary against 70% in the service sector. However, an important number of small firms have also established innovation agreement with foreign collaborators: more than 35% of small innovators have an agreement with another EU country.

Figure 2.6.4: Number of innovators by geographical location and size as a share of innovation collaborators, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.
Source : CIS2, Eurostat / Enterprise DG.

With the exception of large enterprises in the manufacturing sector, the ranking of the geographical location of partners is similar throughout size bands and economic sectors. The dominant partner is domestic, followed by EU-based firms and then the US, other countries and finally Japan. In the manufacturing sector, the larger the enterprises, the greater the shares of collaboration with each geographical zone. This makes sense, since as seen in Figure 2.6.2, large enterprises have a higher overall propensity to establish innovation agreement than smaller ones.

In the service sector, the size trend still holds true for Japan and national partners. However, the small service enterprises have a relatively larger share of cooperation with partners from all the other remaining countries than medium-sized ones.

Location of partner by country

Table 2.6.2 below summarises the percentage of innovation cooperation by the two broad economic sectors, country and location of partner for the innovators engaged in joint innovation projects. In Spain, as mentioned above, one should read R&D cooperation instead of innovation cooperation.

This table reveals a number of disparities between countries. As we have seen above, on average, European enterprises, for collaboration, turn more frequently towards national enterprises than to partners from other countries. For the manufacturing this is not the case in Ireland and in Belgium. 76% of Irish manufacturing enterprises involved in innovation collaboration have a partner from the EU, but 65% with a local partner. The corresponding figures for Belgium are 71% compared to 61%.

At the other end of the scale, France and the UK have a relatively low percentage of innovation collaboration with EU countries in the manufacturing sector (39%). The same is true for German service enterprises that collaborate with their EU counterparts; 14% compared to an average of 38%.

Within the EEA, Germany is the country where manufacturing enterprises collaborates proportionally more in innovation with Japan. 19% of innovators with a joint project have a Japanese partner, compared to an average of 9% at the European level and 2% and 3%, respectively in Spain and Austria.

Table 2.6.2: Number of innovators by geographical location and by country as a share of innovation collaborators, 1996

	Manufacturing sector					Service sector[1]				
	National	EU	US	Japan	Other	National	EU	US	Japan	Other
EU-15	84	50	25	9	14	74	37	29	12	22
B	61	71	28	5	13	79	57	26	12	8
DK	83	67	15	6	23	87	48	24	8	19
D	82	57	32	17	23	95	14	9	1	3
E	87	58	9	2	10	:	:	:	:	:
F[2]	83	39	18	6	8	85	37	38	5	8
IRL	65	76	39	10	8	84	65	20	8	8
I	79	42	15	5	9	:	:	:	:	:
L	26	78	51	13	6	52	78	13	1	9
NL	85	48	17	6	10	84	34	10	3	13
A	75	69	17	3	25	62	60	41	2	12
P	79	53	9	8	3	90	61	21	7	1
FIN	97	65	32	10	16	93	45	28	5	14
S	92	56	31	9	12	95	30	9	6	7
UK	92	39	32	10	10	:	:	:	:	:
EEA	84	50	25	9	14	74	37	28	12	21
NO	93	53	20	6	8	93	35	16	4	9

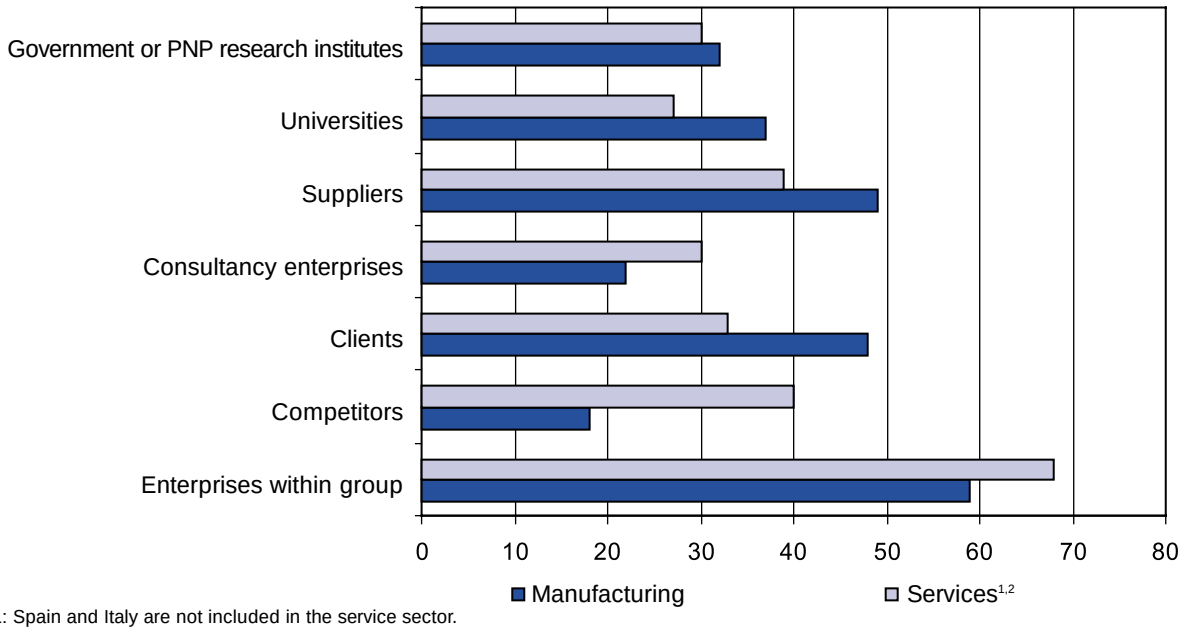
1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included.

Source : CIS2, Eurostat / Enterprise DG.

Innovation cooperation: with whom?

Turning to the type of partner Figure 2.6.5 shows, for enterprises belonging to a group, the main partners for innovation cooperation are other enterprises within the group, 58% of innovation cooperators in manufacturing and 67% in services.

Figure 2.6.5: Number of innovators by type of partners as a share of innovation cooperators, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

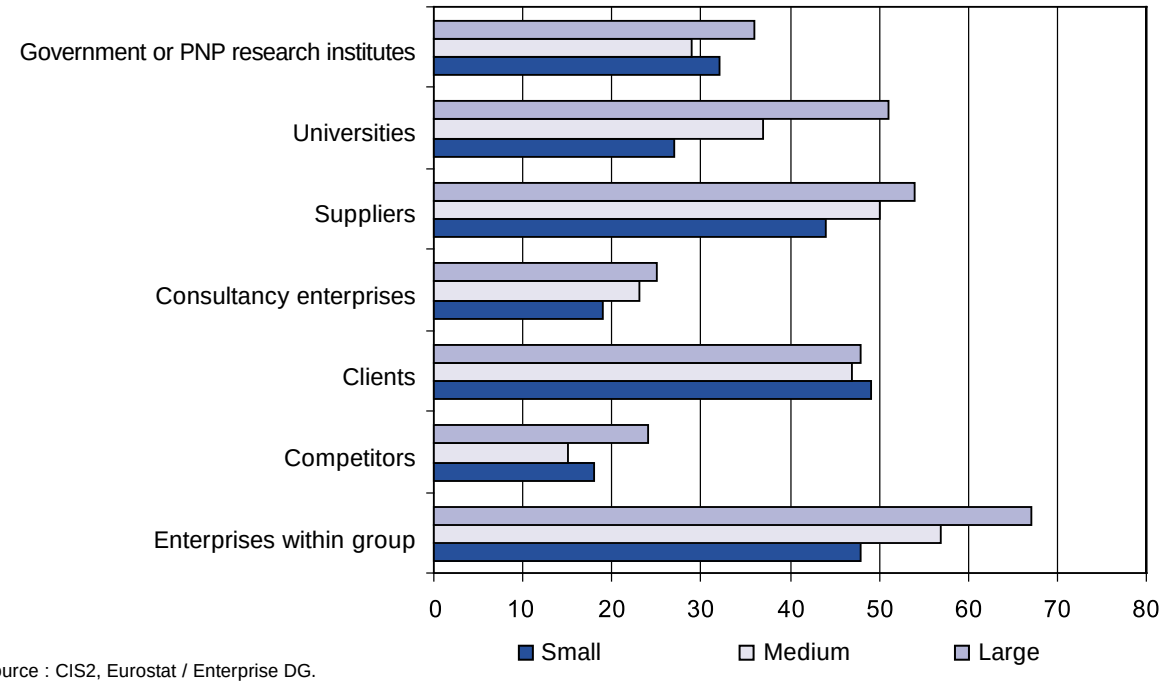
Source : CIS2, Eurostat / Enterprise DG.

In addition to the above-mentioned partner, clients and customers, closely followed by suppliers of equipment, materials, components or software are the main categories with which manufacturing innovators collaborate. The picture is to some extent different for service enterprises where the main partners are respectively competitors and then suppliers. In addition, competing enterprises in the service sectors attract a large number of joint projects for innovation while in the manufacturing sector this type of partner ranks last. Four in ten service enterprises involved in innovation cooperation have a project with a competitor as against less than two out of ten for industrial firms.

A third of enterprises with innovation cooperation have a government or private non-profit research institute as partner. Roughly the same proportion applies to universities or other higher education institutes for the manufacturing sector. In the service sector the latter are partners for over a quarter of the enterprises that have established a joint R&D and other innovation projects.

Regarding consultancy enterprises, they are relatively more often associated with innovation projects in service enterprises than in manufacturing firms, respectively 30 and 22%. These figures are quite high in the light of sources of innovation used. As shown in Figure 2.5.1, some 10% of innovators have declared that consultancy enterprises were very important sources of innovation. However, the level of those two indicators, very important sources used and innovation cooperation, can not be compared directly; the first one relates to all the innovators and the second one to a subset of innovators: those with cooperation arrangements on innovation activities.

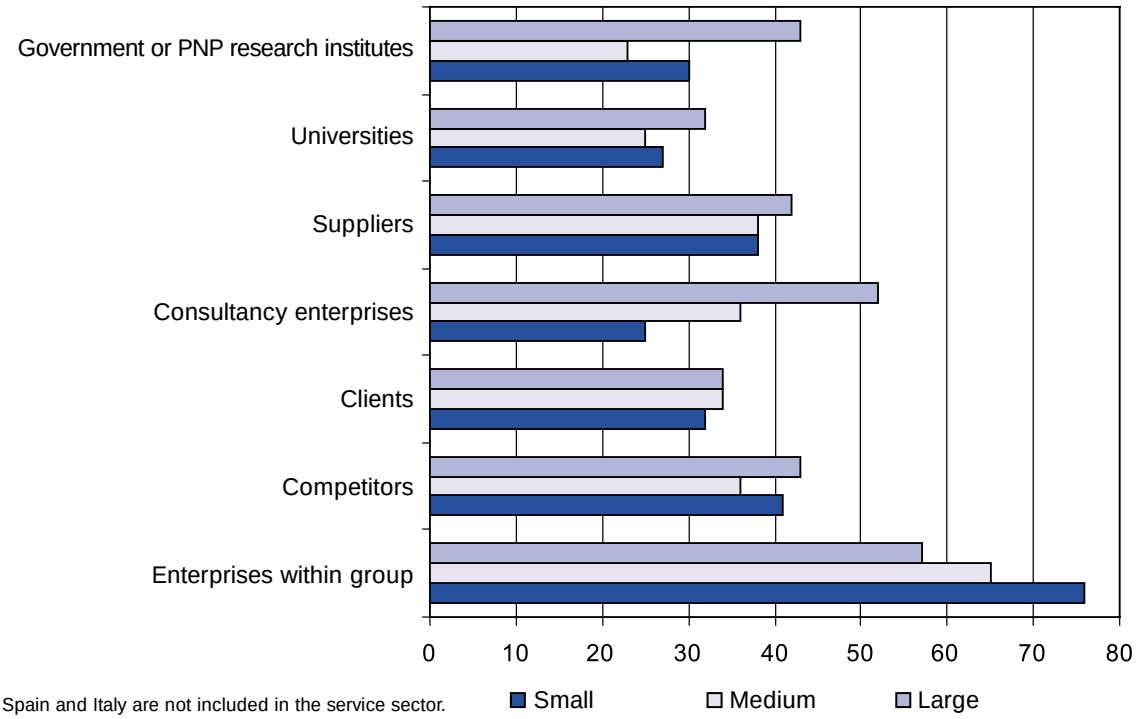
Figure 2.6.6: Number of innovators by type of partners as a share of innovation cooperators, by size class, manufacturing sector, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

In manufacturing, the larger the firm, the higher the relative number of enterprises with another enterprise in the same group as a partner for joint innovation projects. The picture is clearly the opposite in the service sector where service firms are at variance with those in industry concerning education-related and partner. Universities or other higher education institutes have more innovation cooperation with large manufacturing enterprises than with SMEs. This is also the case in services, but the gap between large and smaller enterprises is quite small.

Figure 2.6.7: Number of innovators by type of partners as a share of innovation cooperators, by size class, service sector[1,2], EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

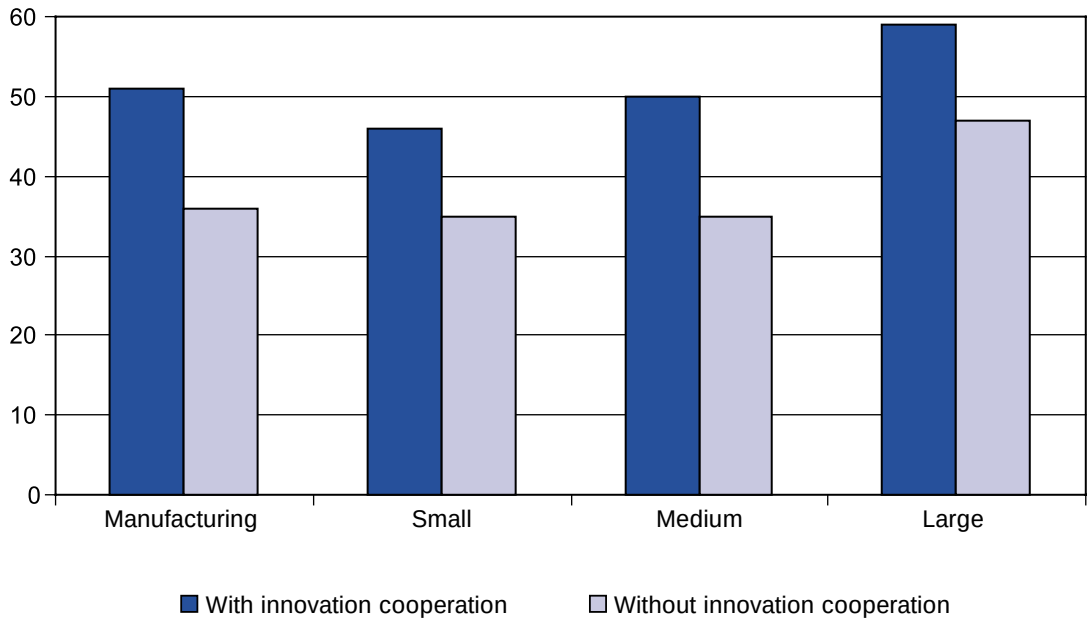
Source : CIS2, Eurostat / Enterprise DG.

Finally, there are twice as many large than small service firms which cooperate with consultancy enterprises to develop innovations: 52% compared to 25%. There is a gradual increase in the shares from small to medium and large. This is not the case for the manufacturing sector where there is a smaller difference across the size bands.

Correlation between innovation cooperation and turnover due to innovative products

On average, there are more novel innovators among enterprises with innovation cooperation than without. More than half of the firms with a cooperation agreement have been implementing an innovation, which was new to their market while only a third of innovators without joint projects, is a novel innovator.

Figure 2.6.8: Number of innovators with/without innovation cooperation having introduced novel products (%), EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

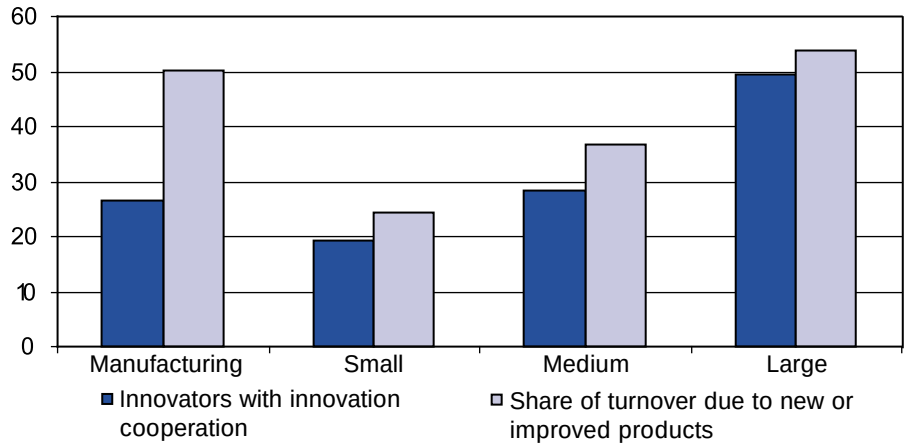
As we have already seen, the larger the enterprises are, the higher the percentage of novel innovators is and the higher the probability of an enterprise involved in a cooperation agreement is. As shown in Figure 2.6.8, regardless of the size bands, the overall picture is the same: there are more enterprises commercialising novel products among firms with cooperation agreement than among firms without a joint innovation project.

Does innovation cooperation affect the share of new or improved sales?

Half of the turnover due to new or improved products comes from innovators who have been involved in innovation cooperation but only 28% of innovators have established an innovation agreement. This would lead to the conclusion that innovation cooperators contribute to an over-proportional share of innovative products.

An analysis by size, as carried out in Figure 2.6.9, shows that this picture is true throughout all the size classes; however, the gap between the two percentages is not as large as for the overall average.

Figure 2.6.9: Number of innovators carrying out innovation cooperation (%) and their share of turnover due to new or improved products (%), EEA[1], 1996



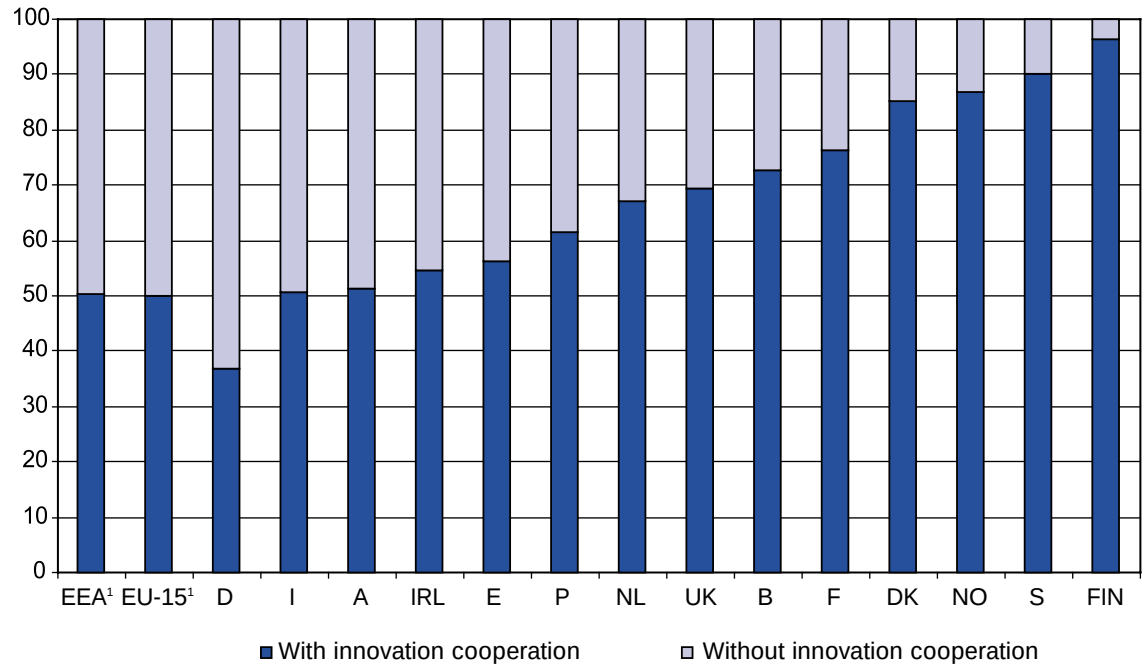
1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Figure 2.6.10 compares the share of turnover linked to innovation cooperators in terms of sales of innovative products. The percentages range between 37% in Germany up to 96% in Finland. Germany is the only country with data below the European average and because of its very large share in the turnover of new and improved products, it highly influences the mean.

In five countries, namely France, Denmark, Norway, Sweden and Finland, enterprises involved in innovation cooperation account for more than three-quarter of the sales due to innovative products.

Figure 2.6.10: Share of turnover linked to new or improved products from innovators by engagement in innovation cooperation, manufacturing, 1996



1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Chapter 7
Obstacles to innovation

- *16% of manufacturing innovators have abolished at least one innovation project (15% in the service sector).*
- *27% of manufacturing and 37% of service innovators had at least one delayed innovation project.*
- *Internal factors, mainly the lack of qualified personnel and organisational rigidities, constitute the main barrier causing innovation projects to be seriously delayed.*
- *Financial barriers are the main hampering factor leading to the innovation project being abolished or not even started.*
- *The lack of appropriate sources of finance represents a hampering factor for relatively more SMEs than large firms.*

This section will focus on the factors considered as barriers to innovation and their influence on innovation projects. Obstacles to innovation may constitute reasons for not starting innovation activities at all, or reasons for projects to be seriously delayed or aborted, therefore not leading to expected results. A number of hampering factors have been identified and as one would imagine, they can be very diverse. Economic factors like market risks or financial restrictions are not the only hindering obstacles; insufficient information, lack of competence, regulatory constraints, rigidities within an enterprise, and so on may also slow down or block innovation.

The data presented below relate to innovators only. Statistics for non-innovators are not included since the results are not reliable for this group.

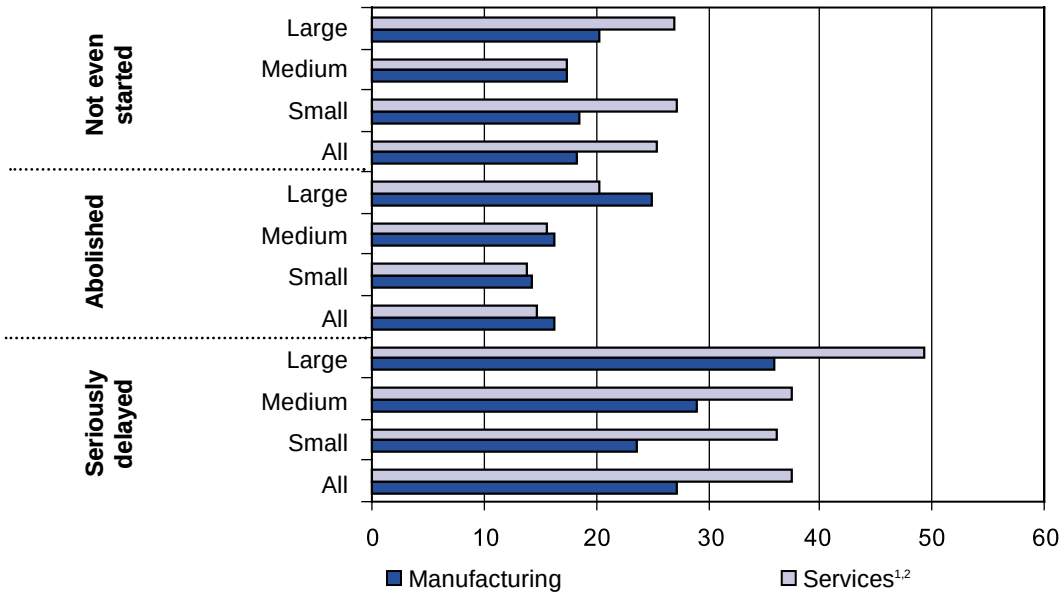
Problems with the implementation of innovation

In the Second Community Innovation Survey's questions on obstacles to innovation, three different cases have been identified: serious delay of innovation projects, abolition of projects and failure to even start planned innovation projects.

Figure 2.7.1 illustrates the percentage of innovators that have declared having at least one innovation project in 1994-1996 which was seriously delayed, abandoned or not even started.

A serious delay of projects is the dominant result of different factors hampering innovation. In fact, 27% of innovators reported that at least one innovation project had been seriously delayed during the period covered. The corresponding figures for the service sector was 37% (excluding Italy and Spain). Large enterprises appear to face more delays than small ones; a third of large innovators as against only a quarter of small sized innovators in the manufacturing sector. In the service sector, half of large innovators had critically deferred innovations against a third for small and medium-sized firms. Throughout all the size classes, there are relatively more innovating service enterprises with seriously delayed projects than in the manufacturing branches.

Figure 2.7.1: Number of innovators with problems in their innovation projects as a share of total number of innovators, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

On average around 15% of the innovators declared to have abolished at least one innovation project. Moreover, the percentage is higher for large enterprises: among large innovating enterprises every fourth and every fifth in, respectively, manufacturing and services have abandoned a project.

When facing factors hampering innovation, enterprises can prefer not to start a project. This was the case for one fifth of innovating manufacturing firms and a quarter of service sector innovators. In this respect there seems to be no particular difference between the three main size classes.

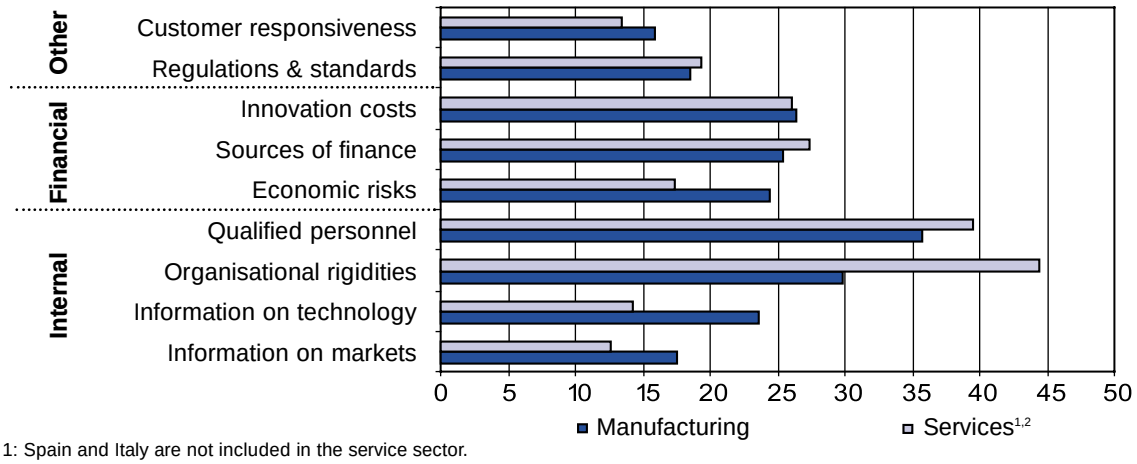
However, as seen from Figure 2.7.1, larger firms appear to more frequently report seriously delayed and aborted projects. This does not necessarily imply that compared to SMEs, large enterprises have more difficulties in overcoming barriers to innovation. Indeed, large enterprises may be implementing a larger number of innovative projects and hence face a higher probability of either abolishing a new project or facing serious delays.

Hampering factors causing innovation project to be seriously delayed

As indicated above, according to CIS2, 27% of manufacturing innovators and 37% of service innovators reported serious delay of at least one innovation project during the period covered. The breakdown of these data according to the different relevant factors hampering innovation are presented in Figure 2.7.2.

Internal barriers are the main factors causing innovation projects to be seriously delayed. Among innovators whose innovation project has been deferred, organisational rigidities are claimed to be the hampering factor by 30% of manufacturing enterprises and 44% of enterprises in the service sector. The lack of qualified personnel has been mentioned in 36% of the cases in the former, 40% in the latter. These two internal barriers are hence more important in the service sector than for the manufacturing sector; this is also the case, but to a lesser extent, for the deficit with respect to adequately qualified staff.

Figure 2.7.2: Number of innovation project by relevant factors hampering innovation, as a share of total number of innovators with seriously delayed project, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Lack of adequate information on technology is a more important obstacle for industrial enterprises than for tertiary activities. The lack of appropriate information was responsible for 24% of the delays of projects in the industrial sector but only for 14% in services. This is also true, albeit to a lesser extent, for information on markets.

Financial constraints also contribute to a large extent to seriously delay innovations. Around a quarter of enterprises admitted that too high innovation costs, excessive perceived economic risks and lack of appropriate sources of financing had caused their plans to be deferred. In this respect, economic risks have a lesser influence in the service sector where only 17% of firms mentioned this factor.

Factors causing seriously delayed projects across size bands

Table 2.7.1 assesses the relative importance of the different factors leading to delays of innovation projects across the three main size classes of firms. The largest disparities across size bands are found with respect to lack of appropriate sources of finance and too high innovation costs. This corroborates the generally admitted fact that large enterprises in general have easier access to external financing with potential partners in the financial system such as banking, collectors of long-term savings, pension funds, retirement funds, and venture-capital firms.

Table 2.7.1 Number of innovators by relevant factors hampering innovation, as total number of innovators with seriously delayed projects, by size, EEA, 1996

	Manufacturing sector			Service sector[1,2]		
	Small	Medium	Large	Small	Medium	Large
Economic factors						
Economic risks	25	25	22	17	20	14
Innovation costs	29	26	20	30	17	18
Sources of finance	31	25	15	31	24	7
Internal factors						
Organisational rigidities	28	30	35	42	47	54
Lack of qualified personnel	34	37	37	38	42	44
Information on technology	22	24	26	13	16	17
Information on markets	17	17	19	13	15	9
Other						
Regulations & standards	18	20	16	20	17	22
Customer responsiveness	13	17	20	14	11	15

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

The gap between small and large firms is smaller but still significant for too high innovation costs. The main reason is probably that large firms in general can spread the fixed costs on a larger volume of sales. However, it cannot be excluded that the term 'too high' may contain a subjective element and the appreciation of this by SMEs might differ from that of large enterprises.

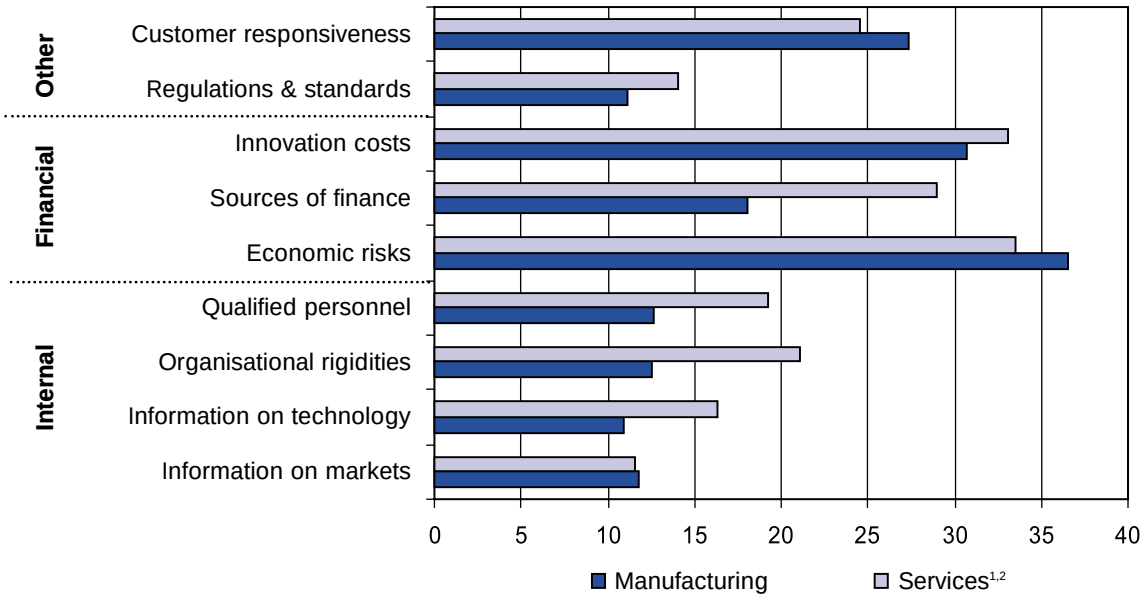
Apart from lack of qualified personnel, there is an increase across size bands for the internal factors, notably regarding organisational rigidities. Large enterprises have a higher number of hierarchical levels, more departments, a larger human base and may be more conservative than small ones. The lack of flexibility in organisation represents an important barrier in the service sector, particularly for large ones where more than half of the enterprises with delayed projects mentioned this as a factor.

Regarding customer responsiveness to new products, the larger the innovators are, the higher is the percentage of enterprises which have seriously delayed projects in the industrial sector, mentioning this as a factor. Small enterprises may have a better knowledge of their customer reaction to their innovation; small enterprises are very often in niche markets and, furthermore large enterprises have a wider mix of products and therefore a wider range of clients and customers. In the service sector the difference in this respect is less pronounced.

Hampering factors causing innovation projects to be abolished

Financial constraints represent the main barriers causing innovation projects to be abandoned. The CIS2 results show that excessive perceived economic risks and too high innovation costs are the two main factors leading to the abolition of innovation projects. 15% of innovators have put an end to at least one innovative project and for one enterprise out of three this was attributed to the economic reasons mentioned. In contrast to the serious delay of projects, organisational rigidities and lack of skilled personnel are less relevant for terminating innovative projects: this factor is mentioned by only approximately 13% of innovators in manufacturing and 21% in services.

Figure 2.7.3: Number of innovation project by relevant factors hampering innovation, as a share of total number of innovators with abolished projects, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Lack of customer's responsiveness, on the other hand, constitutes a major cause of abandoning innovation projects. It represented a barrier in one out of four abolished project in services and even somewhat more in manufacturing.

The role of access to appropriate sources of finance appears to be rather different in services and manufacturing. Lack of finance brought an innovation project to an end for 29% of innovators which have declared to have at least one abolished innovation project in the tertiary activities. In the manufacturing sector this was the case for only 18% of firms.

Factors causing the abolition of projects across size bands

The proportion of manufacturing firms quoting innovation costs, sources of finance, lack of qualified personnel, information on technology and problems of compliance with regulations and standards is higher in small firms than in both medium-sized and large firms. The latter, on the other hand, among the reasons for abolition, relatively frequently quote economic risks, information on markets and customer responsiveness.

Table 2.7.2: Number of innovators by relevant factors hampering innovation, as a share of total number of innovators with abolished projects, by size, EEA, 1996

	Manufacturing sector			Service sector[1,2]		
	Small	Medium	Large	Small	Medium	Large
Economic factors						
Economic risks	34	38	40	34	32	34
Innovation costs	34	29	28	32	34	39
Sources of finance	21	17	14	36	14	17
Internal factors						
Organisational rigidities	13	14	9	17	30	31
Lack of qualified personnel	15	12	10	19	19	22
Information on technology	13	10	10	20	9	8
Information on markets	10	13	14	13	9	7
Other						
Regulations & standards	13	11	7	16	12	9
Customer responsiveness	25	29	30	24	32	16

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

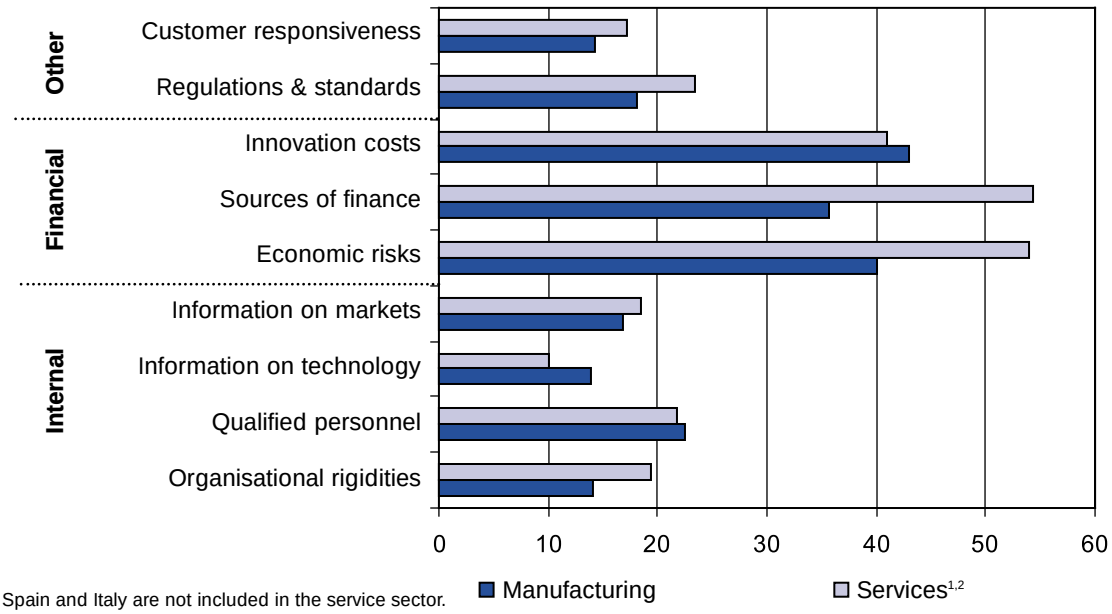
Source : CIS2, Eurostat / Enterprise DG.

In the service branches, the size class breakdown of the assessment of the different causes for ceasing innovation projects does not, in all cases, follow the same pattern as in manufacturing. As in manufacturing, lack of finance and lack of information are quoted as reasons for ending projects by an even higher proportion of small service firms than in manufacturing and about twice the proportion of large service firms quoting these difficulties. But excessive innovation costs appear to have been a particularly important cause of abolition of projects among large firms in services as against 32% and 34% in, respectively, small and medium-sized firms in this sector. In contrast, customer responsiveness is mentioned as a cause of abandoning projects by only 16% of large firms as against 24% of small and, as much as 32% of medium-sized enterprises.

Hampering factors causing innovation project to not even start

As indicated above, less than one fifth of innovating enterprises in manufacturing failed to even start an envisaged innovation project; in the service sector the ratio is one to four. Figure 2.7.4 shows that financial and economic barriers are the main impediments. More than half of the service enterprises that have not launched their innovation declared that it was because the perceived economic risks were too high or that they were unable to find the appropriate sources of finance. For the industrial enterprises, the percentage is lower (40%). Among the other obstacles, innovation costs represented a curbing feature for more than 40% of enterprises, which had failed to start their innovation project.

Figure 2.7.4: Number of innovation project by relevant factors hampering innovation, as a share of total number of innovators with projects not even started, EEA, 1996



1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Other factors are generally of lesser importance. Nevertheless, more than one fifth of the enterprises did not embark on an innovation project because of the lack of qualified personnel. Compared to the already mentioned obstacles to innovation, organisational rigidities and lack of information on technology or customer responsiveness were not quoted by a high number of this category of innovators.

Factors causing innovation projects not to start, across size bands

There are more SMEs than large enterprises that have not launched their innovation projects due a lack of appropriate sources of finance. In the manufacturing sector, 39% of small-sized innovators claimed that they have not yet started their project due to this hampering factor against 25% of large enterprises. In the service sector, the difference in size bands is even larger, ranging from 60% in small firms down to 29% in large ones.

Table 2.7.3: Number of innovators by relevant factors hampering innovation, as a share of total number of innovators with project not even started, by size, EEA, 1996

	Manufacturing sector			Service sector[1,2]		
	Small	Medium	Large	Small	Medium	Large
Economic factors						
Economic risks	41	38	40	57	43	43
Innovation costs	43	45	39	43	33	40
Sources of finance	39	35	25	60	41	29
Internal factors						
Organisational rigidities	14	16	11	21	11	14
Lack of qualified personnel	23	22	21	21	29	20
Information on technology	14	15	11	11	8	7
Information on markets	15	18	21	21	8	15
Other						
Regulations & standards	22	16	9	24	29	13
Customer responsiveness	16	13	12	17	20	14

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France..

Source : CIS2, Eurostat / Enterprise DG.

Regulations and standards are equally perceived as a stronger constraint for SMEs than for large firms, particularly in the manufacturing sector. 22% of small-sized innovators with project which have not even started claimed that the legal environment was responsible for hindering their innovation activities, while the share was only 9% for large ones. The picture is comparable in the service sector. In this respect, however, regulations and standards appear to have induced more medium-sized service enterprises to abstain from even starting a project (29%).

In the industrial sector, excessive perceived economic risk seems to have roughly the same influence across size bands, but in the service activities, small firms have to face more problems than large ones: 57% of small innovators compared to 43% of large and medium ones.

Comparing the causes of barriers to innovation

Different hampering factors have different consequences on innovation projects. Compared to seriously delayed projects, projects that have been abolished are closer to those that have not even started in the sense that they result from the same barriers. The ranking of the obstacles to innovation in Table 2.7.4 shows that financial barriers are mainly responsible for innovation projects to be abolished or not even started. As seen before, economic risk is the dominant factor to cause innovation project to be abolished or not even started. However, in the case of seriously delayed projects, it ranks only in the 5th and 6th positions in respectively the manufacturing and service sectors. The lack of appropriate sources of finance and innovation costs too high also have an important impact on innovation projects; these barriers are ranked in the first half for the three types of problems.

Compared to abolished and not event started innovation projects, organisational rigidities and the lack of qualified personnel have a larger impact on seriously delayed projects; these two barriers rank first for delayed projects.

Customer responsiveness is a moderate hampering factor causing innovation projects to be abolished while is has a lesser impact on seriously delayed or not even started projects.

Table 2.7.4: Ranking of the barriers to innovation, EEA, 1996

	Seriously delayed		Abolished		Not even started	
	Manufactuing	Services[1,2]	Manufacturing	Services[1,2]	Manufacturing	Services[1,2]
Economic factors						
Economic risks	5	6	1	1	2	1
Sources of finance	4	3	4	3	3	1
Innovation costs	3	4	2	2	1	3
Internal factors						
Information on markets	8	9	7	9	7	6
Information on technology	5	7	8	7	4	5
Organisational rigidities	2	1	5	5	7	9
Lack of qualified personnel	1	2	5	6	6	6
Other						
Regulations & standards	7	5	8	8	5	4
Customer responsiveness	9	7	3	4	7	8

1: Spain and Italy are not included in the service sector.
2: Wholesale sector is not included in France.

Source : CIS2, Eurostat / Enterprise DG.

Part 3

INNOVATION IN HIGH-TECH SECTOR AND OTHER SECTORS

Innovation in the high-tech sector and other sectors

- *3% of European manufacturing enterprises are in the high-tech sector.*
- *Three out of four high-tech enterprises introduced an innovation between 1994 and 1996.*
- *On average, at the EEA level, 42% of low-tech enterprises have been innovating during 1994-1996.*
- *Expenditure on innovation in the high-tech sector corresponds to 10% of turnover against only 2% in the low-tech-sector.*
- *The high-tech sector account for 9% of total turnover of the manufacturing sector but for 20% of turnover due to new or improved products.*
- *44% of high-tech innovators have been engaged in innovation cooperation against 19% in the low-tech branches.*
- *High-tech innovators have more product-oriented innovation objectives while low-tech innovators are more process-oriented.*

Innovation in Europe is frequently assessed in a context of level of technology. There are many reasons for this. Firstly, high-tech firms are associated with technological innovation and as we have seen, innovators tend to gain market share and create new product markets. Secondly, firms in high-tech sectors are often associated with high value-added production and success in global markets. Finally, industrial R&D performed by high-tech industries has other spill-over effects that can be used by other sectors by generating new products and processes that can often lead to productivity gains, business expansions and the creation of high-wage jobs.

The technological sectors as used here are based on the OECD classification which takes into account the R&D intensity across different industries in the manufacturing sector, not the nature of the products. The different industries classified in high-tech and other sectors are presented in Table 3.1 (see also Part 4 : Methodological note).

Table 3.1: Manufacturing industries classified according to technological sector

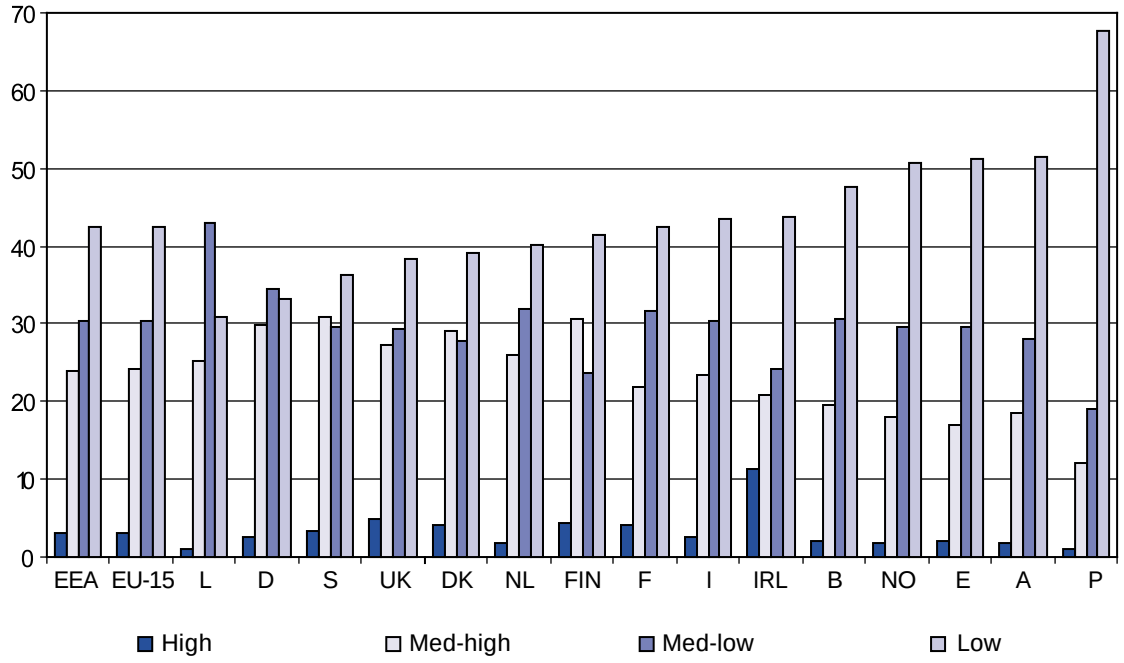
High-tech	Aerospace, computers, office machinery, electronics-communications, pharmaceuticals
Medium-high tech	Scientific instruments, motor vehicles, electrical machinery, chemicals, other transport equipment, non-electrical machinery
Medium-low tech	Rubber and plastic products, shipbuilding, other manufacturing, non-ferrous metals, fabricated metal products, petroleum refining, ferrous metals
Low-technology	Paper printing, textiles and clothing, food, beverages and tobacco, wood and furniture

Source OECD, Revision of the high-technology sector and product classification, STI Working Papers, 1997/2

Distribution of enterprises by technological sector

In a breakdown of enterprises according to the level of technology (see Figure 3.1) only about 3% of European manufacturing enterprises are classified as being ‘high-tech’. The low-tech sector constitutes the bulk of firms, representing 43% of the total population of manufacturing enterprises. Branches in the groups with medium-high and medium-low technology make up, respectively, 24% and 30% of industrial enterprises.

Figure 3.1: Relative distribution of enterprises according to technological sector (%), EEA, 1996

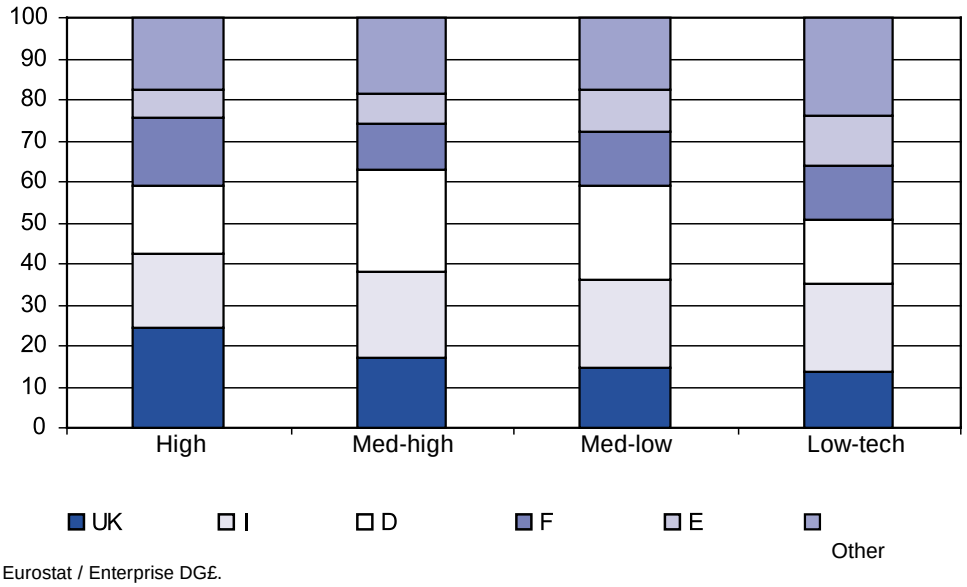


Source : CIS2, Eurostat / Enterprise DG.

At the national level, Ireland has the highest share of enterprises in the high-tech sector (11%), followed by the UK (5%). In the other countries, the share of high-tech enterprises is rather low, 4% or less, with the lowest share found in Luxembourg and Portugal.

On the other hand, Portugal has the highest share of low-tech enterprises, 68% of its manufacturing sector. Every second industrial enterprise in Spain, Austria and Norway is in the low-tech sector. Luxembourg, Germany and Sweden has the lowest percentage of low-tech enterprises: one out of three.

Figure 3.2: Relative distribution of enterprises by technological sector across countries, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG£.

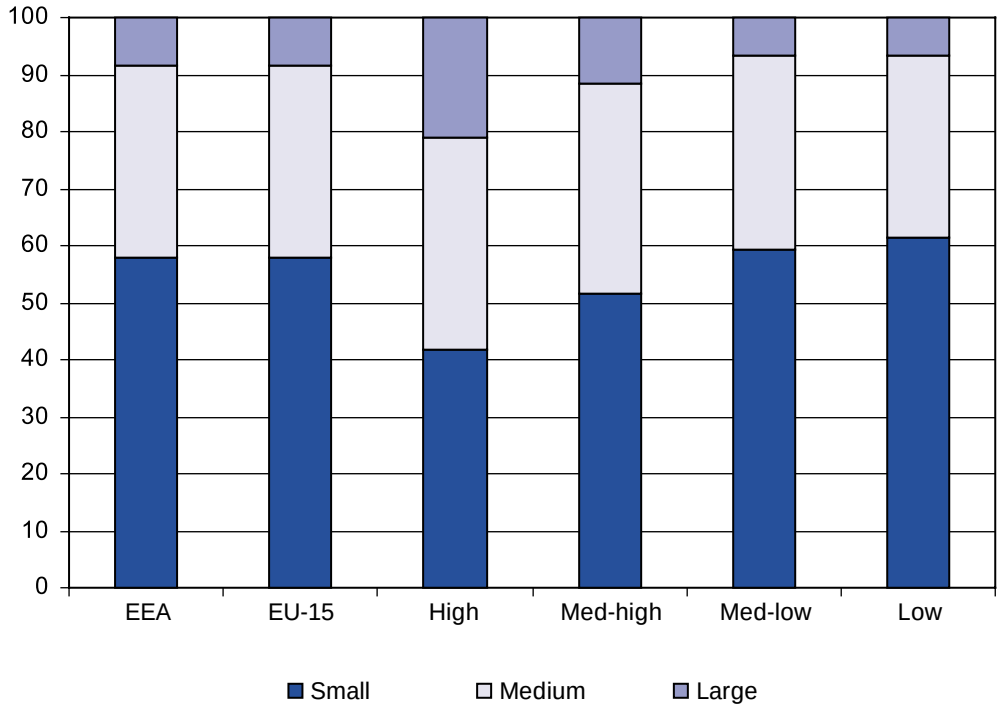
Referring to the absolute number of enterprises, the largest Member States account for by far the largest share of high-tech enterprises. The UK houses the largest number of high-tech enterprises, almost a quarter of the firms, followed by Italy with 18%, Germany and France with around 16% each and Spain with 7%. The remaining 17% of enterprises in the high-tech sector are located in the other EEA countries.

Figure 3.2 also illustrates the strong German position in the medium-high and medium-low branches. In these two groups, Germany has a higher share than in the high-tech branches. This contrasts with France and the United Kingdom whose share in the medium-high and medium-low tech branches is lower than that of the high-tech one.

Level of technology and size classes

As seen from Figure 3.3, large firms constitute a relatively high share of the high-tech branches, more than 20% of firms, as against an average of less than 10% for manufacturing as a whole. As we move form high-tech to low-tech, the share of large enterprises decreases and correspondingly the share of SMEs increases.

Figure 3.3: Relative distribution of enterprises by technological sector and size, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

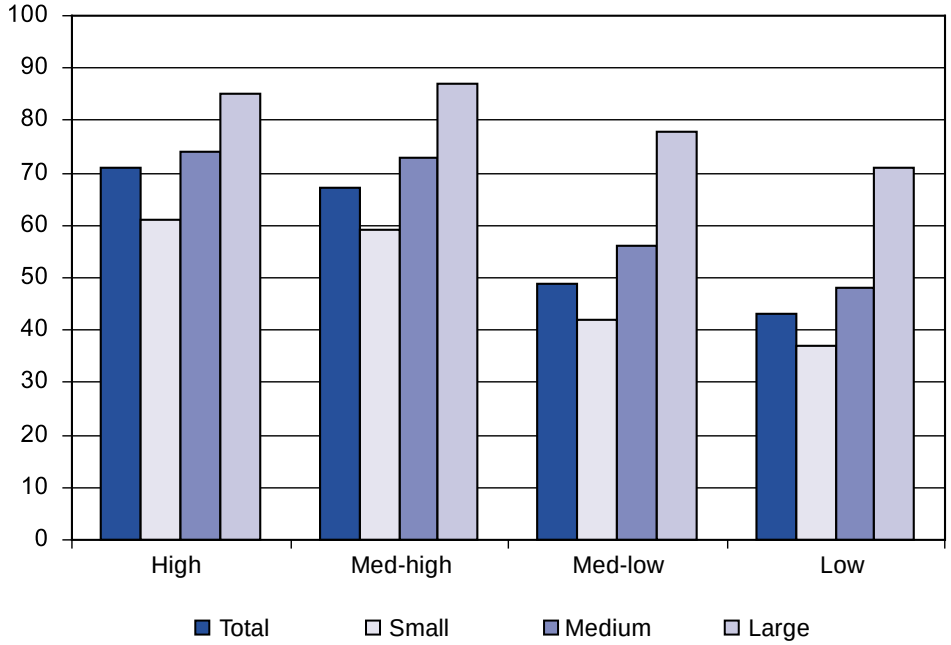
This pattern is not very surprising. As we have already seen, the propensity of innovators to be engaged in R&D activities increases with size and the situation is the same for R&D intensity in manufacturing. Another conclusion from the preceding chapters was that the size of an enterprise was an important factor influencing innovation characteristics.

Innovators by technological sector

In general the share of innovating firms is higher, the higher branch's level of technology. As shown in Figure 3.4 the share of innovating firms ranges between 43% in the low-tech branches of manufacturing and 71% in the high-tech branches.

A breakdown by size classes in all four classes of technology shows a considerably higher proportion of innovators among large firms than among medium-sized and small firms. Consequently, there are proportionately about the same number of innovating firms among the medium-sized high-tech enterprises as among the large low-tech enterprises. An exception is that large firms in the medium-high tech branches, in fact, count a proportionately higher number of innovators than large firms in the high-tech branches.

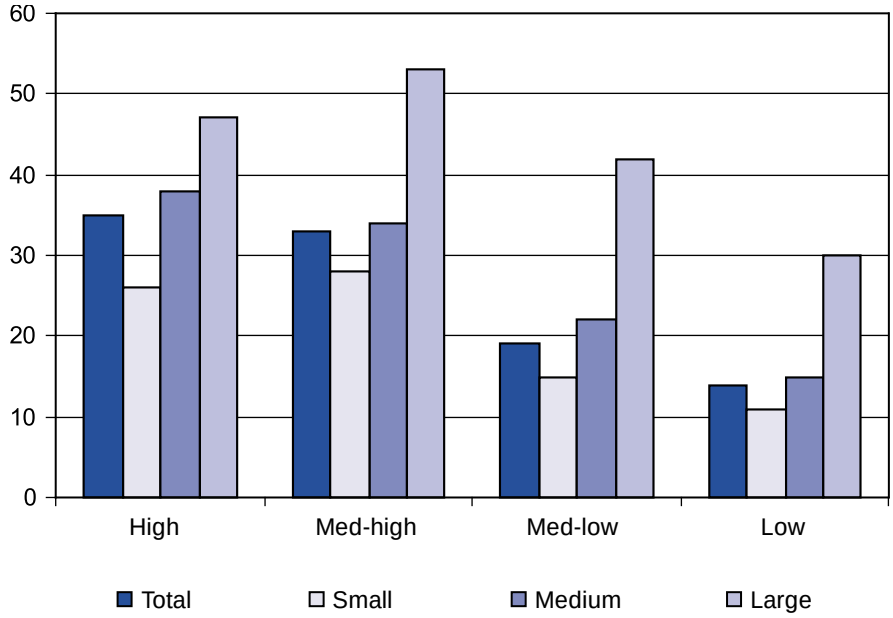
Figure 3.4: Number of innovators by technological sector and size (%), EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

An important finding is, nevertheless, that the share of innovating enterprises in the low-tech sector is by no means, negligible. In this category, in fact, every third small enterprise is an innovator, almost every second one for medium-sized and 7 out of 10 large enterprises have successfully implemented an innovation on the market.

Figure 3.5: Number of novel innovators according to technological sector, as a share of total number of innovators, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

As indicated in Chapter 2.1, innovators launching products, which are new to the market are classified as ‘novel innovators’. Focusing on this kind of innovators, Figure 3.5 shows the same pattern as for all innovators; the proportion of novel innovators is higher among high-tech firms and is lower the lower the level of technology. In this respect, there is, however, in all classes of technology a pronounced difference between the three main size classes: the proportion of novel innovators is marked-

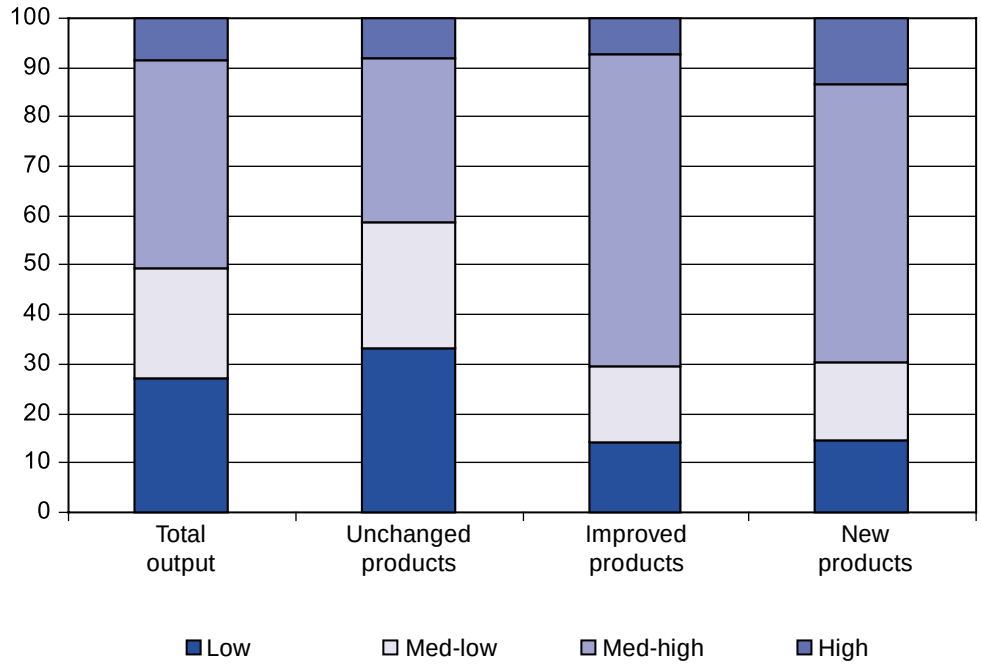
ly higher among large firms than among small and medium-sized firms. Overall, however, the highest proportion of novel innovators is found for large enterprises, not in the high-tech but in the large-size firms in the medium-high tech branches.

The group of medium-high tech branches includes a number of the basic manufacturing industries in the industrial countries, notably motor vehicles, electrical machines (excluding communications equipment), chemicals (excluding pharmaceuticals), other transport equipment (that is, notably, ships, trains, air and spacecraft) and non-electrical machinery. Most of these branches are engaged in the innovation of their products and processes to no lesser extent than the high-tech industries. It is therefore not surprising that in many ways these branches account for a considerable proportion of the overall innovation undertaken in the countries included here.

Output of innovation by technological sector

Enterprises in the high-tech sectors represent only 3% of the total number of manufacturing enterprises and they contribute to only 9% of the total turnover in the manufacturing sector. The remaining 91% of output sales is accounted for by the other three sectors, of which 27% for the low-tech branches, 22% for the medium-low tech sector and, the largest share, 42% for the medium-high tech sector.

Figure 3.6: Breakdown of turnover according to technological sector, EEA[1], 1996



1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

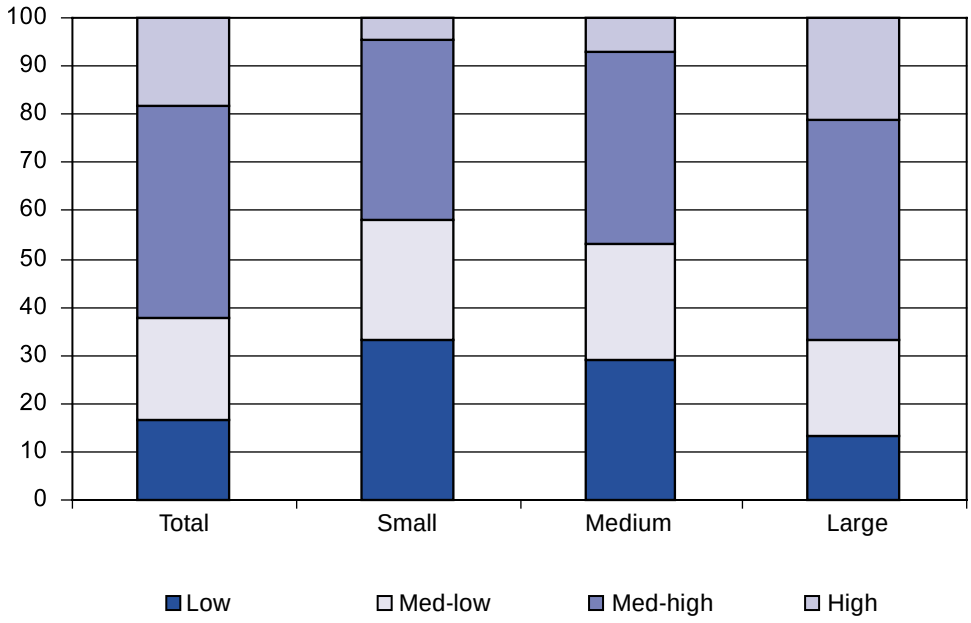
As illustrated in Figure 3.6, the share of high-tech and medium-high tech industries in the turnover of improved and new products, at respectively, 71% and 70%, is higher than their overall share in total output, while that of low-tech and medium-low branches is correspondingly lower.

This illustrates rather strikingly the important role of the high-tech and medium-high tech branches in the innovation process. In this respect, the medium-high contributes to 63% of improved and 56% of products new to the enterprise, thus being the dominating technological sector for innovative products.

Output of novel innovators by technological sector

Focusing only on novel sales, the high-tech enterprises account for 18% of the turnover due to novel products, or about the same level as the low-tech innovators (17%). The medium-high tech sector represents the largest share of novel products (44%), more than twice the share of the medium-low sector (21%). As seen from Figure 3.6, the high-tech sector contribute to only 9% of the total turnover but to twice as much of the turnover due to novel products.

Figure 3.7: Breakdown of turnover due to novel products by technological sector, EEA[1], 1996

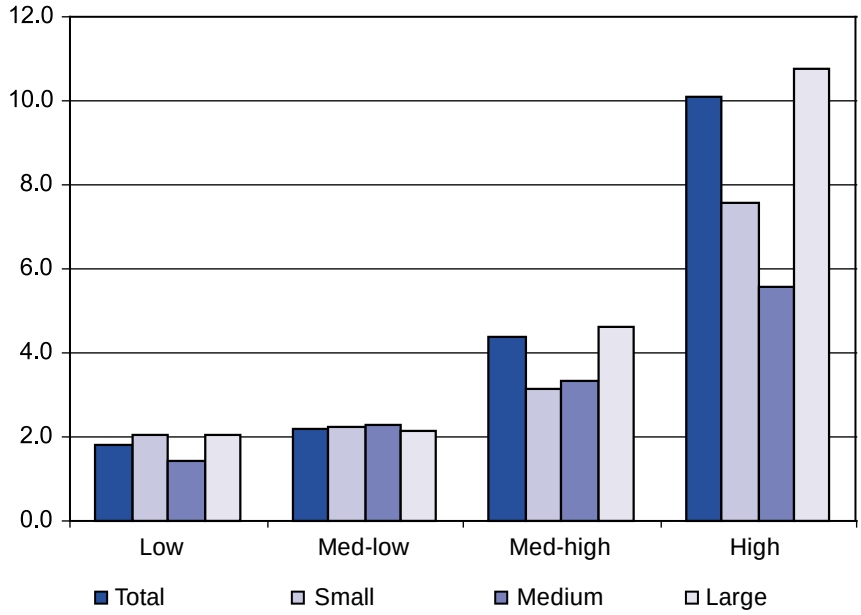


1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

The strong position of large firms in the high and medium-high tech branches is more apparent in the field of turnover due to novel innovation. As shown in Figure 3.7, among small firms, turnover attributable to novel innovation in the low and medium-low branches accounted for 58% of the total with the remaining 42% accounted for by medium-high and high tech branches. Among medium-sized firms, the share is slightly lower, but not substantially different. For large firms, however, the position is the inverse, with about 67% of turnover due to novel innovation being attributable to the high-tech branches (some 21%) or the medium-high tech branches (46%).

Figure 3.8: Innovation intensity by technological sector across size bands, total population, EEA[1], 1996



1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Expenditure on innovation by technological sector

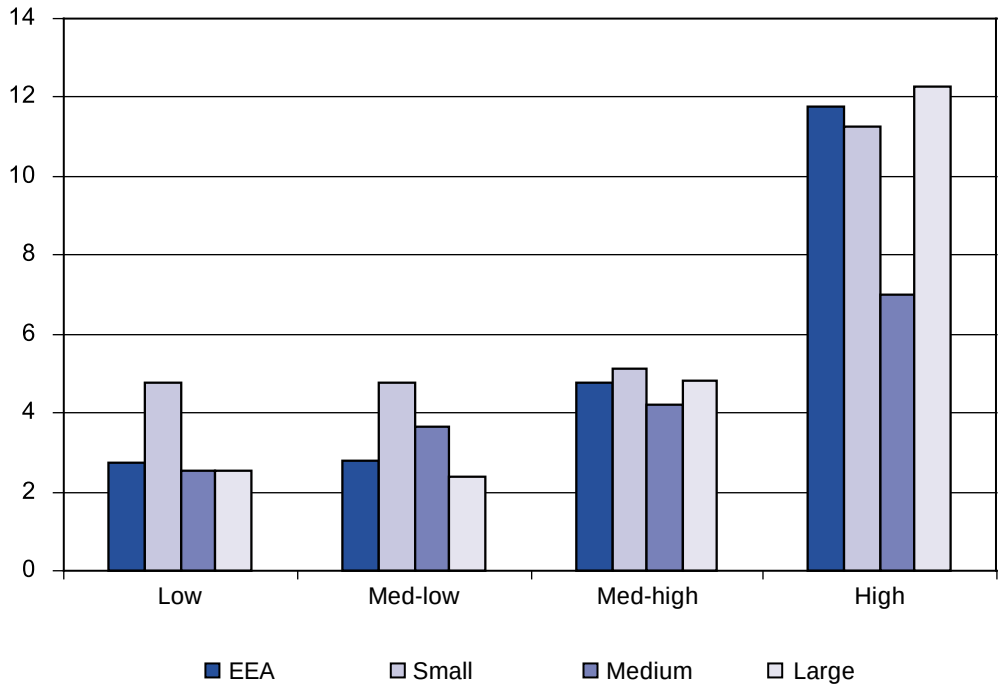
The expenditure for the high-tech branches on the different elements of the innovation activities corresponds, on average, to more than 10% of their turnover. However, some degree of disparity between the three size classes exists: for large firms innovation expenditure amounts to about 10.7% of turnover, some three percentage points higher than for small firms and a full five percentage points higher than in medium-sized firms.

In the numerically important medium-high tech sector, spending on innovation, on average, amounts to only slightly more than 4%, and in medium-low and low-tech branches to only, respectively, 2.2% and 1.8% of turnover. As seen in Figure 3.8, in the latter two groups there is only little difference between size classes with respect to the level of innovation expenditure in proportion to turnover.

When only innovators are considered (Figure 3.9), the level of innovation intensity increases and the level is comparatively higher for the sectors with a lower share of innovators. In the sectors with a low degree of R&D intensity, small enterprises are devoting relatively more resources to innovation than larger firms, 4.8% compared to 2.6%. The situation is the same in the medium-low and medium-high sectors but with a smaller gap for the latter than the former.

On average, low and medium-low tech branches have an equivalent level of innovation intensity, at 2.8%. The ratio is, as could be expected, much higher for the two remaining sectors, 4.7% for the medium-high and 11.8% for the high-tech sector

Figure 3.9: Innovation intensity by technological sector across size bands, innovators only, EEA[1], 1996



1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

Breakdown of innovation expenditure by category

A breakdown of innovation expenditure by level of technology shows that high-tech branches accounted for some 24% of the total innovation expenditure in 1996, whereas these branches represents only 3% of the number of enterprises and 9% of the turnover. The medium high-tech branches account for 50% of the overall expenditure on innovation. The low-tech and medium-low tech branches accounted for only, respectively, 13.5% and 13.1% of this total (see the last column of Table 3.2).

The detailed breakdown of innovation expenditure in four main categories (machinery and equipment, R&D contracted out, in-house R&D and other intangibles) reveals significant differences in the share of each category of expenditure the four main technological-level groups and also between small, medium-sized and large firms within each group.

A particular feature emerging from Table 3.2 is that low-tech branches account for a higher-than-average share in expenditure on machinery and equipment and other intangibles (34.1% as against a share of 13.5% overall). The high-tech branches in contrast have a proportionally high share of in-house R&D (28.2%) and of expenditure on other intangibles (26.6%). Table 3.2 also reveals that the medium-high tech branches in fact account for an over-proportional share in in-house R&D and also, although to a lesser extent, in R&D contracted out.

Table 3.2: Innovation expenditure as a percentage of total of the category of expenditure, EEA[1], 1996

	Machinery and Equipment	RD contracted out	In-house RD	Other intangibles	Total expenditure
Low	34.1	4.1	4.7	19.2	13.5
Medium-low	22.1	23.6	6.7	15.7	13.1
Medium-high	32.0	52.6	60.3	38.5	49.9
High	11.8	19.7	28.2	26.6	23.6

1: Luxembourg is not included.

Source : CIS2, Eurostat / Enterprise DG.

An alternative classification of these expenditure data, with a breakdown of innovation expenditure by the four main categories for each of the levels of technology and size classes illustrates a number of striking differences between size classes and branches.

As shown previously, large innovators rely more on R&D while small ones have a relatively high level of expenditure on acquisition of machinery and equipment (see Figure 2.3.6). The overall tendency for large firms to concentrate their innovation expenditure on in-house R&D is even more apparent in the high-tech branches (c.f. Table 3.3). As can be seen, large high-tech firms allocate 65% of their innovation expenditure on in-house R&D, while expenditure on machinery and equipment accounts for only 9%. Small firms in the high-tech branches, conversely, allocate 54% of the innovation expenditure on machinery and equipment and only 20% on in-house R&D.

The medium-high tech branches in this respect appear to differ significantly from the high-tech branches: small and medium-sized firms participate more actively in the research activity and account for a smaller share in investment and machinery than small firms in the high-tech branches. As seen in Table 3.3, in-house R&D account for 42% and 48%, respectively, of the innovation expenditure in small and medium-sized firms. This is clearly lower than in large firms (67%) but for small firms considerably higher than for small firms in the high-tech branches.

Finally, in the low and medium-low tech branches firms rely, to a much larger extent than in medium-high and high-tech branches, on expenditure on machinery and equipment. Conversely, the share of R&D in general is lower, with, however, a strikingly large share of contracted-out R&D in the innovation expenditure of large firms in the medium-low tech branches.

Table 3.3: Expenditure in innovation activities as a share of total innovation expenditure by technological sector and by size, EEA[1], 1996

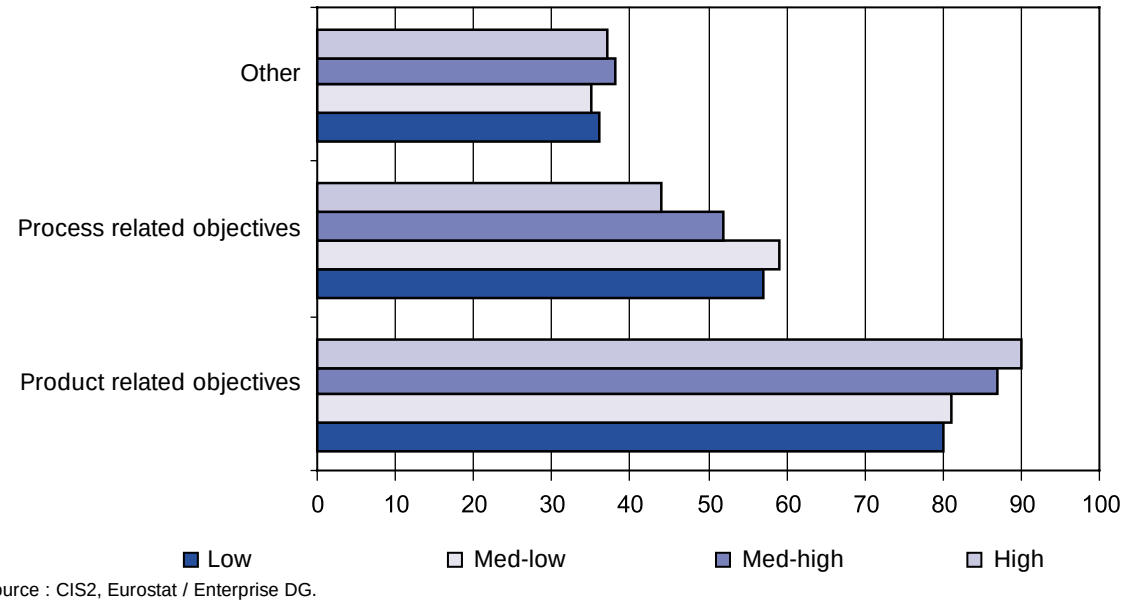
		Machinery and Equipment	RD contracted out	In-house RD	Other intangibles	Total expenditure
Low	Small	69	2	9	20	100
	Medium	69	3	15	14	100
	Large	46	3	23	28	100
	EEA	56	3	19	23	100
Medium low	Small	61	3	18	18	100
	Medium	57	4	21	18	100
	Large	25	23	31	20	100
	EEA	37	16	27	20	100
Medium high	Small	33	6	42	20	100
	Medium	26	7	48	19	100
	Large	12	10	67	12	100
	EEA	14	10	64	13	100
High	Small	54	2	20	24	100
	Medium	21	15	49	15	100
	Large	9	7	65	19	100
	EEA	11	8	63	18	100
Total	Small	56	3	21	20	100
	Medium	44	6	33	17	100
	Large	16	10	58	16	100
	EEA	22	9	53	16	100

1: Luxembourg is not included; Source : CIS2, Eurostat / Enterprise DG.

Objectives of innovation by technological sector

High-tech innovators are more oriented towards product-related objectives whereas low-tech enterprises have more process-oriented aims. On one hand, 90% of high-tech innovators have declared that the main purposes of their innovation were to replace products being phased out, improve product quality, extend product range or open up new markets, against 80% for low-tech innovators. Process-related objectives, on the other hand, appear to be somewhat more important among low- and medium-low tech innovators: 57% and 58% respectively declared to aim at improving production flexibility, reducing labour costs or the consumption of materials or energy. In this respect, the share of the medium-low innovators declaring this objective is slightly larger than for the low-tech sector.

Figure 3.10: Number of innovators according to very important objectives of innovation (%), by technological sector, EEA, 1996



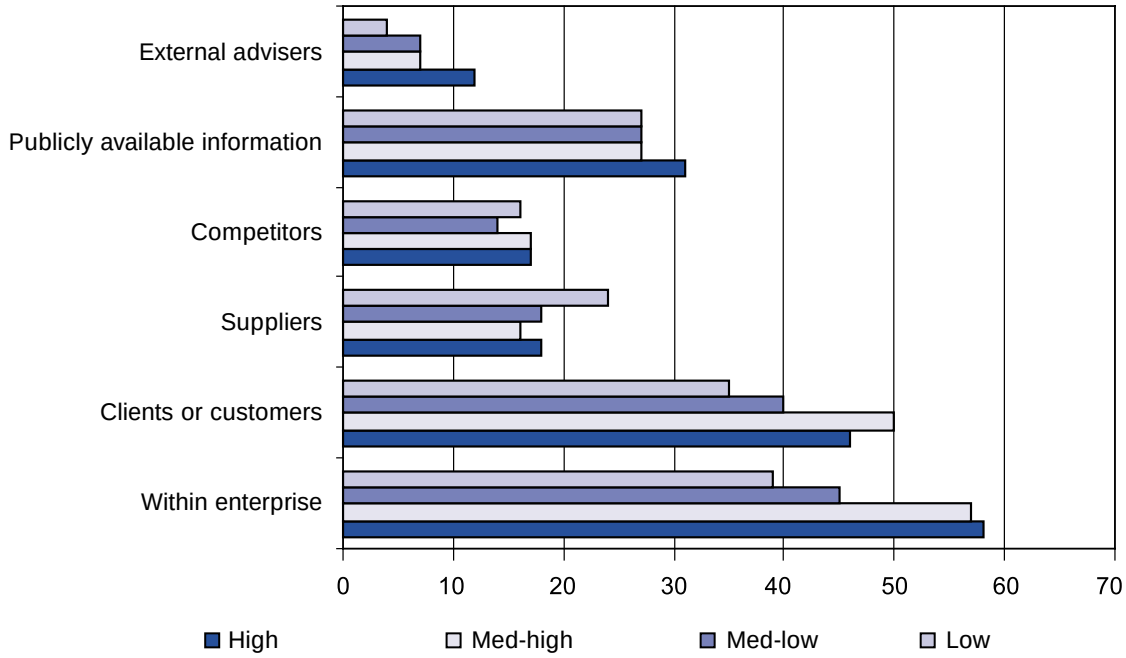
Source : CIS2, Eurostat / Enterprise DG.

Sources of information for innovation by technological sector

Internal information is the dominant information source for innovation regardless of the level of technology. However, the higher the level of technology, the higher the share of innovators using information within the enterprise. Six out of ten high-tech innovators reported that internal sources provided was an important supply of ideas for innovating. This was the case for only four out of ten low-tech innovators.

The ranking of the sources of information is identical in both the low- and high-tech sector although with different degree of reliance. High-tech and medium-high tech branches rely more on clients and customers than the two lower-tech groups. On the other hand, the low-tech branches rely more than high tech-innovators on suppliers of inputs such as components, materials and equipment, 24% for the former and 18% for the latter. There is no significant difference between the two sectors concerning the role of competitors.

Figure 3.11: Number of innovators with very important sources of information for innovation by technological sector (%), EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

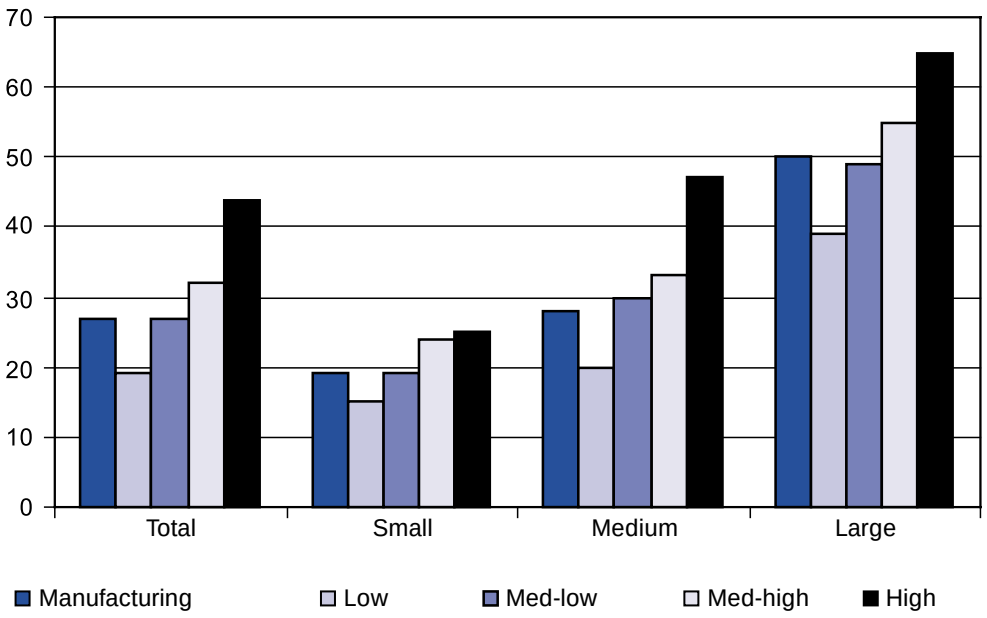
With regards to publicly available information, there are relatively more high-tech enterprises that base their innovation on professional conferences, patents, fairs, exhibitions and patent disclosures than the other sectors. However, concerning fairs and exhibitions the picture is different with 23% of low-tech innovators relying on this source, compared to 18% for the high-tech.

High-tech innovators, conversely, call more frequently on external advisors for their innovation than the low-tech branches. Government or private non-profit research institutes and universities are considered to be very important by 12% of high-tech enterprises against only 4% of low-tech innovators and with medium-low and medium-high tech branches in a middle position.

Innovation cooperation by technological sector

Data on cooperation for innovation purposes reveal several significant differences between firms with different levels of technology. Innovators in branches in the higher technological sector are more likely to establish an innovation cooperation than those in lower sectors. On average, 44% of high-tech innovators have a innovation collaboration against 32% for medium-high, 27% for medium-low and only 19% for low-tech. This pattern, as seen from Figure 3.12, is constant through out the three size bands.

Figure 3.12: Number of innovators with innovation cooperation by technological sector and size, EEA, 1996



Source : CIS2, Eurostat / Enterprise DG.

Innovation cooperation by partner

Table 3.4 shows that cooperation between enterprises within an enterprise group is more frequent within medium-high tech and high-tech branches than between low and medium-low tech ones. The former branches are also involved in cooperation with universities or other academic institutions to a much higher extent than the latter. In one respect, cooperation with clients and customers, low-tech branches stand out as different from the other three groups, reporting a comparatively low reliance on this category of connections. On the other hand, almost 60% of innovators in low-tech branches report cooperation arrangements with suppliers. For medium-low tech branches this ratio is ten percentage points and for the two higher tech groups twelve and thirteen points lower respectively.

Table 3.4: Number of innovators with innovation cooperation by nature of partnership as a share of innovation cooperators, by technological sector, EEA, 1996

	Low	Medium-low	Medium-high	High
Enterprises within group	53	56	67	64
Competitors	15	22	17	30
Clients and customers	34	53	55	50
Consultancy enterprises	26	23	21	23
Suppliers	59	49	47	46
Universities	31	33	44	52
Government or PNP research institutes	32	34	34	34

Source : CIS2, Eurostat / Enterprise DG.

The vast majority of cooperation arrangements are established within the national partners. As seen from Table 3.4, around 90% of enterprises with cooperation arrangements at all levels of technology have made such arrangements at the national level, 85% for medium-high tech. However, the high-tech branches are distinctly more international in this respect, with 66% of enterprises with cooperation arrangements in this group reporting to have established such links with partners in other EU countries, as against 43%, 49% and 58%, respectively in the low, medium-low and medium-high tech groups. Similarly, the higher the level of technology the higher the proportion of firms reporting cooperation links with firms in the US and Japan.

Table 3.5: Number of innovators with innovation cooperation by geographical location as a share of innovation cooperators, by technological sector, EEA, 1996

	Low	Medium-low	Medium-high	High
National	90	91	85	90
EU	43	49	58	66
US	16	27	31	42
Japan	5	9	12	22
Other	15	10	17	15

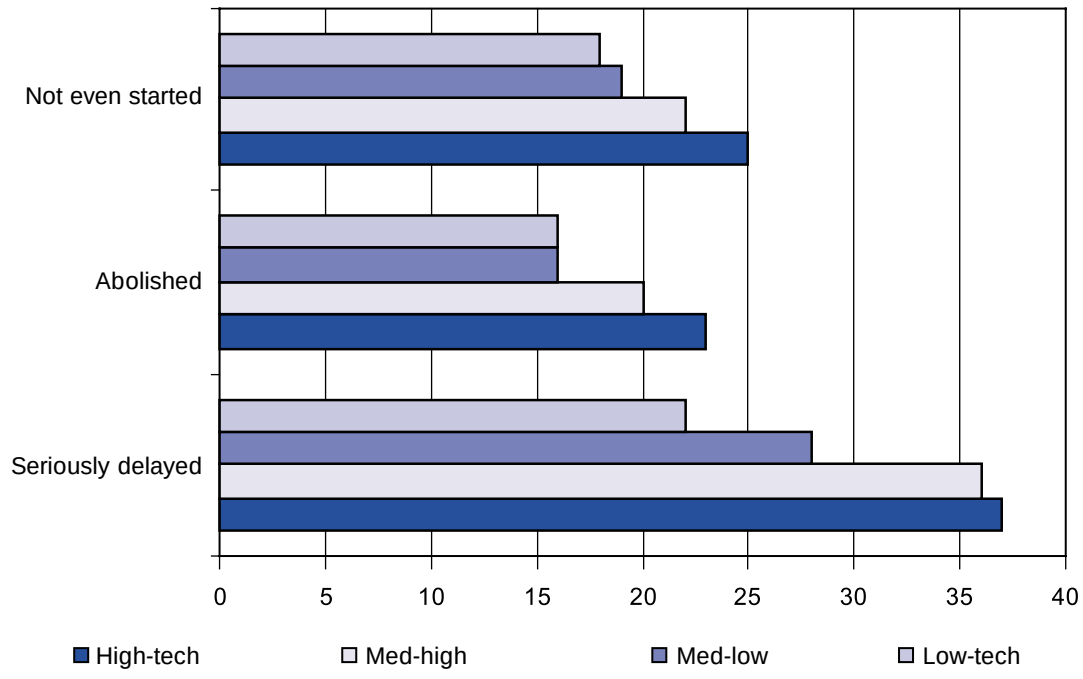
Source : CIS2, Eurostat / Enterprise DG.

Barriers to innovation by technological sector

Whereas the high-tech and medium-high tech branches, as underlined above, are highly involved in innovation, they are also more frequently confronted with different obstacles. They are, consequently, more often facing serious delays of projects, obliged to abandon or to abstain from even starting projects.

As illustrated in Figure 3.13, 37% and 36%, respectively, of high and medium-high tech innovators reported to have encountered serious delays of projects. In the low and medium-low-tech branches only, 22% and 27% respectively of innovators reported such delays. With respect to the abolition of projects and failure to even start innovation projects, the differences between the two main levels of technology are numerically smaller but still significant.

Figure 3.13: Number of innovators facing barriers to innovation by technological sector, EEA, 1996

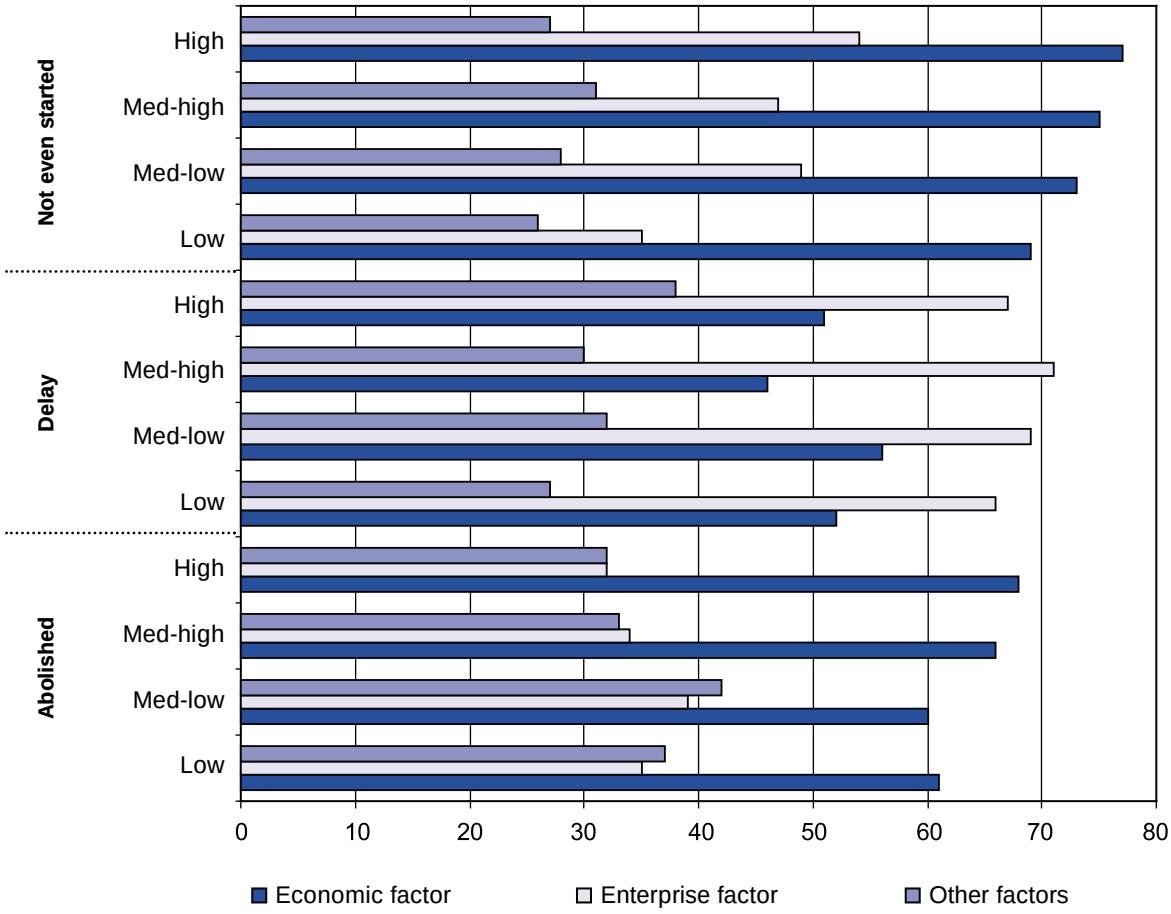


Source : CIS2, Eurostat / Enterprise DG.

Economic reasons are the dominant factors having entailed abolition or failure to even start planned projects. Excessive perceived risks, too high innovation costs or lack of appropriate sources of finance are at the origin of the failure to even start projects for some 28% of firms in the low-tech sector against 77% in the high-tech sector and with the medium-low and medium-high tech branches situated in between the two extremes. Economic factors were the cause of innovation projects being abandoned in approximately two thirds of cases, 68% for high-tech sectors and 61% for low-tech sectors.

As far as delay of innovation projects is concerned, internal factors constitute the most important cause. Organisational rigidities or the lack of qualified personnel, information on technology or information on markets are mentioned for two thirds of enterprises reporting delayed projects. In this respect medium-high tech branches seem to have encountered more problems than high-tech ones.

Figure 3.14: Number of innovators facing barriers to innovation according to hampering factors, by technological sector, EEA , 1996



Source : CIS2, Eurostat / Enterprise DG.

Part 4

METHODOLOGICAL NOTE

Methodological note

The Community Innovation Survey

All EEA countries, except Liechtenstein participated in the second Community Innovation Survey (CIS2). Most Member States launched the survey in 1997/1998, except Greece and Iceland where it was launched in 1999. The first Community Innovation Survey took place in 1993 with broadly the same questions; however, the results from the two surveys are not directly comparable. All the participating countries have agreed on a common methodology and a core questionnaire aimed at providing comparable, harmonised and representative data on a pan-European scale. The survey is based on the Oslo-manual. In general, it is either the National Statistical Institute or a Ministry that is directly responsible for the survey at the national level.

The main aim of this exercise is to obtain direct information on technological innovation, therefore providing a better understanding of the various aspects of the process (economic impact, innovative activities, costs, and so on). In addition to supplying a wide and varied range of data, this study - the first on such a large scale and common methodology - also provides a basic framework for future studies on specific aspects of the innovation process.

At the time when this publication went to press, data processing was not yet finalised for Iceland and Greece. The results presented relate to 14 EU countries (Greece missing) and Norway for the manufacturing sector. CIS2 covers 13 countries for the service branches, data for Spain and Italy not being available. In addition, the wholesale sector has not been surveyed in France. All the aggregate results include Luxembourg as far as nominal or ordinal variables are concerned but not metric variables.

The reference year for the survey is 1996 for most countries. The data for Norway and Portugal refer to 1997. The results can deviate from national published results, because of different target populations.

The target population

The following economic activities have been included in the **target population**:

- all manufacturing industries
- the utility sector (electricity, gas and water supply)
- service sectors (wholesale trade, transport, telecommunications, financial intermediation, computer and related activities and engineering services).

The cut off point for inclusion in the target population is 20 employees in the manufacturing sector and 10 employees in the service sector. Some Member States used lower cut-off points, but these enterprises are not included here. The sampling frames are business registers with the best possible quality. Official statistical business register have been used whenever available.

The Survey method

A combination of sampling and census has been used: census down to a certain threshold of employees depending upon the country's enterprise population, and sampling for the rest. The samples have been selected by using a simple random selection in each stratum (defined by size class according to number of employees and economic activity based on Nace Rev. 1 at 2-digits level). A full census was applied if the total number of enterprises in the frame population in a particular stratum was less than 5.

The results are based on answers from 39 500 enterprises. In total the response rate was about 57%, nationally the response rate varies among countries from 24% to over 90%. To secure an acceptable response rate, at least two reminders were made to the enterprises. If the response rate was below 70% of the active enterprises in the sample, a non-response analysis was performed. The non-response analysis was made on the basis of a simple random sample of the non-respondent population.

Quality of the data

The results presented are grossed-up figures for the whole population, using weighting factors. These are based on ratios between the number of enterprises in the realised sample and total number of enterprises in each stratum of the frame population.

The results of the non-response analysis were taken into account to adjust the weighting factors if the results proved to be significantly different from the original survey results.

When possible, variables have been cross-checked to verify the consistency of the answers. In this process, a set of core variables, considered to be more reliable than others, has been used.

In case of item non-response, missing values have been imputed based on other information from the same enterprise or the enterprise's NACE-group and size bands.

Comparison of results

Even though the basis for the national surveys are a common core questionnaire and survey methodology, there may be some differences between the national questionnaires and the understanding of the concepts and definitions. For these reasons comparison of results between the countries should be made with some care. In addition the following items should be remarked:

- Some variables and sub-specifications are missing for some countries.
- The results may differ from national publications due to different target population, grossing up procedures, etc.
- The results from CIS2 may not be directly comparable with CIS1 for different reasons. In particular this yield for Belgium.
- R&D expenditure from CIS2 may differ from corresponding results from R&D surveys.

Definitions :

Size class

The three size bands utilised are those generally applied in Eurostat's breakdown of enterprises in small, medium-sized and large enterprises.

	Manufacturing	**Service**
Small	20 to 49	10 to 49
Medium	50 to 249	50 to 249
Large	250 +	250 +

Note that for the Netherlands medium-sized enterprises are defined as 50 to 199 employees and large enterprises as 200 employees or more.

Export intensity

has been measured as the ratio of export sales over turnover for 1996. The levels of intensities defined are:

Low	less than 10%
Medium	between 10% and 40%
High	above 40%

R&D intensity

has been measured as the ratio of the expenditure in intramural R&D over turnover for 1996. The levels of intensities defined are:

Low	less than 1%
Medium	between 1% and 4%
High	above 4%

Technological innovations

comprise implemented technologically new products, processes or services and significant technological improvements in products, processes or services. It requires an objective improvement in the performance of a product or in the way in which it is produced or delivered. An innovation has been implemented, if it has been introduced on the market (product innovation) or used within a production process (process innovation). The product or process should be new (or significantly improved) to the enterprise, but does not necessarily have to be new to the enterprise's market.

Innovating enterprises

are enterprise that has introduced new or improved products or services on the market or new or improved processes. Enterprises can have innovation activity without introducing an innovation on the market (it may either have unsuccessful, or not yet completed, innovation projects).

Total innovation expenditure is composed of 7 different types of expenditure:

- **Intramural R&D:** research and experimental development carried out within the enterprise.
- **Extra-mural R&D:** acquisition of R&D services.
- **Acquisition of machinery and equipment linked to technological innovations**
- **Acquisition of other external technology linked to product and process innovations:**

  patents, non-patented inventions, licenses, know-how, trademarks, drawing plans and consultancy services (excluding R&D), related to the implementation of technological innovations, plus the acquisition of packaged software that is not classified elsewhere.
- **Industrial design and other production preparations for technologically new or improved products:**

  plans and drawings aimed at defining procedures, technical specifications and operational features necessary for the production of technologically new or improved products and the implementation of technologically new processes. This item also includes changes in production and quality control procedures, methods and standards and associated software required to produce the technologically new or improved products or to use the technologically new or improved process. Product or process modifications needed to start production, including trial production (not included in R&D) are also included. In the service sector the corresponding question is ‘preparations to introduce new or significantly improved services or methods to produce or deliver them’.
- **Training directly linked to technological innovations:**

  training for the implementation of a technologically new or improved product or process. Expenditure for training might include acquisition of external services and expenditure for in-house training.
- **Market introduction of technological innovations:**

  activities in connection with the launching of a technologically new or improved product. These may include preliminary market research, market tests and launch advertising, but will exclude the building of distribution networks to market innovations.

Enterprises which only have unsuccessful or uncompleted innovation projects are not included among innovators.

Innovation intensity

is defined as the total innovation expenditure as percentage of turnover.

Research and experimental development (R&D)

comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, and the use of this stock of knowledge to devise new applications, such as technologically new or improved products and processes. Construction, design and testing of a prototype is often the most

important phase of R&D. Software development is included as long as it involves making a scientific or technological advance. R&D can be carried out within the enterprise or R&D services can be acquired.

R&D includes basic and applied research and technological development:

- **Basic research** consists of original work, the aim of which is to obtain new scientific knowledge. It is not mainly directed to a specific practical end or application.
- **Applied research** also consists of original work, whose aim is to acquire new scientific or technical knowledge. It is, however, geared to a specific, practical objective.
- **Technological development** involves making use of existing scientific knowledge to produce new or to improve existing materials, devices, products, processes, systems or services, and includes the production of prototypes and pilot plants.

The **turnover** in the manufacturing sector has been split into different categories:

- turnover due to unchanged products
- turnover due to technologically new products
- turnover due to technologically improved products

The sum of these three categories gives the total turnover.

A **new product** is one which is new to the enterprise and significantly different from previously produced products in terms of purpose, performance, characteristics, theoretical properties or the raw materials and components used in its manufacture. This type of product can be obtained by using completely new technology or existing technology in new ways.

The term **improved product** refers to an existing product whose performance has been significantly improved. Again, there may be two types of such product: i) a simple product can be improved (better performance, lower cost) by using more efficient components or materials; ii) a complex product, comprising various sub-systems, can be improved by making partial changes to one of those sub-systems.

The term **process innovation** refers to new or significantly improved production methods. Such innovations may stem from changes in equipment or in production organisation, or a combination of both. The purpose of the introduction of such methods may be to produce new or improved products which cannot be obtained through the use of conventional plant or production methods or to improve manufacturing efficiency for existing products.

In addition, survey includes information on turnover due to technologically new or improved products not only new to the enterprise but also to the enterprise's market (novel innovators).

This split in turnover is only relevant for product innovators.

The objectives of innovation

The following objectives for developing and introducing innovations have been specified:

- Replace products being phased out
- Improve product quality
- Extend product range
- Open up new markets or increase market share
- Fulfilling of regulations, standards (except for Spain)
- Improve production flexibility for the manufacturing sector and improve business process flexibility for the service sector
- Reduce labour cost
- Reduce materials consumption
- Reduce energy consumption (except for France in the financial intermediation sector, NACE 65 to 67)
- Reduce environmental damage

Indication of the objectives of innovation is requested for only innovators.

The sources of information for innovation

The following sources of information needed for new innovation projects or contributing to completion of existing projects have been specified.

- Sources within the enterprise
- Other enterprises within the enterprise group (except for Spain). For the statistics presented, only enterprises which are part of an enterprise group are included
- Competitors
- Clients or customers
- Consultancy enterprises
- Suppliers of equipment, materials, components or software
- Universities or other higher education institutes
- Government or private non-profit research institutes (except for Sweden)
- Patent disclosures
- Professional conferences, meetings, journals (this category has been merged with computer based information networks in France for foods, beverages and financial intermediation)
- Computer based information networks (except for Spain)
- Fairs, exhibitions

The different sources for innovation are indicated by innovators only.
Information from other enterprises within the enterprise's group was not part of the Spanish questionnaire.

Innovation cooperation

is defined as active participation in joint R&D and other innovation projects with other organisations. It does not necessarily imply that both partners derive immediate commercial benefit from the venture. Pure contracting out work, where there is no active participation, is not regarded as cooperation.

Innovating enterprises were asked whether they had any cooperation arrangement with other enterprises or institutions between 1994-1996. Enterprises having answered 'yes' to this question were then asked to specify which type of partner (other enterprise within the enterprise group, competitors, clients, consultancy enterprises, suppliers, universities, government or private non-profit research institutes) and its location (National, EU, US, Japan, other). In Spain the cooperation relates to R&D projects and not innovation projects as a whole.

The factors hampering innovation:

Three main types of problems occurring during the introduction or development of the innovation project have been specified:

- A project seriously delayed
- A project abolished
- A project not even started.

Indication of hampering factors have been requested from innovators only.
For each of the three types of problem the following list of explanatory factors has been given:

- Excessive perceived economic risk
- Innovation costs too high (except for the service sector in Germany)
- Lack of appropriate sources of finance
- Organisational rigidities
- Lack of qualified personnel
- Lack of information on technology
- Lack of information on markets
- Fulfilling regulations standards
- Lack of customer responsiveness to new products.

The percentage for each of these factors relates to the total number of innovating enterprises having encountered one of the specific problems listed above. These statistics are not comparable for Spain and hence have not been included.

The Technological sector

has been defined according to the OECD revision of the high-technology sector as follows:

Table 4.1: Manufacturing industries classified according their technological intensity (ISIC Revision 2 and NACE Revision 1)

High-technology	ISIC Revision 2	NACE Revision 1
Aerospace	3845	35.3
Computers, office machinery	3825	30
Electronics-communications	3832	32
Pharmaceuticals	3522	24.4
Medium-high-technology		
Scientific instruments	385	33
Motor vehicles	3843	34
Electrical machinery	383-3832	31
Chemicals	351+352-3522	24-24.4
Other transport equipment	3842+3844+3849	35.2+35.4+35.5
Non-electrical machinery	382-3825	29
Medium-low-technology		
Rubber and plastic products	355+356	25
Shipbuilding	3841	35.1
Other manufacturing	39	36.2 thro' 36.6
Non-ferrous metals	372	27.4+27.53/54
Non-metallic mineral products	36	26
Fabricated metal products	381	28
Petroleum refining	353+354	23
Ferrous metals	371	27.1 thro' 27.3+27.51/52
Low-technology		
Paper printing	34	21+22
Textiles and clothing	32	17 thro' 19
Food, beverages, and tobacco	31	15+16
Wood and furniture	33	20+36.1
Recycling	371+356	37

Source *OECD, Revision of the high-technology sector and product classification,* STI Working Papers, 1997/2

Exchange rates
The following exchange rates have been used to convert national currency into Ecu.

Table 4.2: Exchange rates in 1996

European Union	Ecu	1.00000
Belgium	Belgian/Luxembourg Franc	39.2986
Denmark	Danish Krone	7.35934
Germany	German Mark	1.90954
Spain	Spanish Peseta	160.748
France	French Franc	6.493
Ireland	Irish Pound	0.793448
Italy	Italian Lira	1958.96
The Netherlands	Dutch Guilder	2.13973
Austria	Austrian Schilling	13.4345
Portugal	Portuguese Escudo*	198.589
Finland	Finnish Markka	5.82817
Sweden	Swedish Krona	8.51472
United Kingdom	Pound Sterling	0.813798
Norway	Norwegian Krone*	8.01861

*: 1997

Country codes
The following abbreviations have been used:

Table 4.3: Country codes

European Union	EU
European Economic Area	EEA
Belgium	B
Denmark	DK
Germany	D
Spain	E
France	F
Ireland	IRL
Italy	I
The Netherlands	NL
Austria	A
Portugal	P
Finland	FIN
Sweden	S
United Kingdom	UK
Norway	NO

Part 5

TABLE

ANNEX

Table 5.1: CIS2 Sample size, 1996

	B	DK	D	E	F[2]	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector	**1 164**	**274**	**1 706**	**4 763**	**4 986**	**440**	**5 097**	**116**	**2 698**	**845**	**800**	**909**	**727**	**1 248**	**25 773**	**1 329**	**27 102**
By size																	
Small	325	115	388	1 795	1 694	211	2 613	55	880	158	229	335	206	322	9 326	541	9 867
Medium	597	85	731	2 191	1 889	184	1 639	43	1 362	439	308	381	213	481	10 543	623	11 166
Large	242	74	587	777	1 403	45	845	18	456	248	263	193	308	445	5 904	165	6 069
By Economic Activity																	
Food, beverages and tobacco	152	31	116	453	850	63	370	18	355	85	94	93	61	106	2 847	228	3 075
Textile and leather	148	19	102	610	562	46	938	:	167	79	318	66	34	99	3 188	75	3 263
Wood, pulp and printing	118	36	110	605	559	36	475	14	448	116	58	174	140	133	3 022	265	3 287
Coke and chemicals	123	14	133	457	361	49	290	7	192	35	29	47	34	85	1 856	52	1 908
Rubber and other non-metallic	139	30	245	521	465	56	551	17	268	91	76	82	58	137	2 736	88	2 824
Basic and fabricated metals	168	38	262	648	809	54	782	39	395	131	64	98	119	145	3 752	169	3 921
Machinery and equipment	91	38	317	302	451	20	644	10	344	104	36	142	113	113	2 725	114	2 839
Electrical and optical equipment	85	37	260	451	497	68	473	8	223	92	53	117	84	231	2 679	108	2 787
Transport equipment	61	13	81	395	222	18	203	3	169	38	35	48	53	133	1 472	143	1 615
NEC & recycling	79	18	80	321	210	30	371	:	137	74	37	42	31	66	1 496	87	1 583
Service sector[1]	**846**	**253**	**909**	:	**2 609**	**283**	:	**192**	**2 521**	**363**	**1 016**	**568**	**709**	**539**	**10 808**	**859**	**11 667**
By size																	
Small	459	146	427	:	1 442	185	:	134	1 013	133	776	340	465	186	5 706	465	6 171
Medium	283	53	279	:	848	70	:	41	1 182	159	182	166	122	133	3 518	276	3 794
Large	104	54	203	:	319	28	:	17	326	71	58	62	122	220	1 584	118	1 702
By Economic Activity																	
Wholesale	440	103	230	:	:	54	:	59	1 200	151	367	235	331	97	3 267	265	3 532
Transport	177	58	121	:	1 247	69	:	43	642	46	304	128	154	120	3 109	141	3 250
Telecommunications	14	2	4	:	38	16	:	:	15	6	14	28	21	22	180	30	210
Financial intermediation	116	49	268	:	205	88	:	65	308	124	180	55	70	146	1 674	145	1 819
Computer and related activities	52	14	136	:	617	34	:	13	154	19	58	55	68	55	1 275	106	1 381
Engineering services	47	27	150	:	502	22	:	12	202	17	93	67	65	99	1 303	172	1 475

1: Spain and Italy are not included in the service sector
2: Wholesale sector is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.2: CIS2 Estimated population size, 1996

	B	DK	D	E	F[2]	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector	**4 443**	**3 089**	**37 061**	**18 811**	**23 590**	**1 872**	**39 282**	**191**	**6 903**	**4 139**	**9 248**	**2 285**	**3 835**	**27 877**	**182 627**	**2 333**	**184 960**
By size																	
Small	2 657	1 705	16 438	13 255	13 024	996	27 804	90	4 001	2 167	5 761	1 271	1 873	14 413	105 453	1 311	106 764
Medium	1 422	1 112	15 878	4 750	8 424	743	10 130	77	2 279	1 542	3 011	753	1 554	10 334	62 008	844	62 852
Large	364	273	4 745	807	2 143	133	1 348	24	623	431	476	260	408	3 131	15 166	178	15 344
By Economic Activity																	
Food, beverages and tobacco	664	293	4 140	3 093	3 107	335	2 744	35	992	543	1 049	248	320	2 212	19 776	473	20 249
Textile and leather	651	217	2 387	3 104	3 085	188	9 380	:	318	473	3 630	170	113	2 825	26 540	100	26 640
Wood, pulp and printing	543	469	4 889	2 310	3 132	206	3 096	23	1 105	698	1 012	422	786	4 114	22 806	477	23 283
Coke and chemicals	287	109	1 322	927	1 166	161	1 446	10	319	104	232	85	142	1 290	7 600	60	7 660
Rubber and other non-metallic	485	246	4 685	2 450	2 273	192	4 284	26	660	447	916	200	330	2 920	20 114	156	20 270
Basic and fabricated metals	765	534	6 502	2 685	4 638	213	6 623	56	1 327	622	805	266	742	4 517	30 296	311	30 607
Machinery and equipment	320	489	5 648	1 281	2 060	100	4 755	19	978	400	557	424	588	3 188	20 806	213	21 019
Electrical and optical equipment	231	321	4 162	942	2 204	286	3 109	16	445	250	227	230	376	3 291	16 092	145	16 237
Transport equipment	155	139	1 059	642	793	64	1 145	6	337	94	214	106	236	1 522	6 513	231	6 744
NEC & recycling	341	272	2 267	1 377	1 133	127	2 700	:	422	510	606	133	201	1 998	12 086	166	12 252
Service sector[1]	**6 702**	**4 905**	**79 602**	**:**	**11 976**	**3 189**	**:**	**651**	**11 443**	**5 346**	**6 300**	**2 182**	**5 720**	**31 916**	**169 933**	**4 049**	**173 982**
By size																	
Small	5 828	3 881	63 282	:	8 635	2 330	:	497	8 626	4 346	5 512	1 773	4 708	25 260	134 677	3 171	137 847
Medium	737	805	12 612	:	2 353	775	:	135	2 343	856	692	322	804	5 279	27 711	738	28 450
Large	137	219	3 708	:	988	84	:	20	474	144	97	88	208	1 378	7 545	140	7 685
By Economic Activity																	
Wholesale	3 735	2 845	22 529	:	:	1 320	:	224	6 469	2 957	4 697	995	3 063	15 918	64 752	2 092	66 844
Transport	1 658	996	23 472	:	5 116	445	:	135	2 560	1 081	825	544	1 286	5 415	43 532	867	44 399
Telecommunications	31	34	59	:	109	44	:	:	34	8	31	61	34	357	803	37	840
Financial intermediation	653	563	5 297	:	1 725	713	:	216	881	796	388	123	248	3 974	15 576	291	15 867
Computer and related activities	341	181	5 997	:	2 632	462	:	40	590	211	129	184	483	2 690	13 940	250	14 190
Engineering services	284	286	22 248	:	2 395	205	:	36	909	293	230	275	608	3 562	31 330	512	31 842

1: Spain and Italy are not included in the service sector
2: Wholesale sector is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.3: Number of innovators (%), 1996

	B	DK	D	E	F[2]	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector	**34**	**71**	**69**	**29**	**43**	**73**	**48**	**42**	**62**	**67**	**26**	**36**	**54**	**59**	**51**	**48**	**51**
By size																	
Small	33	64	63	21	34	68	44	21	54	59	22	26	43	54	44	39	44
Medium	34	76	70	43	48	78	57	52	71	73	30	40	61	59	58	56	58
Large	51	91	85	76	75	85	73	85	84	88	52	77	79	81	79	77	79
By Economic Activity																	
Food, beverages and tobacco	27	73	68	22	45	65	59	15	58	67	25	25	38	58	50	47	50
Textile and leather	28	55	62	18	30	58	32	:	49	55	19	37	45	56	35	45	35
Wood, pulp and printing	30	70	59	21	32	68	45	43	53	62	23	30	45	51	45	36	45
Coke and chemicals	46	93	75	62	68	79	61	53	85	71	77	61	61	81	70	76	70
Rubber and other non-metallic	34	63	67	31	49	79	44	51	67	45	36	44	57	53	51	54	51
Basic and fabricated metals	39	58	59	25	31	68	54	44	53	68	19	31	41	56	48	43	48
Machinery and equipment	44	80	84	46	63	89	61	70	80	80	36	41	73	63	68	64	68
Electrical and optical equipment	51	88	78	55	61	88	56	50	74	87	80	51	75	76	69	65	69
Transport equipment	41	85	72	46	49	88	47	:	60	78	19	36	58	63	57	44	56
NEC & recycling	25	60	69	23	38	71	53	:	57	82	17	22	59	44	48	51	48
Service sector[1]	**13**	**30**	**46**	**:**	**31**	**58**	**:**	**48**	**36**	**55**	**28**	**24**	**32**	**40**	**40**	**22**	**40**
By size																	
Small	11	24	41	:	25	60	:	45	32	54	28	22	29	40	137	20	36
Medium	21	45	60	:	33	49	:	55	45	58	27	30	48	37	49	26	48
Large	55	71	83	:	73	87	:	83	71	74	52	43	45	55	73	50	73
By Economic Activity													29				
Wholesale	10	27	39	:	:	52	:	37	36	58	26	15		33	34	18	34
Transport	9	13	26	:	11	33	:	57	21	54	28	16	19	34	24	5	24
Telecommunications	27	100	100	:	52	86	:	:	74	81	45	79	51	60	65	56	65
Financial intermediation	13	48	69	:	45	67	:	43	40	55	43	28	56	49	54	44	54
Computer and related activities	41	89	71	:	52	73	:	88	68	69	53	63	55	81	68	50	68
Engineering services	43	36	61	:	39	78	:	76	52	20	30	31	47	38	55	38	55

1: Spain and Italy are not included in the service sector
2: Wholesale sector is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.4: Number of novel innovators (%), 1996

	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector	**14**	**27**	**24**	**11**	**20**	**27**	**26**	**21**	**28**	**24**	**7**	**18**	**25**	**19**	**21**	**14**	**21**
By size																	
Small	12	22	19	7	14	23	23	9	21	14	4	12	21	15	16	8	16
Medium	13	32	22	17	22	28	32	28	33	31	11	17	24	19	23	17	23
Large	29	42	46	38	42	50	50	41	53	42	17	45	43	37	42	36	42
By Economic Activity																	
Food, beverages and tobacco	15	15	17	8	13	29	28	15	24	24	6	15	13	21	17	11	17
Textile and leather	10	34	33	5	14	11	14	:	26	17	3	20	18	15	13	18	13
Wood, pulp and printing	6	21	8	6	10	18	17	15	14	12	8	9	12	6	10	5	10
Coke and chemicals	22	45	28	29	33	23	40	42	43	32	5	43	34	48	35	25	35
Rubber and other non-metallic	19	22	23	9	26	25	27	30	31	22	12	23	36	18	22	16	22
Basic and fabricated metals	12	26	15	8	14	28	26	8	21	19	8	11	22	15	17	10	17
Machinery and equipment	21	16	39	20	36	34	42	39	47	33	20	23	37	17	33	24	33
Electrical and optical equipment	27	53	37	27	33	48	37	41	35	42	26	23	39	37	36	32	36
Transport equipment	12	18	30	20	28	21	29	:	36	37	3	21	19	19	24	15	24
NEC & recycling	7	43	18	9	18	14	32	:	24	32	4	5	25	13	20	15	19

Source : CIS2, Eurostat / Enterprise DG

Table 5.5: Innovation expenditure as a share of total turnover, total population[1], 1996

	B	DK	D	E	F[3]	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector	**2.1**	**4.8**	**4.1**	**1.8**	**3.9**	**3.3**	**2.6**	**:**	**3.8**	**3.5**	**1.7**	**4.3**	**7.0**	**3.2**	**3.7**	**2.7**	**3.7**
By size																	
Small	2.1	10.4	3.3	1.0	1.4	2.8	2.4	:	3.0	4.4	1.8	1.6	2.6	3.3	2.5	2.2	2.5
Medium	1.4	3.5	2.4	1.6	2.2	3.2	2.2	:	1.8	3.1	1.9	1.6	2.7	2.9	2.3	2.8	2.3
Large	2.3	4.5	4.4	2.2	4.9	3.7	3.1	:	4.6	3.5	1.6	5.1	8.2	3.2	4.2	2.8	4.2
By Economic Activity																	
Food, beverages and tobacco	0.7	1.9	2.1	0.9	0.9	1.1	1.9	:	1.2	1.3	1.0	1.0	1.2	2.2	1.6	1.2	1.6
Textile and leather	0.6	3.0	1.7	1.0	1.2	3.2	1.3	:	1.1	2.2	2.1	1.1	1.0	3.2	1.6	1.7	1.6
Wood, pulp and printing	3.8	3.0	1.7	1.4	0.9	2.2	1.9	:	3.2	2.3	:c	:c	3.7	3.6	2.5	2.5	2.5
Coke and chemicals	2.5	9.3	7.4	1.8	3.4	5.3	2.5	:	4.7	6.3	0.5	3.0	7.3	2.8	4.0	5.6	4.0
Rubber and other non-metallic	2.6	8.1	2.5	1.5	2.9	2.9	2.4	:	3.4	4.2	2.0	1.8	2.4	3.1	2.7	1.9	2.7
Basic and fabricated metals	2.8	2.4	2.2	1.4	1.6	4.6	2.1	:	1.7	2.8	0.5	1.3	1.8	2.5	2.1	2.4	2.1
Machinery and equipment	1.9	6.0	3.9	2.0	3.7	3.8	2.6	:	3.3	4.0	1.6	3.0	5.3	4.2	3.7	2.2	3.7
Electrical and optical equipment	7.1	13.2	7.6	3.8	11.7	5.0	5.4	:	:c	7.1	:c	10.6	16.1	7.3	8.2	6.8	8.2
Transport equipment	1.1	6.7	4.0	2.9	6.7	5.8	4.7	:	:c	4.1	3.2	:c	10.5	1.7	4.3	2.7	4.3
NEC & recycling	1.4	6.1	2.2	1.7	1.9	3.9	2.4	:	2.4	2.4	2.0	1.0	4.8	2.4	2.3	1.8	2.3
Service sector[2]	**1.2**	**4.7**	**3.0**	**:**	**1.2**	**2.1**	**:**	**:**	**1.6**	**3.0**	**1.1**	**2.4**	**3.8**	**4.0**	**2.8**	**3.5**	**2.8**
By size																	
Small	0.9	2.6	3.1	:	0.8	6.0	:	:	2.4	2.8	2.1	3.6	1.1	6.9	2.9	2.2	2.9
Medium	2.7	1.5	2.5	:	1.0	1.2	:	:	2.4	3.9	1.6	3.0	6.1	2.7	2.4	1.2	2.3
Large	1.1	6.3	3.0	:	1.5	2.9	:	:	1.3	2.7	0.7	1.8	5.0	3.7	2.8	5.4	2.9
By Economic Activity																	
Transport and telecommunications	0.7	5.5	1.7	:	0.9	2.7	:	:	1.2	2.1	1.0	1.7	1.9	3.4	1.8	2.8	1.8
Computer and related activities and engineering services	2.2	3.9	5.1	:	2.0	1.7	:	:	1.9	4.9	2.0	4.4	8.1	5.3	4.4	5.9	4.4

1: Luxembourg is not included
2:Spain and Italy are not included in the service sector
3: Wholesale sector is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.6: Turnover due to products new to the enterprise as a share of total turnover, total population, 1996

	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector[1]	**6**	**7**	**17**	**10**	**9**	**17**	**8**	**:**	**7**	**13**	**9**	**9**	**14**	**8**	**12**	**10**	**12**
By size																	
Small	4	7	18	4	4	9	5	:	4	9	1	3	5	4	7	5	6
Medium	4	5	14	7	6	13	6	:	5	8	4	4	9	5	8	8	8
Large	7	8	17	13	11	24	10	:	9	15	13	11	15	9	14	13	14
By Economic Activity																	
Food, beverages and tobacco	6	2	12	4	5	4	4	:	7	12	1	4	10	5	7	6	7
Textile and leather	9	3	17	6	4	6	4	:	5	9	3	2	8	5	7	6	7
Wood, pulp and printing	2	4	6	3	4	:c	5	:	2	6	:c	2	4	3	4	:c	4
Coke and chemicals	6	14	14	5	7	9	9	:	8	8	1	9	1	8	8	11	8
Rubber and other non-metallic	4	7	17	6	8	5	7	:	8	7	4	6	5	5	11	6	11
Basic and fabricated metals	3	8	7	4	5	9	4	:	4	8	5	4	6	3	6	20	6
Machinery and equipment	7	8	20	18	11	21	10	:	10	15	8	11	14	7	15	10	15
Electrical and optical equipment	13	19	49	23	18	48	17	:	17	27	:c	:c	36	27	37	23	37
Transport equipment	4	15	4	24	14	:c	11	:	6	22	48	:c	23	4	8	14	8
NEC & recycling	3	12	27	9	9	:c	9	:	7	13	2	:c	5	7	14	7	14

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.7: Turnover due to products improved to the enterprise as a share of total turnover, total population, 1996

	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector[1]	**8**	**14**	**28**	**17**	**12**	**15**	**19**	**:**	**18**	**19**	**6**	**15**	**17**	**16**	**20**	**10**	**20**
By size																	
Small	7	11	12	5	4	13	10	:	10	20	3	4	6	10	9	3	9
Medium	7	13	17	9	8	13	14	:	15	12	5	9	12	16	13	8	13
Large	9	15	30	24	14	18	28	:	20	22	7	18	19	16	24	13	24
By Economic Activity																	
Food, beverages and tobacco	4	5	13	11	3	6	15	:	14	12	3	7	6	11	10	8	10
Textile and leather	9	5	16	8	7	29	11	:	11	10	4	7	8	12	11	9	11
Wood, pulp and printing	5	9	10	10	7	:c	12	:	13	19	:c	8	13	16	11	:c	11
Coke and chemicals	9	7	20	24	13	13	35	:	23	13	5	11	18	12	19	19	19
Rubber and other non-metallic	9	6	23	13	12	23	12	:	15	20	2	13	14	11	16	5	16
Basic and fabricated metals	7	10	8	13	8	17	11	:	10	20	2	8	13	19	10	3	10
Machinery and equipment	15	23	21	23	16	19	22	:	22	18	22	30	23	19	21	23	21
Electrical and optical equipment	22	37	6	20	23	23	20	:	29	30	:c	:c	29	28	15	19	15
Transport equipment	9	36	65	25	15	:c	32	:	24	21	3	:c	17	15	46	10	46
NEC & recycling	3	20	18	11	13	:c	15	:	15	19	5	:c	12	11	15	4	15

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.8: Turnover due to products unchanged to the enterprise as a share of total turnover, total population, 1996

	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector[1]	**86**	**79**	**55**	**73**	**79**	**68**	**73**	**:**	**75**	**69**	**86**	**75**	**69**	**77**	**67**	**80**	**68**
By size																	
Small	89	82	70	91	92	79	85	:	85	71	96	94	89	86	85	91	85
Medium	88	82	69	84	86	74	80	:	80	80	91	87	78	79	79	84	79
Large	84	78	52	63	75	57	62	:	72	63	80	72	66	75	62	74	62
By Economic Activity																	
Food, beverages and tobacco	90	93	75	85	92	90	81	:	80	76	96	89	84	84	83	86	83
Textile and leather	82	93	68	86	89	66	84	:	84	81	93	91	84	82	82	85	82
Wood, pulp and printing	93	87	84	87	88	80	84	:	85	74	88	90	84	82	85	94	85
Coke and chemicals	85	80	66	71	80	78	56	:	69	78	95	81	81	80	73	70	73
Rubber and other non-metallic	87	87	59	80	80	72	81	:	77	73	94	81	81	83	73	89	73
Basic and fabricated metals	90	82	85	83	87	74	85	:	86	72	94	88	81	78	84	77	84
Machinery and equipment	77	69	58	60	72	60	68	:	68	66	70	58	62	74	63	68	64
Electrical and optical equipment	65	44	45	57	59	29	63	:	54	43	71	36	35	45	48	58	48
Transport equipment	88	48	31	51	71	80	57	:	70	57	49	69	60	81	46	76	46
NEC & recycling	93	67	54	79	77	73	76	:	78	67	93	87	83	81	71	89	71

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.9: Turnover due to novel products as a share of total turnover, total population, 1996

	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	EU-15	NO	EEA
Manufacturing sector[1]	3	**5**	**4**	**9**	**8**	**8**	**13**	**:**	**7**	**6**	**7**	**7**	**7**	**7**	**6**	**4**	**6**
By size																	
Small	2	3	4	3	2	11	8	:	3	2	2	2	3	3	5	3	5
Medium	2	4	3	5	4	7	11	:	5	3	2	3	4	3	5	3	5
Large	3	6	4	13	10	9	18	:	8	7	12	9	8	8	7	5	7
By Economic Activity																	
Food, beverages and tobacco	3	1	4	3	2	3	7	:	4	5	1	2	3	5	4	3	4
Textile and leather	2	3	5	4	4	5	7	:	3	3	2	3	2	5	5	3	5
Wood, pulp and printing	1	4	2	4	2	5	9	:	2	8	1	1	2	2	3	1	3
Coke and chemicals	1	8	5	12	7	10	11	:	11	:c	:	:c	2	9	8	5	8
Rubber and other non-metallic	3	4	7	6	9	13	10	:	4	5	2	5	4	3	7	4	7
Basic and fabricated metals	2	2	1	7	5	8	8	:	5	3	1	2	2	2	3	2	3
Machinery and equipment	3	7	5	14	10	4	18	:	10	7	14	4	3	5	8	5	8
Electrical and optical equip	9	14	7	16	16	15	19	:	11	:c	4	:c	30	23	12	11	12
Transport equipment	4	10	2	18	14	:c	36	:	8	6	48	:c	8	3	7	7	7
NEC & recycling	1	22	4	7	5	:c	14	:	6	6	3	:c	2	5	7	4	7

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.10: Number of innovators by technological sector (%), 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA	**51**	**71**	**67**	**49**	**43**
EU-15	**51**	**71**	**67**	**49**	**43**
By size					
Small	44	61	59	42	37
Medium	58	74	73	56	48
Large	79	85	87	78	71
By country					
B	34	49	46	36	28
DK	69	83	80	62	64
D	71	91	84	59	66
E	29	70	51	28	20
F	43	60	62	37	36
IRL	73	90	84	73	65
I	48	59	59	49	41
L	42	0	56	46	26
NL	62	73	79	57	55
A	67	76	81	61	66
P	26	51	49	28	21
FIN	36	56	45	35	29
S	54	78	70	47	44
UK	59	78	70	54	52
NO	48	69	66	45	43

Source : CIS2, Eurostat / Enterprise DG

Table 5.11: Number of novel innovators by technological sector (%), 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA[1]	**21**	**35**	**33**	**19**	**14**
EU-15[1]	**21**	**35**	**33**	**19**	**14**
By size					
Small	16	26	28	15	11
Medium	23	38	34	22	15
Large	42	47	53	42	30
By country					
B	14	21	22	15	10
DK	27	59	25	27	26
D	24	29	37	19	16
E	11	36	23	9	6
F	20	30	34	18	12
IRL	27	49	30	24	21
I	26	42	39	26	19
L	21	0	38	15	15
NL	28	36	44	24	20
A	24	37	36	24	19
P	7	10	16	10	4
FIN	18	29	25	15	12
S	25	46	33	27	13
UK	19	34	28	16	12
NO	14	34	26	12	10

Source : CIS2, Eurostat / Enterprise DG

Table 5.12: Innovation expenditures as a share of total turnover by technological sector, total population, 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA[1]	**3.7**	**10.1**	**4.4**	**2.2**	**1.8**
EU-15[1]	**3.7**	**10.1**	**4.4**	**2.2**	**1.8**
By size					
Small	2.5	7.6	3.2	2.2	2.0
Medium	2.3	5.6	3.3	2.3	1.4
Large	4.2	10.7	4.6	2.1	2.0
By country					
B	2.1	7.9	1.8	2.5	1.2
DK	4.8	19.3	5.3	5.9	2.3
D	4.1	13.4	4.5	2.3	1.9
E	1.8	5.8	2.2	1.4	1.1
F	3.9	11.5	5.2	1.8	1.0
IRL	3.3	4.9	5.2	3.5	1.4
I	2.6	7.7	3.0	2.2	1.7
L	:	:	:	:	:
NL	3.8	22.1	4.6	1.8	1.6
A	3.5	9.8	4.1	3.2	1.9
P	1.7	1.5	2.4	1.0	1.8
FIN	4.3	12.9	4.0	1.1	4.0
S	7.0	12.1	8.7	2.3	2.8
UK	3.2	5.4	3.1	2.3	2.6
NO	2.7	14.7	3.9	1.8	1.7

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.13: Turnover due to products new to the enterprise as a share of total turnover, total population, by technological sector, 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA[1]	**12**	**19**	**16**	**9**	**6**
EU-15[1]	**12**	**19**	**16**	**9**	**7**
By size					
Small	6	10	10	6	5
Medium	8	18	12	7	6
Large	14	19	17	10	7
By country					
B	6	11	6	3	6
DK	7	10	12	11	3
D	17	19	20	12	12
E	10	20	18	5	4
F	9	16	12	6	5
I	8	16	11	6	5
IRL	17	44	15	7	5
L	:	:	:	:	:
NL	7	19	8	6	6
A	13	31	16	8	10
P	9	8	28	3	2
FIN	9	37	10	6	3
S	14	18	19	6	6
UK	8	19	6	7	5
NO	10	23	12	15	5

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.14: Turnover due to products improved to the enterprise as a share of total turnover, total population, by technological sector, 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA[1]	**20**	**17**	**30**	**14**	**11**
EU-15[1]	**20**	**17**	**30**	**14**	**11**
By size					
Small	9	12	13	9	6
Medium	13	16	19	13	9
Large	24	18	33	16	13
By country					
B	8	17	10	7	6
DK	14	46	20	11	7
D	28	11	40	12	13
E	17	16	22	21	10
F	12	18	15	12	5
IRL	15	23	13	23	8
I	19	19	22	24	13
L	:	:	:	:	:
NL	18	24	25	15	14
A	19	32	19	20	14
P	6	14	10	1	5
FIN	15	36	24	12	7
S	17	24	19	13	11
UK	16	15	21	14	12
NO	10	22	19	6	6

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.15: Turnover due to products unchanged to the enterprise as a share of total turnover by technological sector, total population, 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA[1]	**68**	**64**	**54**	**77**	**83**
EU-15[1]	**68**	**64**	**54**	**77**	**82**
By size					
Small	85	78	77	85	89
Medium	79	66	69	80	85
Large	62	63	50	74	80
By country					
B	86	72	84	90	88
DK	79	44	68	78	90
D	55	70	40	76	75
E	73	64	60	74	86
F	79	66	73	82	90
IRL	68	33	72	70	87
I	73	65	67	70	82
L	:	:	:	:	:
NL	75	57	67	79	80
A	68	37	65	72	76
P	85	78	62	96	93
FIN	76	27	66	82	90
S	69	58	62	81	83
UK	76	66	73	79	83
NO	80	55	69	79	89

1 : Luxembourg is not included

Source : CIS2, Eurostat / Enterprise DG

Table 5.16: Turnover due to novel products as a share of total turnover, by technological sector, total population, 1996

	Manufacturing	High	Medium-high	Medium-low	Low
EEA[1]	**6**	**14**	**7**	**6**	**4**
EU-15[1]	**6**	**14**	**7**	**6**	**4**
By size					
Small	5	7	8	4	3
Medium	5	8	7	5	3
Large	7	14	7	7	5
By country					
B	3	8	2	2	2
DK	5	8	9	5	3
D	4	7	4	3	4
E	9	11	15	10	4
F	8	15	9	9	3
IRL	8	12	7	16	3
I	13	19	20	11	8
L	:	:	:	:	:
NL	7	13	6	11	4
A	6	10	6	4	6
P	7	3	27	1	1
FIN	7	39	5	5	2
S	7	16	7	3	2
UK	7	16	5	6	4
NO	4	13	6	5	2

1 : Luxembourg is not included
Source : CIS2, Eurostat / Enterprise DG

INDEX

Statistics on innovation in Europe is a joint publication of Eurostat and Enterprise DG. It has been managed by unit A4 of Eurostat, responsible for Research and development, methods and data analysis. The opinions expressed are those of the individual authors alone and do not reflect the position of the European Commission.

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Translation:
Translation service of the European Commission, Luxembourg

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