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THE MEASUREMENT OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES

USING PATENT DATA AS SCIENCE AND TECHNOLOGY INDICATORS
PATENT MANUAL 1994

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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This manual is intended to supply persons who wish to use patent statistics to construct science and technology indicators with the key information about how to obtain and analyse such data.

Earlier versions were submitted to the Group of National Experts on Science and Technology Indicators who discussed it at their annual meetings in 1992 and 1993. A small group of experts was set up to finalise the Manual, notably by including the conclusions of the later NESTI session and subsequent written comments from Member countries.

After these amendments had been made, the document was submitted to the Committee for Scientific and Technological Policy (CSTP) by the usual written procedure. They then approved it and recommended its release for general distribution. This Manual is derestricted on the responsibility of the Secretary General.

PREFACE

This Manual has been prepared by the OECD Secretariat in conjunction with the Organisation's Group of National Experts on Science and Technology Indicators to provide the users of patent statistics with the main information required for collating and analysing these data.

The importance which OECD attaches to the use of patent statistics is by no means new; it goes back to the late 1970s. Following two meetings in 1978 and 1979, a major conference was held in Paris in September 1980 to seek a consensus among users in Member countries about indicators measuring the output of R&D and innovation activities and to examine the approaches which seemed most promising at international level. At a workshop on patents, invention and innovation in June 1982 there was further discussion on the use of patent statistics and other indicators to evaluate and analyse invention and innovation activities.

The Patent Manual follows on from the TBP Manual[1] (on international trade in technology) and the Oslo Manual[2] (on innovation surveys), and is an essential item for fuller understanding of the process of technological innovation and dissemination.

All three belong to the Frascati family of OECD manuals dealing with the measurement of scientific and technical activities. They focus on result and impact indicators, as successors to the Frascati Manual which measures R&D inputs. They more particularly address the users of S&T data, whereas the Frascati Manual is chiefly designed for the producers of R&D data.

All these manuals are the outcome of work by the Organisation and its group of national experts to conceptualise scientific and technological activities and develop statistical methods of measuring their most pertinent aspects on internationally agreed lines. Subsequent stages will deal with further areas of science and technology such as human resources, trade in high-tech products and intangible investment.

Patent data have been put to profitable use by analysts and policymakers for a long time now. They provide detailed information on countries' technological activities, covering long periods through the time series available; in addition, computerised databases make the content of patent documents easier to access and analyse, and allow more convenient data manipulation.

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1. The Measurement of Scientific and Technological Activities. Proposed standard method of compiling and interpreting technology balance-of-payments data -- TBP Manual, OECD, Paris 1990. General distribution.

2. Proposed OECD guidelines for the collection and interpretation of data on technological innovation -- Oslo Manual, OECD, Paris 1992. General distribution.

The main information that can be drawn from patent documents relates to the type of technology covered by the claim, the name and nationality of the inventor (individual, government agency, private corporation), links between a new patent and knowledge in earlier ones and scientific publications, the economic sector where the invention originated, and the fields and markets covered by the patents.

Overall, patent documents contain a wealth of detailed information to be found nowhere else; but successful use of that information for economic analysis needs to take account of a range of methodological problems, differences between one country or institution and another, the role of multinationals, and specific characteristics of given technologies and economic sectors. This Manual sets out guidelines for tackling these problems, while encouraging the use of patent data and giving impetus to the international harmonization of these statistics.

Acknowledgements

The drafting of the Manual was entrusted to Mrs. Francoise Laville (Observatoire des Sciences et des Techniques, France), who was assisted in this task by Mrs. A. Sigogneau et Mrs. V. Rabeharisoa (CSI - Ecole des Mines, France) under the direction of the OECD Secretariat. Mr. Mario Pianta, Mr. Giorgio Sirilli (ISRDS, CNR, Italy) and Mr. Ulrich Schmoch (FhG-ISI, Germany) also contributed to its preparation.

Active assistance was received from the United States Patent and Trademark Office, the Japanese Patent Office, France's Institut National de la Propriété Industrielle and the European Patent Office, which reviewed the preliminary version of the Manual, notably to check and supplement those aspects referring more particularly to them.

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(*) The Manual contains references of two kinds. Numbered references will be found in the Notes. The Bibliography, in three parts (A, B and C), lists books and papers mentioned in the text.

Introduction

We are concerned here with patents as indicators of technological activity. Alongside other science and technology indicators such as R&D expenditure and personnel, data on the technology balance of payments, and so on, patents provide a uniquely detailed source of information on inventive activity. The Manual deals solely with patents for industrial invention; other forms of intellectual property, such as trademarks, designs and copyright, fall outside its scope.

Patents are a means of protecting inventions developed by firms, institutions or individuals, and as such may be interpreted as indicators of invention. Before an invention can become an innovation, further entrepreneurial efforts are required to develop, manufacture and market it.

In recent years analysts and policymakers have made increasing use of patent indicators to analyse the rate and direction of technical change. The requirement of novelty for the granting of patents means that the indicators are particularly appropriate for advanced countries; they may not adequately portray technological activity in less developed countries.

Patent data have particular strengths and weaknesses as technology indicators. Problems naturally arise when information which patent offices collect for administrative reasons are used to investigate technological activity.

The strengths lie in:

a) the availability of data from patent offices in most countries across the world, generally in very long time series;

b) the detailed information available about the type of technology, the inventor, relevant markets and so on;

c) the wide range of computerised databases developed by institutions and commercial entities which facilitate access and data manipulation.

The weaknesses are linked to:

a) institutional factors, including aspects of patent law and procedures which may vary from one country or institution to another;

b) the particular role of patenting in the complex process of invention and innovation, and its role in firms' strategies;

c) differences in patenting behaviour across sectors, patent institutions, markets, types of inventor and firms.

Some international standardization is now required in the use of patent data as technology indicators. That is why OECD has prepared this Manual, which is intended as a standard-setting tool for harmonized methodology in the use of patent statistics. The Manual, of which this is the first edition, will be reviewed at intervals and improved in the light of experience.

This is one of the Frascati family of OECD manuals, others being the Frascati Manual on R&D, the technology balance of payments (TBP) Manual, the Oslo Manual on Innovation and the Human Resources Manual. They fall into two groups: manuals which deal with definitions of concepts and data collection procedures, and manuals whose objective is to set guidelines for the use of available sources of data (often gathered for administrative reasons) as science and technology indicators. The Patent Manual belongs to the second group.

The Manual is intended in the first place for users and producers of science and technology indicators working in research organisations, government departments and statistical agencies. It provides basic information on how patent data can be used as indicators, and shows how patent data can be linked to other statistics on science, technology and economic activity (R&D, scientific publications, trade and production, etc.). Research is not yet far enough advanced to permit detailed recommendations on the use of standard or accepted indicators. But some broad and useful suggestions are set out, based on an extensive review of present work using patent data.

The Manual falls into four parts. Chapter I places patents in a general conceptual framework and describes their main limitations and their advantages.

Chapter II covers patent law systems. Some awareness of the rules that apply, at least in broad outline, is valuable in understanding how much can be at stake in a patent and what part patents therefore play in technology output.

Chapter III deals with the kind of technological information that a patent can provide. It describes the classifications and databases in use, pointing out questions about the state of technologies which the patents can help answer.

Chapter IV presents patent-derived indicators for analysis of technological activity. Various dimensions of analysis are examined, including the country, sector and firm levels, as well as links with R&D, science, innovation and economic indicators.

Annexes cover various aspects of practical interest in the use of patent data, providing examples of the information contained in a number of databases, classification systems and other background information. A substantial bibliography lists the main relevant works on patent data and their uses. For ease of consultation it is presented under three main headings, with references in each case arranged in alphabetical order of authors.

CHAPTER 1

BACKGROUND AND CONCEPTUAL FRAMEWORK

1.1 How patent indicators relate to other science and technology indicators

The aim of this chapter is to give the reader a general idea of the uses of patent indicators and their spheres of application. We discuss how patent indicators relate to other science and technology (S&T) indicators, and describe their main advantages and shortcomings. It is a general introduction rather than an exhaustive analysis, but references are made where appropriate to the more detailed presentation in Chapters II to IV.

Patents are just one of a number of intellectual property rights, which fall into two broad categories:

- industrial property, chiefly in technical inventions, trademarks and industrial designs, and
- copyright, chiefly in literary, musical, artistic, photographic and audiovisual works, including some software.

Industrial property rights are officially registered, whereas copyrights are not. Protection for technical inventions is offered primarily by patents, and by utility models ("petty patents") as well. The main differences are that utility models can be registered only for selected areas of technology, and some countries recognise patents but not utility models. Given these limitations, utility models will not be mentioned further below.

Technological change and innovation are important factors for productivity and competitiveness and have thus become a central topic of economic analysis in most industrialised countries. Within the innovation process, S&T activities are decisive, although the influence of other elements like marketing, design and human skills have become increasingly evident in recent years. This is discussed in more detail in the Oslo Manual (OECD, 1992b-C). In any case, understanding innovation presupposes an understanding of S&T activities.

One major concern of analysts is to describe S&T activities in quantitative as well as qualitative terms so that the indicators can be used in the context of models, explicit or implicit. However, the general problem is that S&T can only be measured indirectly, using input, output or impact indicators which, OECD has recently suggested, should be called S&T resource, results and impact indicators (Sirilli, 1992 B). Furthermore, it is harder, in both theory and practice, to determine the results of S&T activities than to record the resources (Grupp, 1990-B). The results of S&T activities, and the likelihood of new products and processes becoming successful in the marketplace, cannot be measured in the customary scientific sense of "measuring" a variable. One solution is to use indicators which are proxies rather than direct measures and it is in this context that patent indicators are currently used for measuring the output of S&T activities.

S&T activities comprise research and development (R&D) and other activities such as collecting S&T information, testing and standardization, etc. The Frascati definitions explicitly exclude the latter activities from R&D. Patents are often linked to research and development and can be considered as indicators of R&D output (1).

As mentioned above, S&T, and even more R&D, are only one element in innovation. Furthermore, R&D processes are not necessarily sequential (linear), and the borderlines between the stages in the R&D process are not clearcut. Various models have been proposed to describe the stages in innovation, especially R&D (2).

The linear model of innovation shows a system in which the development of new technologies follows a clearcut time sequence that originates in research, involves a phase of product development and leads on to production and commercialisation (Figure 1). In the chain-linked model, innovation is presented as a process of continuous and repeated interactions and feedbacks. This model emphasizes the central role of design, the feedback effects between the downstream and upstream phases of the earlier linear model, and the numerous interactions between science, technology and the innovation process in every phase. Figure 2 illustrates innovation as an interactive process.

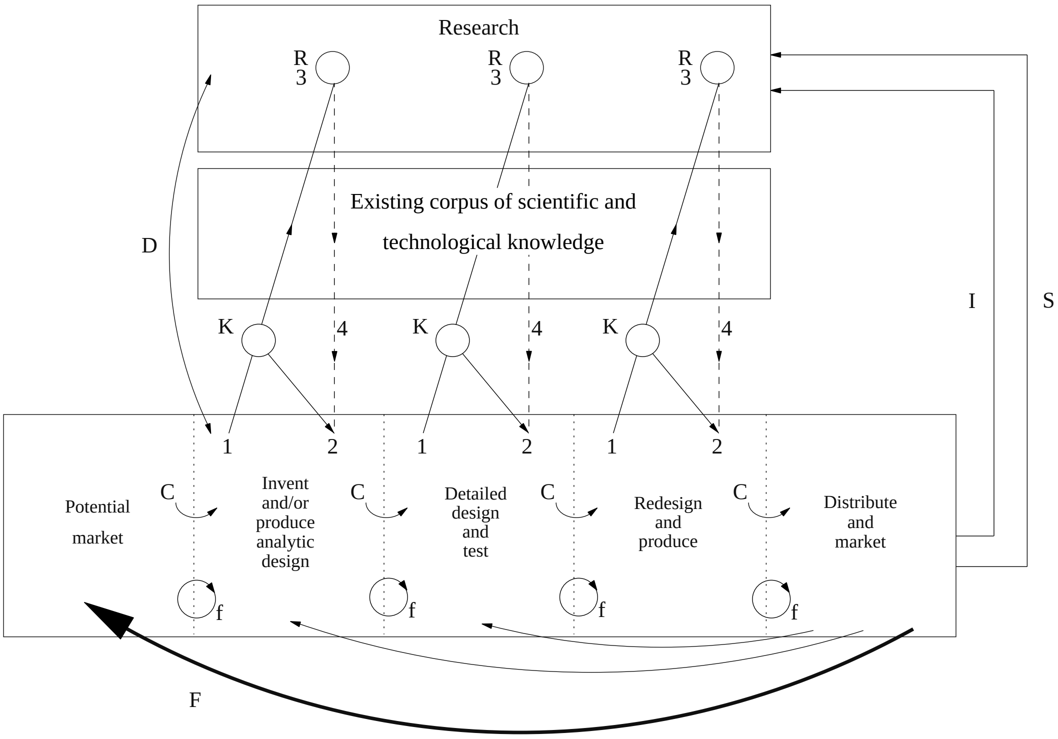
The two approaches are combined in Figure 3, which shows a simplified cognitive model describing the linkages of S&T indicators to innovation(3). It demonstrates that the innovation process can be subdivided into stages that may follow a typical sequence, but will not do so in all cases: for instance, the technical concept and its industrial development may come before the theoretical clarification. Furthermore, innovation can be viewed from the R&D standpoint (using the Frascati definitions, "types of R&D"). As a general rule individual types of R&D are not linked to particular stages of innovation, but are found at all stages, often in parallel. Even when a product has been brought to market, R&D and other innovative activity will continue. Similarly, patents cannot be tied to a single stage of innovation; they are generated throughout almost the whole of the technological life cycle.

At the same time, patents are a typical output of application-oriented types of R&D, formal and informal, i.e. applied research and experimental development, and sometimes oriented basic research as well. Inventions are often generated in the context of industrial and design engineering (chiefly linked to the stock of knowledge), while some come about by accident. The legal requirement to show potential industrial applications, and the high cost of patenting, indicate a close link to industrial innovation activities, but it is not the sole link.

Although patent indicators do reflect an important part of the overall innovation process, for a number of reasons they should not be used in isolation. First, they show only one aspect of innovation, so that a consistent picture of technological change can only be achieved by combining several indicators (Sirilli, 1992-B and Grupp, 1990-B). Second, patent indicators have shortcomings which can often be identified by confronting them with other indicators. This need for an integrated view of innovation indicators applies to other series as well, and even the classic series such as R&D expenditures should be viewed in a wider context.

Figure 1. **A linear model of the linkages from research to production**

Figure 2. **An interactive model of the innovation process**
The chain-linked model



Individual firms and productive sectors at a more aggregate level

Symbols used on arrows in lower boxes:

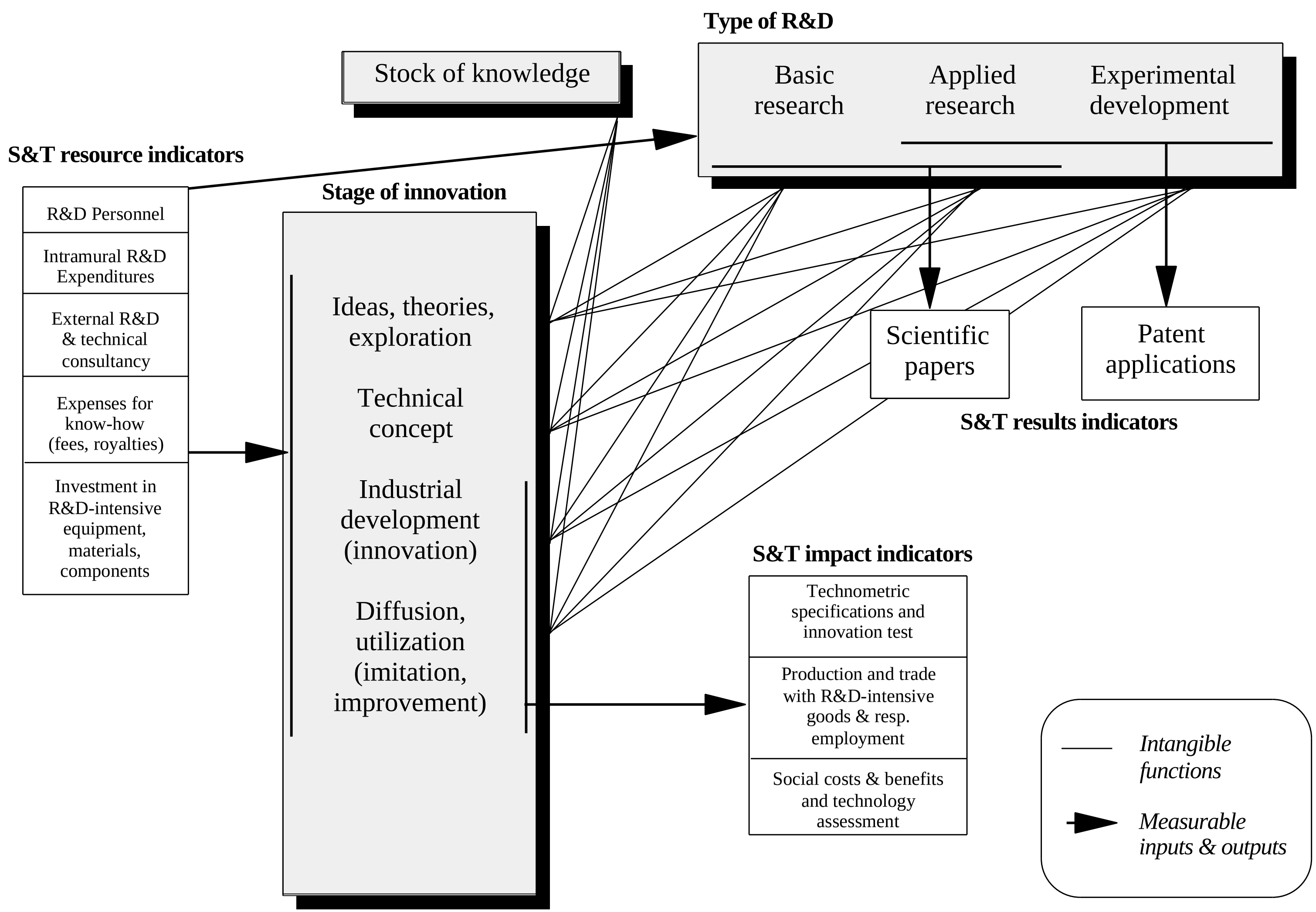
C = Central-chain-of-innovation.
f = Feedback loops.
F = Particularly important feedback.

Vertical links:

K-R: Links through knowledge to research and return paths. If problem solved at node K, link 3 to R not activated. Return from research (link 4) is problematic -- therefore dashed line.
D: Direct link to and from research from problems in invention and design.
I: Contribution of manufacturing sector scientific research by instruments, machine tools, and procedures of technology.
S: Financial support of research by firms in sciences underlying product area to gain information directly and by monitoring outside work. The information obtained may apply anywhere along the chain.

Source: TEP, Technology and the Economy, the Key Relationships -- OECD, Paris 1992.
Adapted with minor changes from Kline and Rosenberg (1986-B)

Figure 3. **Assignment of indicators to the innovation process: a cognitive model**



Source: Schmoch and others (3)

1.2 Methodological problems in using patent indicators

Patent protection is not the only way to reap market success from an innovation. Secrecy, rapid launching, low prices and so on can supplement or even replace patent protection. In areas of fast-moving development, patent protection may be of little value because inventions quickly become obsolete.

In this context, a number of empirical studies of the relative importance of patents have led to the following substantially similar findings (4). Patents are an important means of asserting ownership of inventions and protecting them, at least as significant as other factors. Not all technical innovations lead to a patent application, but the coverage is generally broad, as patents are useful not only in protecting against imitation but in obtaining licence fees and negotiating transfer agreements as well. Practically all innovating companies do patent at least their most important R&D results, but the extent of patenting less important products and processes differs significantly. That can be largely explained by the observation of Schankermann & Pakes (5), based on ex-post analysis, that the economic value of patents is highly skewed, with those of high value concentrated in a very small percentage of the total. The authors may have underestimated the value of patents, as their deterrent effect is not directly visible. All the same, a company has to strike a balance between the risk of paying high patent fees for an invention that may ultimately be of low value and the risk of foregoing protection for innovations that may turn out to be important. Hence there is still debate on the optimal level of patenting, and firms may pursue different policies.

The first conclusion has to be that, while patents do not cover all kinds of innovation activity, they do cover a considerable part of it.

Firms' differing propensities to patent are one important source of bias in patent indicators (6). The problem can be overcome by linking the R&D expenditures of a company and its patents, thus "calibrating" the number of patents for comparisons between firms. Individual companies do change their patenting policy, but only seldom, so that time series are generally meaningful.

A second source of bias is that propensity to patent varies from one field of technology to another, due to differences in the effectiveness of patent protection and intrinsic features of technologies. For example, the propensity to patent is high in chemistry and in some fields of mechanical engineering, but low for aircraft (Scherer, 1992-C). Highly aggregated patent analyses covering a range of technology accordingly yield poor results, and it is essential to examine homogeneous fields of technology (Schmoch and others, 1988-B)). Differences between technologies are also crucial to an understanding of innovation, and patent indicators can help to achieve better insights when they are disaggregated.

As a third source of bias, propensity to patent may vary from one country to another: size and geographical position give rise to different expectations of the returns from patent protection. Any such variation can be determined by combining patent series with other input and output indicators, which will provide important insights into innovation and market diffusion.

A further source of bias lies in differences among national patent systems, arising from legal, geographical, economic and cultural factors. As a rule it is not sensible to base country comparisons on totals for domestic patents, since they relate to different systems. It is more meaningful to compare countries using a given national system; one problem with this, however, is that the host country has a statistical "home advantage" and that other countries' economic interest in seeking protection there may differ. Various approaches have been suggested to tackle this: counting only patents with at least one foreign application, systematic comparisons of different national systems, or basing analysis on regional patent systems such as the European one (7). The bias caused by differences among patent systems can largely be overcome by these methods; at the same time, it is clear that a good understanding of the organisation and legal features of national and international patent systems is a prerequisite for meaningful analysis of patent data. This is why the corresponding sections of this Manual are relatively detailed (cf. Chapter II). When comparing countries' patent performance the differences in companies' propensities to patent are generally less influential as long as large enough numbers of companies are involved. Nevertheless, with smaller countries a given field of technology may be dominated by very few companies; a more careful approach is then needed.

As patents are generated during the whole technology life cycle, they cover basic as well as incremental innovations. Recent studies (Kline and Rosenberg, 1986-B), in fact, point to the decisive impact of incremental innovations for market success. Patents of higher technical and economic relevance can be identified by analysing foreign patents or patent citations (cf. sections 4.1 and 4.2).

Patents are not granted as soon as an application is filed; in most countries publication occurs 18 months later (cf. section 2.2.1), so they always lag behind. But as a rule they are granted well before the products or processes in question come to the marketplace -- "innovation" according to Schumpeterian definitions. As a result, patent statistics are more up-to-date than production or trade statistics. The strict legal requirement of worldwide novelty for patents means that the advanced countries are more heavily represented, and for the time being patent statistics are not very meaningful for developing countries. In years to come patent protection will be important in building up effective innovation systems in these countries, as successful examples demonstrate, so that patent analysis will be applicable. (Further limitations of patent indicators are discussed in section 4.3.)

1.3 The advantages of patent indicators

Given the range of methodological problems mentioned above, it may be asked why patent indicators should be used at all for analysing innovation processes, since other well established indicators are available. As Figure 3 showed, however, the special proximity of patents to the output of industrial R&D and other inventive and innovative activities means that there is no other equivalent indicator for this purpose.

A second advantage of patent data is that they cover virtually every field of technology. The main exceptions are software, which is generally protected by copyright and can be patented only when it it integrated in a technical process or product, and most results of fundamental research, which are better reflected by bibliometric indicators. This broad coverage of technology is very useful, in analysing the diffusion of key technologies for instance, or in generating specialisation profiles for countries or companies (examples can be found in Table 9 for countries and in Figure 7 for companies). In contrast, the databases on scientific articles which are used to construct bibliometric indicators generally cover only restricted sets of S&T areas.

Patents offer worldwide geographical coverage, as most countries have a patent system and, more important, all of them are represented in large systems like the American and European ones; the heavy bias to advanced countries has to be borne in mind.

A further extremely important advantage is the very detailed classification in patent documents, which allows almost unlimited choice of aggregation levels from broad fields of technology down to single products. Here patent indicators are much better than R&D expenditures or trade and production statistics, where the degree of disaggregation is much less. In order to obtain meaningful results, patent, trade and R&D indicators can be combined for work at highly aggregated levels, while finer analysis can be made using the patent indicators alone. A number of studies have been carried out with the aim of evaluating the technological performance of firms, sectors or countries by linking indicators such as R&D, trade and production statistics, patents, bibliometrics and so on.

Patent documents include many details of interest, such as the year of invention (priority year), technical classification, assignee (applying company), inventor and so on, which are rich sources for various types of analysis. In recent years, evaluation of this information for economic purposes has expanded rapidly with improved on-line availability of patent data. The statistical processing of patent data is largely free of errors, because patents are legal documents in which the details mentioned are very carefully recorded; for example, spelling mistakes in company names are very infrequent compared to publication databases, so working up the assignee statistics is quite easy.

All in all, patents contain so much detailed information on the innovation process not available elsewhere that their use for economic analysis is very fruitful. A careful methodological approach is, however, necessary to cope with the sources of bias. Studies based on patent indicators have already provided interesting insights into innovation processes (8), and many promising starting-points for future work.

CHAPTER II

SYSTEMS OF PATENT LAW

A patent is an expression of the industrial property laws of the country granting it. Patenting all or part of a new technological device or process involves its inventor in publicising the invention, which receives time-limited statutory protection from the country of filing against unlicensed copying. The product or process need not actually be made or applied to qualify for patent protection. That being so, a patent may not always be protecting some existing prototype or fully developed process. What it primarily signifies is that the applicant's invention is novel. So patenting expresses and gives legal status to a particular definition of technological invention. This sets certain limits to the ways in which patent data can be used.

2.1 Background: principal conventions

The "inventor's right" concept emerged during the 15th century but did not really develop until the 19th century, when today's patent systems gradually took shape as a result of growing international trade.

To begin with, *the patent was a national right.* Every country laid down its own rules for industrial protection, rules which applied only within the borders of the country concerned.

However, once national patent systems had been introduced, a need to link them up to one another was very soon felt. International conferences led to a number of agreements.

1883: Paris Union Convention

After five years of preparation the Convention for the Protection of Industrial Property was signed in Paris on 20 March 1883. The purpose of the convention, which entered into force in July 1884, was to harmonize and interlink countries' industrial property law systems and to establish some international legal institutions. Eleven countries signed the original convention: by 1 January 1993, there were 108 signatories.

Union priority right: before the Union Convention came into force, an inventor filing a patent application in one country could be refused the right to patent the same invention in another country on the grounds that his invention was no longer novel. Under the Convention, an inventor filing an application in any one Union country may validly apply to patent the same invention in other Union countries within 12 months and the application cannot be refused on grounds of prior disclosure as a result of the first filing.

Since 1883 several conferences have been held to revise the Convention in the interests of a more efficient patenting system. In 1893 an International Bureau was established for the protection of industrial property. In 1947 an International Patent Institute was established in The Hague. Its role was to carry out novelty searches for its member countries. It was subsequently absorbed into the European Patent Organisation.

A European convention was signed on 19 December 1954 under which the Council of Europe introduced the International Patent Classification (IPC). This was followed by the Strasbourg Agreement on that classification, signed on 24 March 1971; it entered into force in 1975.

In 1967 a conference held in Stockholm to revise the Union Convention established the *World Intellectual Property Organisation (WIPO).*

1970: Patent Co-operation Treaty

The *Patent Co-operation Treaty* (PCT) was signed in Washington on 19 June 1970 and came into effect on 1 June 1978. It provides for the filing of an international application to have the same effect as a national application in each of the contracting States designated in the application.

International applications are centralised through WIPO. They are then examined by the European Patent Office, or an approved national office. The resulting search reports provide a basis for subsequent examination, where this is considered necessary, by the patent offices of the countries named in the application. However, patents are still granted nationally.

The PCT system is superimposed upon the national and European systems. Another point is that a PCT application may designate either a national office or a regional one such as the European Patent Office (Euro-PCT), to apply for protection in one country or in a set of countries.

1973: Munich Convention

This convention was signed in Munich on 5 October 1973 and entered into force on 1 June 1978. It establishes a uniform patenting system for all countries signatory to the Convention. The *European patent* is protected under national law in each of the countries designated in the application.

The Munich Convention also established the European Patent Organisation, which makes senior appointments to the *European Patent Office (EPO).*

The **Luxembourg Convention,** signed on 15 December 1975, introduced a single *Community patent* affording protection across the entire European Community. This convention has not yet entered into force.

2.2 Patent procedures

We look first at patenting procedures in general, then at some special features of three leading offices, the European, United States and Japanese patent offices.

2.2.1 General features

In legal terminology, "inventor" means the individual person who produced the invention, while "filer" means the invention's individual or corporate owner. So when the inventor is employed by a company, it is usually the company which owns the invention when that has been produced as part of its activities. In what follows, "inventor" and "filer" are used indiscriminately unless the difference happens to be significant.

a) Protection in a single country

An inventor (individual, agency or company) wishing to protect an invention in a particular country files an application with that country's patent office. The application takes the form of a document prepared to a pattern established by the office concerned (9). A larger company may have its own law department prepare the application, but it may also, like an individual inventor, retain a specialist patent agency, first to prepare the application and then to take it through the subsequent formalities.

The patent application

A patent application is a form on which details relating to the filer and inventor(s) are to be provided, together with a detailed technical description stating in what ways and in what technological areas the invention represents an innovation.

Reference may also be made to other patents and/or scientific and technical literature against which the invention can be seen as an innovation. The application will set out one or more claims, showing those aspects in which the inventor considers that the product or process is an innovation and entitled to protection. The claims are generally subdivided into one or more main independent claims and one or more dependent claims giving further details or variations in the purpose of the main claim on which they are dependent. Where appropriate the application will also include drawings.

Examining the application

When an application is filed, the office concerned will have it examined by one or more examiners before granting a patent. The examiner will usually be a specialist in the fields mentioned in the application and will often have patent law training as well. The examiner's function is to assess the novelty of the inventor's application by comparing his claim with the published state of the art at the time of filing. One or more classification codes will be attributed to the invention as claimed.

To qualify for a patent an invention must satisfy certain criteria. In particular it must be new, which means that it must not have been divulged anywhere, by any means whatsoever. It must also be inventive in character, which means that it must surpass the skills of a professional confronting the technical problem concerned. To assess novelty and inventiveness, the examiner compares the claim with the published state of the art at the time of filing. The state of the art is made up not only of patents already published (whether or not they have been granted) but also of material other than patent literature, such as scientific publications, books, reports, theses and so on. On the basis of all this the examiner issues a search report. What happens next depends upon the legislation of the country concerned.

In the "examination countries", if the search report finds the claim to be new and inventive the patent is granted, otherwise the application will be rejected. Before final rejection the filer may discuss his claim with the examiner and rework it to show that it really is an advance on the prior art.

In the "automatic grant countries" the patent is granted in practically all cases, sometimes with a search report.

b) Protection in more than one country

So far we have described patenting procedures for a single country. We now consider how protection may be obtained in more than one country. Since there is no truly worldwide patent office, the inventor has to have his application granted by the patent office of every country in which he wants protection. The inventor's first application is usually to the patent office of the country in which his laboratory or company is located. But various considerations, marketing strategy for example, may prompt him to file in some other country. The first application is the "priority application" (in other words, it enjoys the right of priority under the Paris Convention). The applicant then has a year in which to protect his invention elsewhere, either by filing for a patent in each country in which he desires protection or by filing a regional application (e.g. a European application through EPO for a number of European countries) or an international application with WIPO (PCT) to obtain protection in various countries by means of a single application.

2.2.2 Some special features of European, United States and Japanese practice

Although patenting is basically the same process in every country, some patent offices have differences in their procedures. We now consider some special features of three particularly busy offices: the European Patent Office, the United States Patent Office and the Japanese Patent Office.

a) The European Patent Office

As a general rule, a patent office acts only for its own country. The European Patent Office is an exception in that on some matters it can act for a group of European countries. An inventor desiring protection in several European countries may apply to EPO for protection in the countries he names, regardless of whether he filed his priority application with the patent office of any of those countries or directly with the European Office. At present, national systems and the European system function in parallel, though inventors seem to be making increasing use of the European system. This is especially true of United States inventors, and of inventors in smaller European countries, like the Netherlands and Belgium, seeking wider geographical protection for their inventions. This development is definitely influencing the trend in the number of filings with individual offices. When the Community patent comes into effect, the trend can be expected to alter still further, so analysts of patent statistics will need to bear this in mind.

b) The United States Patent and Trademark Office

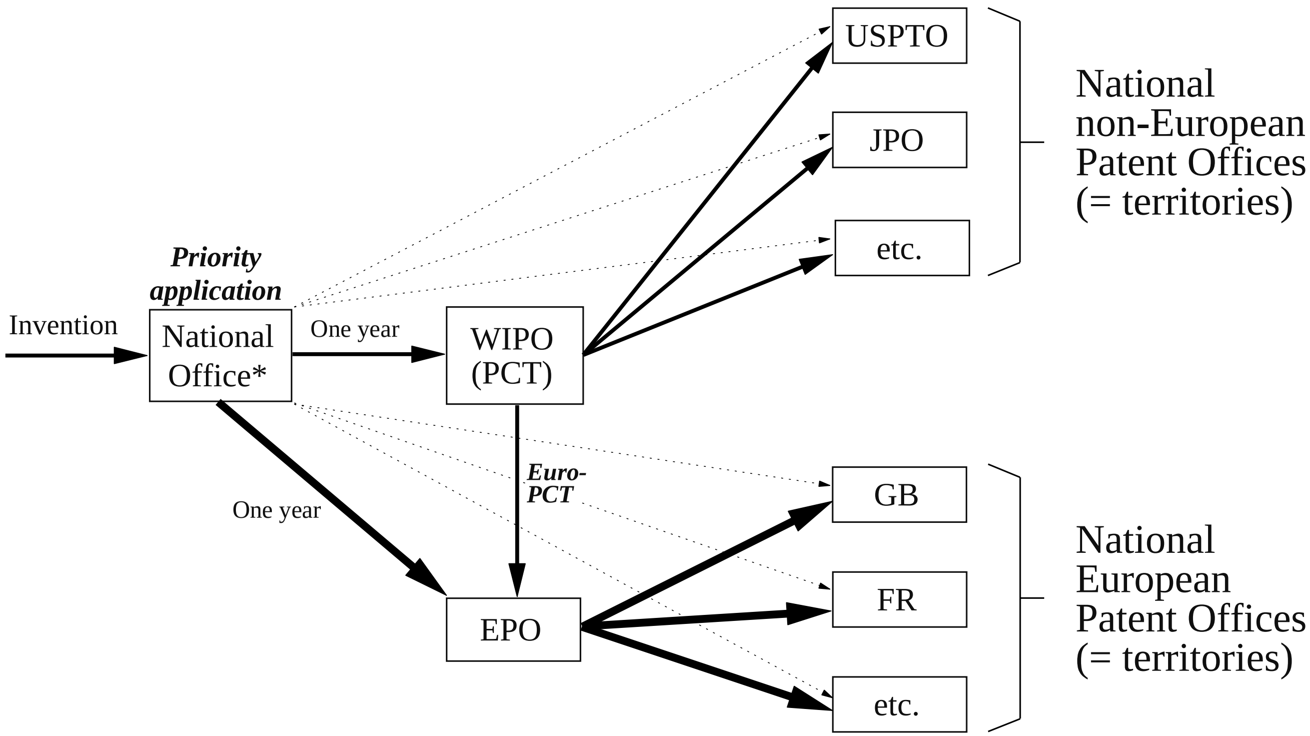
One important way in which patent offices can differ is in their patent document publishing procedures. A filing with the United States Patent Office is only published if a patent is granted. Patent grants do not follow a strict timetable, and can sometimes take as long as five years; they are not necessarily granted 18 months after the priority date as in many countries. These differences in practice elsewhere are very important in interpreting the number of patent documents published. Furthermore the US laws require a very detailed disclosure of the invention so that US patents are of considerable interest for information purposes.

c) The Japanese Patent Office

The Japanese Patent Office considers that 40 per cent of world patent applications are filed with the Japanese system. This rather high figure can be explained by several reasons. During the dynamic growth of the 1960s and 1970s, patents were highly esteemed as an instrument for promoting innovation; until recently every application filed with the Japanese Patent Office had to be in respect of a single claim; patent fees are quite low; patents are important for the standing of companies in Japan; patents are decisive for the career of scientists and engineers. Although the position of Japan in the world market has changed and patent law now allows for multi-claim applications, the high propensity to patent -- at least in the domestic market -- has hardly changed. The large number of applications has had a very interesting technological effect: in December 1990 the Japanese Patent Office was the first in the world to introduce an electronic filing system in an attempt to speed up examination procedures. Another advantage is that it provides the applicant with better procedural guidance.

This overview emphasizes the importance of statutory practice in the formulation of patents. Anyone wishing to use patents as a source of information about the technological state of the art will find it helpful to understand the practice, as a guide to how much reliance to put on data and to avoid misinterpreting them.

Figure 4. **Patent application channels**



* Office of the filer's country.
Source: Schmoch (1990-A).

Figure 4 illustrates the various channels available to the inventor (or filer) to apply for patent protection:

-- he can file in a single country (usual practice at the outset, in the National Office box here);

-- he can file in several countries with a single application (PCT or EPO).

2.2.3 *The costs of patenting*

Any general description of patent systems should give some indication of the costs of patenting. A number of considerations will affect the cost -- for instance, whether protection is sought in one country, a few countries, or a large number. The route selected is also relevant.

A range of costs are incurred:

-- for the patenting procedure itself (registration, examination and search fees);

-- for a patent agent or attorney (fees vary widely, but may well be high);

-- renewal fees, to keep the patent valid;

-- translation charges, for foreign applications;

-- fees for foreign patent agents or attorneys authorised to deal with foreign patent offices (the French magazine L'Usine Nouvelle, from which Table 1 is derived, estimated such fees at between FF 10 000 and FF 100 000 -- or between 2 000 and 20 000 US dollars -- according to whether the firm retains a French agent alone or a European one as well for multiple applications).

For France, where costs are probably typical, the formal procedures cost about FF 25 000. When other countries are covered via the European, United States or Japanese systems, the overall cost may be as much as FF 300 000 (or 60 000 US dollars). The major difference is in the cost of translating the patent application into the languages of filing countries, and of adjusting it to statutory requirements in foreign systems.

Table 1 shows typical costs for a patent application by a French machinery company.

Table 1. **Costs of patenting in different countries: applications by a French company**

FRANCE	EUROPE	UNITED STATES	JAPAN
Costs of procedure at INPI: 20 600	Costs of procedure at the EPO: 79 450	Cost of procedure: 38 000	Cost of procedure: 33 000
Renewal fees (for 5 years): 2 490	Renewal fees (for 3 years): 60 000		
	Adjustment, translation and registration in:		
	Sweden: 30 900 Netherlands: 20 720 Germany: 17 700 Italy: 14 600 United Kingdom: 11 400 Belgium: 6 300 Switzerland: 6 300		
TOTAL COSTS TO THE COMPANY: circa 300 000 Frs (or 60 000 US dollars)			

Source: "L'Usine Nouvelle", June 1993

CHAPTER Ill

FROM PATENT DOCUMENTS TO THE TECHNOLOGICAL STATE-OF-THE-ART INFORMATION THEY CAN PROVIDE

Patents have many uses. As well as attesting to industrial property rights, patents form part of the technological documentation from which companies may derive information about their own industries (competition profiles, state of the art, etc.). Another related use is for assessing technological areas or subjects by means of indicators prepared from patent-derived information.

3.1 A glossary of patent-derived data

Here it may be helpful to set out the main kinds of information that can be derived from a patent document and the data from which technology indicators can be devised.

Application, filing

Patenting an invention involves filing an application with the patent office. For any such application we can distinguish the *year of filing* and the *country of filing*.

In interpreting patent data various classes of application can be distinguished:

-- national applications (NA): all applications filed with a national patent office;

-- resident applications (RA): all applications filed with a national patent office by inventors resident in the country;

-- non-resident applications (NRA): all applications filed with a national patent office by persons resident abroad.

FOR ANY ONE COUNTRY, NA = RA + NRA

Non-resident applications (NRA) become external applications (EA) if they are considered in terms not of the recipient patent office country but of the applicant's country of residence.

AT WORLD LEVEL, NRA = EA

Patents granted may similarly be defined as national patents granted (NG), patents granted to resident inventors (RG), patents granted to non-residents (NRG) and external patents granted by other offices (EG).

Inventors, applicants

Every patent application has to give the names and addresses of the inventor and of the person, firm or institution filing for the patent (the inventor and filer may be one and the same person). From this, the **country of invention** can be ascertained.

Priority (priority application)

For any given invention, the priority filing is the first application. It is generally filed with the patent office of the country in which the invention was produced. Upon first filing the application receives a code number, the "priority number".

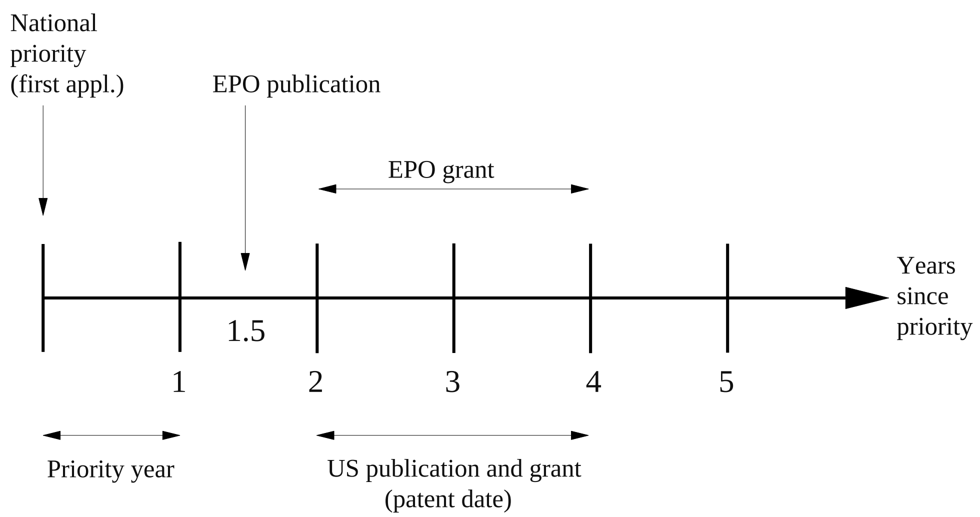
Data should be available for the **year of priority application** (or first filing) and the **country of priority application**.

Publication

Publication occurs when the application is made public. Patent applications are usually published 18 months after priority application. The only significant exception is the United States, where the filing is only published if a patent is granted, which may take up to five years from the first application. When an application is published it is given a publication number, the one used in subsequent searches.

The different lead times in patent filing procedures (single country applications, or applications to the European or United States systems) are summarised in Figure 5.

Figure 5. **The different lead times for patent application procedures**



Source: Schmoch (1990-A)

Each application published is also given a code (usually a letter) to show what kind of patent document it is. This shows at once whether the application has been examined, rejected or granted. Data should be available for **year of publication** and **country of publication**.

Search report

The patent office examiners' search report will mention the documents against which they assessed the application. These may be the ones referred to in the application, or other documents identified by the examiners. A prior art search checks that the invention really is novel. The examiner generally bases this on the applicant's claims. The search report is generally published at the same time as the application. Search reports for applications to PCT and the European, United States and French offices are available in certain databases.

Indicators can be derived from **documents cited** in search reports.

Designated countries

These are the countries in which the applicant for a European or international patent wishes to protect his invention. The applicant will not necessarily proceed in all the designated countries, in which case those countries where he does not proceed will not grant patents.

Grant of patent

This refers to the fact that a patent has effectively been granted. As mentioned above, in most systems (apart from that of the United States) applications are published 18 months after filing, whether a patent is granted or not. However, the date from which protection is provided is the date on which the application was first filed, the priority date.

Data should be available for **year of grant** and **country of grant**.

Patent family

The family comprises all the patent documents covering the same invention. As a rule, a patent family consists of the priority application to a national office and equivalent foreign versions of the application. The first patent publication for a family entered in a database is called the basic record.

In fact the expression "patent family" is only used in those databases which collect information from more than one patent office, such as WPI(L), INPADOC and EDOC.

In other words, the **"basic record"** corresponds to an invention which, being wholly new, is unknown to the database concerned. "Equivalents" cover the same invention as the basic record. "Basic" and "equivalents" are indicated by the same priority number.

3.2 Patent classification systems

Inventions are classified by one or more symbols, so that patents belonging to a given technological field can be filed and retrieved.

3.2.1 The International Patent Classification

As mentioned above, some system is necessary for accessing the technical information contained in published patent documents. In view of the worldwide dissemination of patent information, a single international system has proved to be necessary. This is the International Patent Classification (IPC), which is applied by 52 countries and four international organisations. Its symbols are printed on published patent documents.

IPC entered into force in 1975, under the Strasbourg Agreement of 1971 which determined its principles and form of operation.

a) Principle

IPC is a retrieval system for inventions claimed in patent documents and for certain significant information only available in descriptions. IPC is designed so that each technical object to which a patent relates can be classified as a whole. A patent may contain several technical objects and therefore be allocated several classification symbols.

An invention is normally classified according to its function or intrinsic nature, except when its application alone determines its technical characteristics. The distinction is an abstract one, and may usefully be illustrated. In IPC, subclass FO2K is a product-oriented subclass which contains all jet propulsion plants. But subclass HO3K is a function-oriented subclass covering the whole range of pulse techniques and contains many different products, including telephones, transmitters, computers and measuring devices. As a result, subclass HO3K is not confined to a single application or product group, whereas subclass FO2K fits almost exactly one specific product group (group 714 in the Standard International Trade Classification, Revision III). IPC is a combined function/application classification system in which the function takes precedence.

b) Structure

IPC is a tiered structure in which all techniques are classified in sections, classes, subclasses, groups and subgroups. Each subgroup may be further subdivided. It contains about 64 000 entries, each represented by an alphanumeric symbol corresponding to one of the tiered divisions in the classification plan. Table 2 illustrates an example.

Table 2. **Main characteristics of IPC**

Heading name	Heading number	Code Letter	Code Label
Section	8	G	Physics
Sub-section	20	G0	Instruments
Class	118	G06	Computing Calculating, Counting
Subclass	616	G06F	Digital Computers
Main Group	6 871	G06F-009/000	Program control devices
Subgroup	57 324	606F-009/046	Multi-Programming

Every patent document receives one or more classification symbols corresponding to the invention claimed in the application. So that the classification can be understood, the designations of the various IPC symbols are defined by IPC entry labels. Coding rules, applied generally or locally, have also been established.

Examiners have precise instructions on how to classify a claim in accordance with the technical description. Some countries have added classification symbols for information contained only in the description, which might nevertheless be of use to the researcher. Some countries, too, classify only at subclass level (4 digits, e.g. A61K), but most allocate full classification symbols to every document (e.g. A61K 6/083) (9).

c) Updating method

The International Patents Classification is revised and if necessary amended every five years, but not retroactively. The 5th Revision, in force in 1993, is from 1990. A patent indicated by symbols which have subsequently been amended is not as a rule re-indexed in accordance with the new symbols. For a search to be as exhaustive as possible these changes must be taken into account. In particular, the relevant versions of the classification should be used for a study covering a number of years. Annex III-B presents a short extract from IPC to give an idea of how complex such a classification must be (10).

IPC has been modified in a number of ways to produce other technological nomenclatures. Instances are classifications produced:

-- by Grupp and others at the Fraunhofer Gesellschaft-Institut für Systemtechnik und Innovationsforschung (FhG-ISI, Germany);

-- more recently by the French Intellectual Property Institute (INPI) and the Observatoire des Sciences et Techniques (OST). A new classification is given in Annex III-A. It is based on the combined work of INPI-OST and FhG-ISI.

These nomenclatures consist of a number of technology fields defined by IPC symbols. The fields as defined differ appreciably from the IPC classification pattern. They are constructed with the aim of forming homogeneous technology groups with similar volumes of documents in such a way as to reflect recent developments in a more up-to-date fashion than other conventional classifications would permit. The nomenclatures thus defined are intended to be applicable internationally and all adjustments are made with that purpose in view.

3.2.2 The United States classification

Although IPC is an international classification system, some patent offices prefer to use one of their own. This applies in particular to the United States Patent Office, which classifies patent applications filed with it in accordance with USPOC, the United States Patent Office Classification. Although this is a national classification, the United States patent system is so important that USPOC has become internationally significant. Another factor is the concordances established between the USPOC classification of patents by technologies and the SIC classification by product groups.

a) Principle

USPOC is a technology-based classification but its pattern differs somewhat from that of IPC. The reason is that USPOC classifies patents in accordance with the technology as it appears in the patent claims (it is what a patent claims that determines what the patent will protect by law). In IPC, conversely, patents are classified in terms of the technology associated with the invention (not only what the patent claims, but also certain information contained in the patent document itself). As a result, USPOC is seen as being geared more to function, i.e. towards the intrinsic characteristic of products or processes, attempting to give a picture of the state of the art. In mechanical engineering, for example, the US system is generally more function-oriented. This is not the case, however, in all areas of technology.

b) Structure

USPOC also has a tiered structure but it is different from the IPC structure. USPOC consists of three main patent groups (chemicals, electricals, machinery). The three groups form 415 classes, which are themselves subdivided into 127 000 subclasses (or twice as many codes as IPC). However, the tiers are not discernible from USPOC classification codes and for analytical research purposes the structure is less convenient than that of IPC.

c) *Updating*

The USPOC classification is revised every month, and so provides an up-to-date view of the state of the art. Patent classifications are updated simultaneously to incorporate successive amendments to USPOC, so individual patent classifications correspond to USPOC's most recent revision. The more frequent updating compared to IPC is due to the greater flexibility of a national system, in contrast to an international one where long procedures are necessary to reach agreement.

d) *Correspondence between IPC and USPOC*

An IPC/USPOC correspondence table has been drawn up so that United States patents can be classified in terms of IPC. But some serious matching problems have arisen because of the two systems' different characteristics and updating methods. The introduction of cross-references in USPOC further increases the difficulties of IPC/USPOC correspondence. The difficulty is especially conspicuous when assigning United States patents to IPC groups and subgroups (research by Stiller - 1987-A - suggests an "error" rate of 52 per cent). To avoid this kind of inconsistency it is therefore advisable to work with subclasses or at some more aggregated level. For work at more detailed levels, concordance needs to be checked carefully for accuracy.

3.2.3 Selected special classifications

Alongside the patent office classification systems, some database operators have produced classifications of their own. Two may be mentioned here:

-- the WPI(L) classification produced by Derwent Inc. Each patent abstract is assigned to one or more "Derwent classes" according to subject area, regardless of the patent's original IPC, USPOC or other national classification;

-- the classification under 80 main chemistry headings devised for the Chemical Abstracts database (CAS). In this database of chemistry-related scientific literature and patents, every abstract (publication or patent) is assigned to a "CAS section".

These classification systems obviously have different logical patterns since they are not designed for the same kinds of application as the IPC and USPOC systems.

3.3 Patent databases

Patent offices can always be consulted for the kind of information discussed above, but with the new electronic and computer technologies of recent years it has become possible to develop large databases, already including well over a hundred for patent data, that can be interrogated on-line via servers such as QUESTEL, ORBIT, DIALOG and DIMDI. These databases take information from patent documents and format it over various "bibliographic fields", some even working it up to produce additional data as a basis for special forms of investigation. The front pages of the patent documents filed in seven patent offices are given in Annex I.

Some of these databases can be really effective interfaces between analyst and patent document. Individual features may make some more suitable than others for particular kinds of investigation. Specimen extracts from five databases are given in Annex II.

3.3.1 The WPI(L) database

WPI(L) is owned by Derwent Incorporated. It covers all patent documents published since 1963.

Two very important features of databases are their geographical and thematic coverage. WPI(L) is one of the multidisciplinary international databases, scanning material from 30 national patent offices.

WPI(L) groups patent documents by family, so that there is only one record per family, and indicates the number of documents in each. As mentioned in section 3.1, a family is a set of patent documents all related to one invention, the link being the priority patent (11), showing the geographical extent of an invention's protection.

Derwent makes some of the more detailed information it holds, such as the "manual" or "fragment" codes, available to subscribers only, i.e. to firms paying for supplementary retrieval facilities. Other data can be accessed on-line by all users. We now consider some of these data.

For each patent family, WPI(L) derives a title from the text of the basic patent. Furthermore, WPI(L) provides each patent family with a "standardized title" telescoping all the important words of the title by omitting prepositions, "the", "a" and "an", etc. The standardized title becomes a kind of list of keywords characterising the patent family. WPI(L) also produces an abstract for each family and creates a "use/advantage" field for what WPI(L) regards as the inventor's most significant claims. On the classification side, WPI(L) takes the IPC codes for the documents constituting each family. As we saw in the discussion of classifications in section 3.2.3, every patent family is indexed by one or more Derwent codes, in addition to the IPC codes, as a way of synthesising technological information more effectively than would be possible just by combining IPC codes.

All this indicates that WPI(L) attempts to provide the best possible representation of the invention regarded as a common denominator for documents in the same family.

As mentioned above, patent office examiners consult not only other patents but also scientific publications, books and reports in determining whether or not the application under consideration is novel. For each patent family including European and PCT patents, WPI(L) lists some of the documents that examiners have referred to in their search reports. These are called "patent citations", not quite accurately, and as we shall see below they partially reflect the linkages between one technology and another and also between technologies and scientific knowledge. For several reasons, though, scope for using WPI(L) citations is rather restricted:

1) WPI(L) provides on-line citations only from 1978 (the year in which the European and PCT systems were introduced) onwards;

2) WPI(L) does not provide all the citations made by all patents in a family. Only families including patent applications filed with the European Patent Office or via PCT contain such information. Derwent in fact transcribes the data from search reports;

3) for scientific publications, papers and reports cited in patents, WPI(L) only gives the number. Bibliographical data for this material (titles, authors, etc.) have to be sought by more intensive retrieval, first in other patent databases and then in science databases.

In conclusion, the WPI(L) database is very useful for constructing patent indicators in an international context, because it covers applications to and grants by over 30 national patent offices. In view of the efforts by Derwent analysts to produce relevant textual information (titles, abstracts), the database provides a different approach to patent content from the classification code approach. However, a weakness of WPI(L) is that it still gives no indications of affiliation (especially the countries of inventors and filing companies).

3.3.2 The EPAT and PCTPAT databases

The Munich Convention establishing the European patent laid down rules for drafting the application and for the various procedures subsequent to filing. Main data for each European patent are recorded in INPI's EPAT database (coverage: 1978 onwards), which is updated weekly.

It contains information about the technological content of inventions together with the administrative and legal history of every published patent application. One of its special features is that it provides the titles of applications in all three official languages of EPO (English, French, German), the abstract in the official language used for filing (since 1988), and the complete text of the first claim (since 1991 only). Each application's history (withdrawal, grant of patent, rejection, lapse, etc.) is reported, and updated regularly. The database lists affiliations (full addresses, and hence countries) of inventors and filers.

The EPAT database provides access to technological data for inventions for the purpose of building up various technology indicators for the European patent. Furthermore, a feature of this database is that it also provides data, via a variety of retrieval procedures, for the patent's history throughout the grant procedure and even afterwards.

In Chapter II we referred to the Patent Co-operation Treaty (PCT), or Washington Treaty, which makes it easier to obtain protection for an invention in all the signatory countries. Increasing use is being made of this facility. As a result, the main data for PCT applications are now being recorded in a special PCTPAT database produced by INPI, which was put on-line in 1992. It is updated every fortnight. This database contains all PCT applications since 1978, but the information is only complete in all fields for applications since 1983. It gives titles and abstracts of applications in English and in French. Like EPAT, PCTPAT gives full addresses of inventors and filers.

The EPAT and PCTPAT databases give both the international classification (IPC) and the European classification (ECLA).

3.3.3 United States databases

Patents filed in the United States (i.e. with the US Patent and Trademark Office) can be accessed via two databases, US PATENTS and CLAIMS. Under the United States system, as we have seen, an application is not published unless a patent is granted, so only successful applications can be accessed via the US PATENTS or CLAIMS databases.

a) The US PATENTS database

Derwent Inc. in fact produces one database, called USPB, for patents published between 1970 and 1981, and another, USPA, for patents from 1982 onwards. There is also a full version from 1970 onwards called USPM.

The US PATENTS database offers the fullest bibliographical information about United States patents. As well as abstracts and the full text of all claims, it also gives additional "front page" details. All examiners' citations of other patents and science and technology literature are reported. Nationalities of inventors and companies filing are indicated alongside their names. Documents are indexed in great detail using USPOC and IPC classification codes.

b) The CLAIMS database

The CLAIMS database is produced by IFI/Plenum Data Corporation (USA). Its main advantage is its extensive time cover. For example, it includes chemicals patents going back to 1950.

CLAIMS gives patent abstracts and main claims, but does not provide details of priority or the nationality of the inventor or filing company. As in US PATENTS, documents are indexed using USPOC and IPC classification codes.

The CLAIMS database has certain extensions, in particular one for chemical compound uniterm searches, and another for searches on additional chemistry-related topics.

An important difference between the US PATENTS and CLAIMS databases relates to the updating of USPOC classification codes: the US PATENTS database only gives the initial version of the code assigned to each patent, whereas documents in CLAIMS are reclassified every time USPOC codes are updated.

c) The TAF (Technology Assessment and Forecast) database

Yet another kind of database for United States patents is being produced as part of the United States Patent and Trademark Office's TAF programme. This database gives bibliographical details for United States patents issued since 1963. It is not accessible on-line, however; it has to be purchased from USPTO for local mode use.

3.3.4 Other patent databases

a) INPADOC

The INPADOC database is produced by the International Patent Documentation Centre, Vienna. It covers patent documents from 52 national and international offices. It contains patents filed in leading offices since 1968 and patents from smaller offices since 1973.

INPADOC is comparable with WPI(L) except that it does not group patent documents together into families. It too is a multidisciplinary international database, and its geographical and time coverage are wider. Unlike WPI(L), though, it only indicates its patents by their original titles and IPC codes, making keyword profile retrieval much harder.

b) EDOC

The EDOC patent database is used by the European Patent Office for documents search. It comprises published applications and patents granted in the leading industrialised countries, including European patents and PCT patents. Time coverage is exceptional, with information going back to 1920 for some leading industrialised countries (United States, United Kingdom, France, Netherlands) and even as far as 1887 for Germany. Other patent systems have gradually been incorporated. Since EDOC is an "international" database it permits patent family searching. Every record corresponds to a document as in INPADOC, not to a family as in WPI(L).

EDOC does not contain very much bibliographical information (it omits inventors' names, patent titles and abstracts), but provides date and country of publication and priority. The European Patent Office classifies documents by the highly detailed ECLA system, reclassifying them whenever the ECLA classification is updated.

EDOC is used for very detailed searches by technological field with the ECLA classification and for searches far back through time. Missing details can then be retrieved from databases containing more text.

c) JAPIO

JAPIO contains English-language translations of all unexamined patent applications published in Japan. In particular, titles of all applications are translated, as are abstracts of Japanese filers' applications. Produced by the Japan Patent Information Organisation (JAPIO), this database covers patents applied for in all significant technological fields from 1976 onwards. Patents are classified using both IPC and Japanese classifications.

3.3.5 Patent bases on-line and on CD-ROM

a) On-line databases

Databases which can be accessed electronically on servers are on-line databases. Until recently this was the only way to access patent data electronically, notably for prior art searches or to establish statistics. Some of the most important databases we have mentioned are available on-line [WPI(L), EPAT, CLAIMS, JAPIO, and others].

b) Databases on CD-ROM

Trends in information technology now allow other means of accessing patent data in text and even picture form. A number of patent databases are now available on CD-ROM, including some of those we have mentioned above [CLAIMS, WPI(L), and others], sold by the companies which provide the on-line services.

A range of other CD-ROM products are also on sale. EPO has a number of products on CD-ROM with information on European patents, such as ESPACE-FIRST, ESPACE-ACCESS, each with its own specific coverage. WIPO recently brought out IPC:CLASS (International Patent Classification Cumulative and Linguistic Advanced Search System) on CD-ROM, in conjunction with the German and Spanish patent offices. IPC:CLASS is essentially a simple IPC search tool. For example, for a search (in English and in French) of patent documents filed since 1980, the CD-ROM replaces three printed IPC editions (each one comprising nine volumes), the catchword index and the revision concordance list. Other distributors sell data from other patent systems on CD-ROM.

The advantage of CD-ROM is its ease of use. A researcher needs no outside connections, and can work with simply a CD-ROM reader plus a microcomputer. Initial expenditure on the equipment may be relatively high, but it will be less than the cost of multiple connections to database servers. In addition the CD-ROM comes with query software which assists bibliography searches (for prior art searching, for example).

CD-ROM databases do have some drawbacks, however. At the moment one problem is with updating. As the on-line bases (on servers) are updated weekly, the information on CD-ROM very rapidly becomes out of date, at least for certain types of analysis. Another problem is that the query software supplied with the disks is not as powerful as the software developed by service companies, and statistical series are not easy to compile.

To sum up, CD-ROM databases are very convenient for documentary searches. Using multimedia, searches can also be made for images. But they are not yet suitable for more statistical applications. It is possible to create files of information selected from CD-ROMs on a given topic, store them on a microcomputer and then conduct the desired analysis.

3.3.6 Conclusion: the right database for the job

The above survey of databases is by no means exhaustive but it does show that some can be more useful than others, depending on the kind of investigation in hand. This part of the Manual ends with a brief summary of the main categories.

a) The different kinds of patent database

Two broad families can be distinguished: databases deriving from a single national or regional patent office, and those combining information from several offices. The two families require slightly different search and retrieval procedures.

1) National and regional databases

Within this class of database two other important distinctions may be required, depending on what kind of indicator it is hoped to construct, to reflect differences in breadth of coverage for the database concerned:

i) *Databases whose scope is national only*: these refer exclusively to applications filed with a given country's patent office.

Examples are FPAT for applications filed with the French office (INPI) and PATDPA for applications filed with the German office.

ii) *National and/or regional databases with international coverage*: examples are EPAT, PCTPAT, and the United States patent databases.

2) International databases

These are produced not by national offices but by independent operators such as Derwent and international agencies like WIPO. They collect information from a number of national offices, combining applications published and patents granted by national and regional patent offices. WPI(L) and INPADOC are examples. It is especially these international databases which utilise the patent family concept discussed earlier.

b) Choosing a database

Depending on the purpose in hand, choice of database may be governed by a number of criteria, some purely technical, others relating to the nature of the task:

i) a user interested in technologies developed within any one country's boundaries will go for a national database covering all that country's inventions;

ii) if he is concerned with technologies of worldwide interest, he will choose national or regional databases that are international in their coverage, though only for inventions of some economic or commercial significance, because they derive their data from patenting systems that are more internationally oriented;

iii) for a global view of world technology output, he will choose an international database for an instant appraisal of which countries are working on the technology concerned.

Some more technical criteria may have a bearing, since some databases provide material not available from others, such as inventors' and filers' addresses, or textual data. It can then be appropriate to use several databases in parallel, retrieving such information as each can provide. Database servers usually provide facilities for such cross-searching.

This overview of the databases available may be concluded by stressing their importance nowadays as essential tools for analysing and processing the scientific and technical literature.

Table 3 summarises the major databases at present, much used for bibliometric and statistical purposes.

Table 3. **Major databases available on main servers**

QUESTEL	ORBIT	DIALOG	STN
WPI(L)	WPI(L)	WPI(L)	WPI(L)
(CAS)*	(CAS)*	(CAS)*	(CAS)*
EPAT	--	--	--
EDOC	--	--	--
JAPIO	JAPIO	--	--
PCTPAT	--	--	--
--	CLAIMS	CLAIMS	IFIPAT
--	US PATENTS	--	--
--	INPADOC	INPADOC	INPADOC

Patent information centres represent a special type of database. The libraries of patent offices, or local patent depository libraries, stock patent documents in paper or microfiche form, and recently on CD-ROM, classified by IPC groups or subgroups. The full text of the documents is thus easily accessible to the general public. These documents can be used for establishing Manual statistics. The full text of patent documents is often important for the correct interpretation of unannotated patent statistics.

CHAPTER IV

PATENT INDICATORS IN THE ANALYSIS OF SCIENCE TECHNOLOGY AND THE ECONOMY

From the information available in patent documents, indicators are produced for the analysis of technological activities, offering a clearer understanding of the inventive and innovative process. Chapter IV considers some of the more important indicators currently in use, the kinds of question they may be able to answer, and some inherent limitations.

4.1 Technology output indicators derived from patents

4.1.1 Technology indicators: definition and use

Patent documents contain impressive amounts of information of various kinds: about technology, markets, relations with other types of data, and so on. All this information is first processed by the producers of patent databases which, as we have seen above, sort the information into different areas according to content. This makes the information easier and quicker to access.

Some questions, though, cannot be answered merely from qualitative descriptions of technologies (content of one or more patents) but will also require a more quantitative kind of processing. Such statistical processing produces indicators which provide information on patterns of technological activity at different levels of aggregation. A number of indicators of this kind have been produced, ranging from simple patent counts to more complex indicators linking technology fields, or technology and science, or technology and R&D, or -- more broadly -- technology and economic activity.

Patent data can be combined with several other indicators, including indicators for R&D spending (as defined in the Frascati Manual, OECD 1992a-C), indicators for innovation (as defined in the Oslo Manual, OECD 1992b-C) and indicators for technology flows, (as defined in the TBP Manual, OECD 1990-C). However, patent data offer more specific indicators, at different levels of aggregation and detail, for a type of activity or a sector of technology, and it is with these that we shall be concerned here.

The reliability of patent data as an indicator of technological innovation has been illustrated by a number of surveys, showing that a large proportion of firms' inventions are patented and that a large proportion of patents become innovations with an economic use. Furthermore, patents give a good picture of invention and innovation in small firms and in the production engineering departments of large firms, something that R&D indicators alone do not properly measure (12).

Patent data can be aggregated and analysed in a number of ways, including:

1) patenting by type of inventor, by firms or groups of firms;
2) filings in one or more fields of technology;
3) the patenting activity of a country or a region;
4) patenting patterns over time.

Those four basic modes can be variously combined, depending on the purpose of research needs, but they call for different approaches, and caution in using and interpreting the results. In methodological terms there is a considerable difference between analysis of patenting at country level and at firm level. These two aspects will be examined separately at some length.

4.1.2 Patent counts

The simplest type of patent indicator is derived merely by counting the number of patents which satisfy one or more criteria. Before discussing analyses based on patent counts, however, we may usefully consider the main methodological questions mentioned in Chapter I.

Patents do not all have the same technological and economic relevance, nationally or internationally. Whether a firm takes out a patent reflects not only the kind of business it is in, but also its own technical and marketing strategies and therefore the markets it wishes to reach.

Some fields of technology lend themselves better to patenting than others. In electronics, for example, the patenting process may not keep up with fast-moving technological advance, so a firm may prefer to keep its inventions secret rather than seek patent protection (13). Some types of invention, such as software, are protected under copyright rather than patent law. In other fields (chemicals and engineering, to cite just two leading areas), filing for a patent is the usual way for a firm to protect itself in the market.

This limitation also influences the interpretation of international comparisons between sectors. One country may concentrate on a field such as chemicals where patenting is the most effective means of protection, whereas another focuses on a field such as aviation in which patenting is less prevalent.

The classification of patents may also be a source of problems. Classification systems are updated frequently. A leading-edge invention can be hard to classify precisely because patents in fast-evolving technological fields do not always fit into any pre-established class. Then it is best, so far as possible, to work with the most detailed and regularly updated system, such as USPOC for United States patents or ECLA for European ones, or to use keyword searches.

Certain other limitations are administrative in nature, but may have their significance. A wide swing in the patent grant statistics may be an administrative artefact, stemming from fluctuations in the administrative processes of patent review. For example, a fall in the number of patents granted in the United States in 1979 was not due to a reduction in patent filings, but simply to lack of funds for printing patents.

Bearing these methodological problems in mind, we may now consider three key questions for appropriate use of patent counts.

a) How can patents be counted?

Two or more inventors may make a joint application for a patent. If the inventors are of different nationalities, some analysts suggest "sharing" the patent among the various countries concerned. In measuring a country's patent output this results in fractional counting. As an example, when four inventors of different nationality file jointly for a patent, one-quarter of that patent is credited to each of the countries concerned.

The same fractional cunt may be used for attributing patents to different fields of technology. As mentioned above, output for a field may be assessed via the number of patents bearing the relevant classification code, but some patents have more than one code. In such cases, equal fractions of the patent can be allocated to each field.

When patenting by type of inventor is investigated, fractional counts can be used to assign patents to the different groups considered (firms, universities, government laboratories, individual inventors and so on).

It should be noted that, especially at country level or for large aggregations of patents, the findings are much the same whatever method is used.

b) Which patent institution should be considered?

Patent counts lead to different results according to the patent institution where patent activity is considered (already noted in Chapter I, paragraph 21). An inventor will usually file for a patent with his own country's patent office, and often with that office alone. As a result the country is over-represented in its own patent office, due to what can be called "home advantage". The extent of this home advantage can be estimated by comparing patenting activity in national and foreign institutions and matching patent indicators to other R&D and technology indicators (Schmoch and Grupp, 1989-B).

One way to overcome this bias is to consider only those patents which the country's inventors and companies have filed abroad. This approach is based on the assumption, often borne out in practice, that the important patents are the international ones.

Possible courses here include the following:

- an international patent institution such as the European Patent Office can be considered, rather than a national office. It should be noted that European and especially German activity is over-represented at EPO, relative to US and Japanese patenting; the bias is lower than with national patent offices, however;

- the activity of two countries (or firms in different countries) can be compared in a third market; typically, European comparisons have been conducted on the basis of patenting in the United States;

- patent data from the major world offices (USPTO, EPO, JPO) can be combined, considering only the patents applied for (or granted) in all three institutions.

The choice of the patent institution to be considered may lead to widely different results in the description of the patenting activity of individual countries (see Table 7 below).

c) Patent data by country of origin and type of inventor

The specific nature of the different types of patent statistics should also be remembered. As mentioned in the glossary in Chapter III, patent applications can be classified in several ways:

-- the number of resident applications (RA) can be regarded as reflecting the country's invention output;

-- the number of non-resident applications (NRA) provides information on the extent to which the country is considered a worthwhile market for the introduction of foreign inventions, or a serious competitor in technological activity, prompting foreign firms to use patenting as a tool in their competitive strategy;

-- the number of external applications (EA) may be regarded as an indicator of the interest of a country's firms in safeguarding the return from their inventive activity in foreign markets.

The types of inventor should also be considered. They include firms, government agencies, universities, non-profit institutions and individual inventors. In most countries, individuals and non-profit institutions have a lower interest in protecting their scientific and technological output with patents.

Filing statistics provide a broad picture of technological activity. Such statistics are often used for comparison between countries, regions, sectors and so on. The long time-series available enable us to follow technological trends over a fairly long period and to analyse the technological activity of the country, region, sector or firm concerned. As technology indicators evolve over time, they provide information about the different positions a country or a firm has taken up.

Now that some of the basic methodological questions to do with counting and interpreting patents have been clarified, we may examine the use of patent statistics as an indicator of the technological activity of countries and firms.

4.2 Analysis of countries' patenting activity

4.2.1 Cross-country comparisons

The two tables below show how patent indicators at country level can be used in comparisons over time and across fields of technology. Table 4 shows the total number of patents filed by selected countries in the European Patent Office over a fairly long period. Table 5 provides a breakdown of national patenting in major fields of technology, using the nomenclature developed by INPI-OST/FhG-ISI. More refined levels of sectoral disaggregation can be obtained, depending on the classification used.

Table 4. **Patent applications with the European Patent Office by selected countries**

COUNTRY	**1982**	**1985**	**1988**	**1991**
EUROPE	17 703	21 280	26 594	24 825
EC	13 313	18 012	22 890	21 527
France	2 632	3 357	4 257	4 353
Germany	6 313	8 567	10 763	10 163
United Kingdom	2 331	3 017	3 611	2 666
Italy	723	1 238	1 847	2 034
Other West European countries	2 257	3 089	3 504	3 122
East European countries	131	179	200	177
North America	7 622	11 100	13 695	13 081
Canada	239	377	512	383
Far East	3 557	6 079	9 182	11 633
Japan	3 512	5 985	9 032	11 371
NICs	31	55	106	216
Other Far Eastern countries	14	38	45	46
CIS	1	11	88	191

Source: OST - EPAT bibliometric data.

Table 5. **Patents filed with the European Patent Office in certain fields of technology, 1991**

	Electricity Electronics	Instruments	Chemistry Pharmaceuticals	Process engineering	Mechanical Engineering Machinery	Consumer goods Civil Engineering
Europe	3 409	2 553	3 273	3 358	5 382	2 101
EC	3 060	2 185	2 874	2 850	4 697	1 765
France	788	479	561	493	973	373
Germany	1 265	1 078	1 382	1 468	2 318	835
United Kingdom	371	238	326	317	430	143
Italy	223	189	265	284	544	242
Other West European countries	301	328	330	471	633	309
East European countries	10	8	41	19	20	10
North America	2 831	1 794	2 180	1 486	1 556	496
United States	2 784	1 758	2 144	1 422	1 517	462
Canada	47	36	36	64	39	33
Far East	3 769	1 745	1 808	1 130	1 465	298
Japan	3 686	1 726	1 772	1 105	1 433	256
NICs	76	16	15	18	28	38
Other Far Eastern countries	7	3	21	7	4	4
CIS	8	11	3	8	11	9

Note: The technology nomenclature is given in Annex III-A.

Source: OST - EPAT bibliometric data.

Data for individual countries can also be expressed as a percentage of total patenting in the European system (or in another patent institution). Table 6 shows world percentages of patent filings (all fields of technology) in the European Patent Office. Within a particular patent institution, data shown in Table 6 can identify the relative changes in countries' patenting activity over time; for instance it shows that Asian countries are increasing their share of European patents, while Europe and North America are reducing their large shares.

However, an individual country's share of total patenting will depend on the relevance of the particular patent institution for that country. Table 7 shows how different a country's shares of total patents (either applications or grants) can be, depending on the patent institution used for the analysis. The United States, for example, accounts for 56 per cent of all United States patents granted, 26 per cent of EPO applications, and less than 8 per cent of patents granted by the Japanese patent office. The last column of Table 7 shows the shares of the citations a country's patents in the United States have received from later patents, an indicator of the impact of patented inventions discussed in section 4.3.1. Countries' shares do not change significantly, with the United States and Japan showing a higher share than in patent counts, and European countries accounting for a lower share of patent citations.

National patenting activity depends on institutional factors, the nature of the legal system and many domestic factors, including the size of the population and the economy, the size of its R&D and research community and the technological infrastructure. Data on patent counts can be divided by these demographic, economic and research variables, producing patent indicators which are independent of the size of countries and can offer some information on the comparative patent 'productivity' (in relevant patent institutions) of countries (14).

There are some problems associated with the linking of patents to individual countries. The patent's nationality may be that of the inventor or it may be the nationality of the country of first filing. Other statistics may also be taken into account. For example, reports by the US Office of Technology Assessment and Forecast (OTAF) present US patent statistics by origin of filer. They distinguish patents of United States origin from those of foreign origin, and within each of these categories they further distinguish whether applications are from government agencies, firms or individual owners. Other leading patent offices and organisations (INPI, WIPO) produce similar statistics.

Countries' patenting activity can also be investigated, breaking down national data by region, in order to investigate the geographical distribution of technological activities. The main methodological problem here is how to assign individual patents to regions in a way that reflects the presence of inventive activity. Usually patents are assigned according to the address of the inventor or the firm which owns the patent. Patenting data can also be related to a variety of variables which describe the demographic, economic and social characteristics of regions (see Boitani and Ciciotti 1992-B; OST 1993-B).

4.2.2 The sectoral specialisation of countries in patenting

The sectoral structure of countries' patenting activity can be investigated using a measure of specialisation relative to other countries. The most frequently used indicator is called the "specialisation index" or "activity index" or "Revealed Technological Advantage" (RTA), and is defined as the share of a country (i) in patents in a given field of technology (d) filed with a given institution, divided by the country's share of all patents in that institution.

Table 6. **World percentages of patents filed with the European Patent Office for selected countries**

COUNTRY	1982	1985	1988	1991
Europe	57.5	54.3	52.9	48.8
EC	48.7	46.0	45.5	42.3
France	9.6	8.6	8.5	8.6
Germany	23.1	21.9	21.4	20.0
United Kingdom	8.5	7.7	7.2	5.2
Italy	2.6	3.2	3.7	4.0
Other West European countries	8.3	7.9	7.0	6.1
East European countries	0.5	0.5	0.4	0.3
North America	27.9	28.3	27.2	25.7
United States	27.0	27.4	26.2	25.0
Canada	0.9	1.0	1.0	0.8
Far East	13.0	15..5	18.3	22.9
Japan	12.9	15.3	18.0	22.3
NICs	0.1	0.1	0.2	0.4
Other Far Eastern countries	0.1	0.1	0.1	0.1
CIS	0.0	0.0	0.2	0.4

Source: OST - EPAT bibliometric data.

Table 7. **Patents registered by selected countries in the main patenting offices**

(Percentage distribution of patents registered in selected patent offices by country of origin)

Countries	EPO 1980-89 applic. %	Japan 1979-87 applic.	granted %	W. Germany 1982-87 applic.	granted %	France 1981-87 applic.	granted %	United States 1979-88 granted	citations %
United States	25.82	4.47	7.86	6.48	13.71	10.79	15.54	56.31	59.86
Japan	15.57	89.42	83.67	9.48	13.85	7.36	9.40	16.26	17.46
EC	47.64	4.50	6.09	75.55	63.03	74.24	62.50	19.47	16.72
W. Germany	23.26	2.28	2.98	71.00	52.74	10.58	15.54	9.41	7.92
France	8.98	0.71	0.99	1.30	3.61	55.88	36.03	3.36	2.98
United Kingdom	7.26	0.68	0.90	1.14	2.16	1.91	3.49	3.55	3.41
Italy	3.27	0.27	0.30	1.25	1.33	3.10	3.31	1.31	0.96
Netherlands	3.22	0.40	0.70	0.59	1.98	1.01	2.58	1.07	1.01
Belgium	0.90	0.06	0.10	0.15	0.29	0.59	0.66	0.37	0.34
Denmark	0.33	0.05	0.09	0.19	0.60	0.36	0.31	0.23	0.17
Spain	0.27	0.03	0.03	0.11	0.28	0.76	0.55	0.12	0.06
Ireland	0.09	(1)	(1)	0.01	0.01	0.03	0.02	0.04	0.02
Portugal	0.01	(1)	(1)	(1)	(1)	0.01	0.01	0.01	0.01
Greece	0.03	(1)	(1)	0.01	0.03	0.01	0.01	0.01	0.01
Switzerland	4.46	0.52	0.82	2.19	3.61	2.05	3.32	1.81	1.50
Sweden	1.63	0.23	0.32	0.67	1.28	0.76	1.58	1.16	0.92
Austria	1.07	0.08	0.12	0.57	1.83	0.60	0.49	0.44	N.A.
Canada	0.91	0.11	0.17	0.15	0.33	0.29	0.42	1.83	1.50
Australia	0.57	0.10	0.08	0.07	0.34	0.25	0.23	0.47	N.A.
EPO countries	54.66	--	--	--	--	--	--	--	--
Others	2.35	0.59	0.87	5.06	2.21	3.66	6.51	2.24	2.04
WORLD	100	100	100	100	100	100	100	100	100

(1) Less than 0.00 per cent.
N.A. = Not Available.
Source: Archibugi and Pianta (1992-C)

The index is equal to zero when the country holds no patents in a given sector, is equal to 1 when the country's share in the sector is equal to its share in all fields (no specialisation), and grows rapidly (the upper limit will depend on the world distribution being used) when a positive specialisation is found. The logarithm of the index is often used to obtain a new indicator, the revealed patent advantage (RPA), with a distribution ranging from -1 to + 1.

Specialisation indicators can be calculated for different periods, to show how countries' specialisation patterns have evolved over time. It should be remembered, however, that such indicators are relative to the world sectoral distribution of patents; if one country holds its distribution of patents steady while others increase their activity in an emerging field, its specialisation index in that field will decline (15).

Table 8 gives specialisation indicators for the United States, the European Community, Japan and the United Kingdom in given technology sectors (again using the INPI-OST/FhG-ISI nomenclature) based on patenting at the European Patent Office in 1990. As already mentioned, the figures must be compared and interpreted with due expertise. The very high (and low) values are straightforward enough -- Japan certainly does specialise much less in consumer goods and civil engineering than the other countries -- but it is not safe to conclude that the United States is more specialised in process technology than the European Community.

Figures 6-a and 6-b show specialisation indicators in another way. Figure 6-a compares data for 1986 and 1991 for the European Community (Schmoch and Grupp 1989-B). Figure 6-b gives another example of specialisation indicators: France and Germany are compared for a given period (1991) for the same technology sectors. The broad patterns are similar, akin to those for the European Community as a whole in Figure 6-a (16). The main differences are in process technology where a positive specialisation for Germany and a negative specialisation for France emerge, while in electronics the German weakness is greater than that of France.

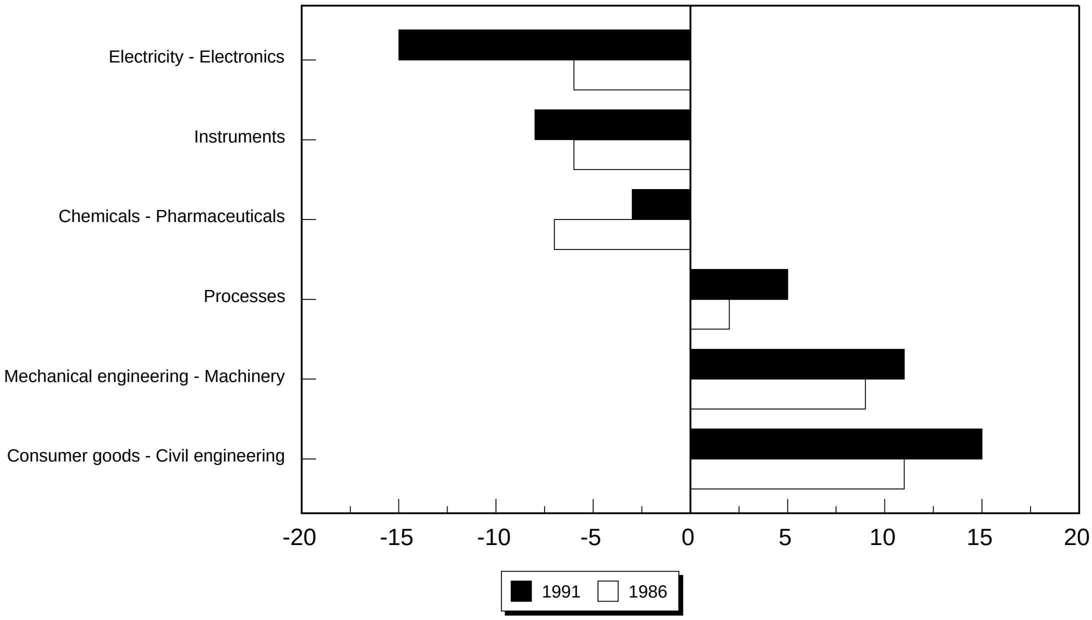
Table 8. **Specialisation indicators (RTA) for selected countries and sectors (Patents filed with the European Patent Office in 1990)**

INPI-OST/FhG-ISI Sector	USA	EC	JAPAN	UK
Electricity-Electronics	1.10	0.77	1.51	0.84
Instruments	1.20	0.85	1.05	1.00
Chemistry-Pharmaceuticals	1.24	0.89	1.03	1.09
Process engineering	1.05	1.01	0.87	0.81
Mechanical engineering-Machinery	0.69	1.28	0.65	1.01
Consumer goods-Civil engineering	0.61	1.37	0.38	1.17

Source: OST-EPAT bibliometric data.

Figure 6a.

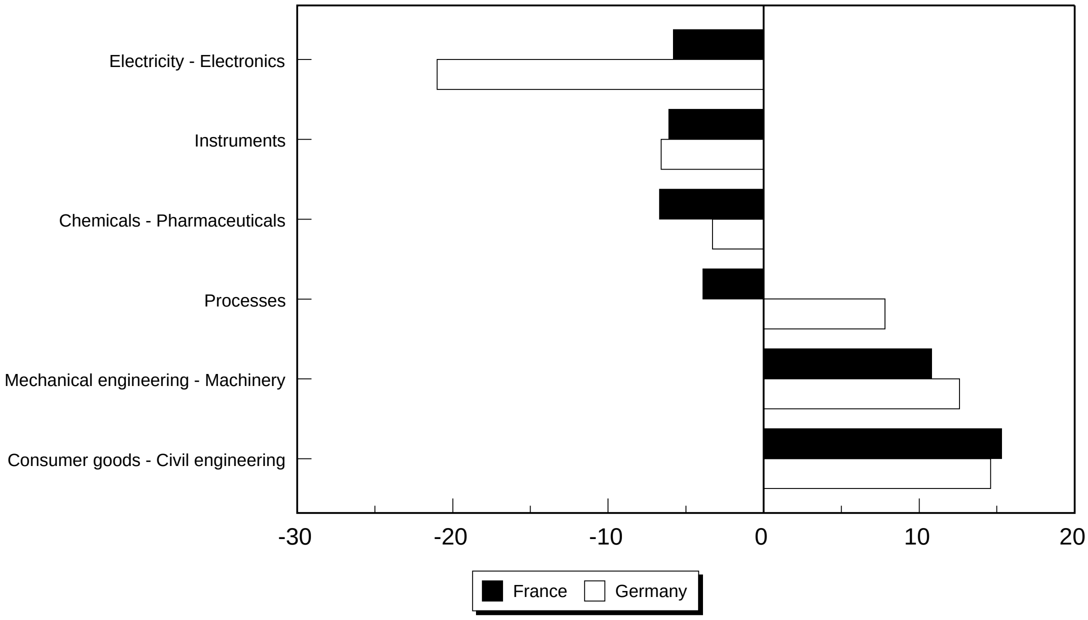
Specialisation indicators (RPA) and trend by selected fields of technology for the EC area



Source: OST - EPAT bibliometric data (patent applications at the European Patent Office)

Figure 6b.

Specialisation indicators (RPA) for France and Germany by technology field, 1991



Source: OST - EPAT bibliometric data (patent applications at the European Patent Office)

4.3 Relational indicators for technology and science

Relational indicators show linkages between patents and other S&T literature, and between patent indicators and other kinds of indicator (economic ones in particular).

4.3.1 Technology linkage indicators

Potential linkages between technologies can be identified in two ways: patent citations of earlier patents, illustrating linkages at a detailed level, and co-classifications which can identify linkages at broader levels.

a) Patent citations of earlier patents

There are two kinds of patent citations of earlier patents: citations by the inventors themselves in the text of their application, and citations by the patent examiner in his search report. Bibliometrists work with examiners' citations, which are the only ones readily available from some databases [WPI(L), EPAT, US PATENTS, etc.]. Inventors' citations are only shown in their applications, but those are not at present accessible on-line from databases.

By looking at such citations of earlier patents we can identify lone patents (those whose inventions receive little follow-up in later patents) and patents cited by a number of later patents. Two-thirds of patents are cited rarely, if at all. A patent more frequently cited than other patents of the same age is regarded as a patent of greater impact, or of higher 'quality'. Citation data on patents of a given year cannot be used until a few years have elapsed, so that a sufficiently large number of new patents can refer to older ones. Citing patterns may also differ across sectors, either in the average number of citations received, or in the average time lag observed. The same statistical analyses discussed above for patent counts can be carried out for the number of patent citations received by a country or a firm. When large aggregations of patents have been considered, mainly at the national and sectoral levels, patent counts and patent citations have shown similar patterns (Archibugi and Pianta 1992-B; Grupp and Schmoch 1992-C).

Patent citations of earlier patents can be used to calculate other indicators, quantitative and qualitative, that are more complex than straightforward counts. The technological links among sectors can be investigated and the relevance of a particular technology field can be examined (using the ratio of citations to patent publications). From links between patents revealed by such citations, it is possible to trace a network of patents corresponding to various technologies which show patents standing at the crossroads of several technologies.

CHI Research, a United States company specialising in science and technology indicators, has produced a citation performance index from very highly cited patents within a class or product field. Its procedure is to compare the most highly cited 10 per cent of patents for a country with those of the world. A ratio of 1.0 means the country's citation performance exactly matches that of the world. The formula for the top decile indicator is Pi/Pt, where Pi is the percentage of country i's patents appearing among the most cited 10 per cent, while Pt is the same percentage for the world's patents.

This indicator is used to measure the impact or "quality" of patents. It is often calculated for fields of technology but can also be calculated for companies (Grupp and Schmoch 1992-C).

b) *Co-classifications*

Another way of establishing technology linkages is through classification codes. This is because one and the same patent may be classified under several headings if it refers to a product or process of concern to more than one technology field. Classification codes show linkages between such fields.

4.3.2 Indicators for technology/science linkages

The best-known technology/science linkage indicators are patent citations of scientific papers, but attention may also be drawn to other kinds of indicators that are currently being investigated and to potential avenues for establishing relationships between patents and written science outputs.

a) *Patent citations of scientific papers*

The usual way of establishing science/technology linkages is by considering patent citations of scientific papers. A patent examiner may also cite patents or scientific papers as they describe the prior art relevant to the patentability of the application. However, some questions have been raised about citing patterns for scientific papers, as they may be affected by the examiner's expertise, the nature of the particular field and a variety of other factors.

For certain technology fields, especially the emerging ones, examiners' citations of scientific papers do seem to be relevant in tracing linkages between technology and science. More exactly, such citations' "weight", both quantitative and qualitative, does attest the extent of the scientific basis for any given technology. At least three indicators can be used to assess that extent:

- numbers of scientific papers cited: the more papers are cited, the closer the linkages between technology and science;
- average lead time between publication of papers cited and patent grants: the shorter the time, the closer the linkages between technology and science;
- types of journal in which cited papers appear: the more such journals publish fundamental research findings, the more fundamental the scientific knowledge on which the patents depend.

b) *Researchers' patent filings and/or scientific publications by inventors*

Collaboration between industry and university can be highlighted by a comparison of patenting and publications by researchers. Patent filings by researchers and/or the publication of scientific papers by inventors are often the outcome of joint research by a firm and a university research laboratory. Statistics calculated from these data show those sectors in which close links and greater co-operation can be found.

This overview of indicators for technology and science linkages suggests that their interpretation often depends on understanding how the industrial and research worlds interact; hence the significance of the strategies that shape agents' R&D policies.

4.4 Analysis of patenting activity at sectoral level

Indicators of patenting activity can be aggregated at sectoral level using a range of criteria. The IPC and USPOC classifications were discussed in Chapter III. They are based on the technical characteristics of the invention, focusing either on its function or on its application. But other criteria can also be used for aggregating patents. Patent classifications can be matched to nomenclatures used for industrial production and trade; patents can be aggregated by sector of use of the invention, and patterns of technological interdependence can be then explored. At firm level, patents are often assigned to the main economic activity of the inventing firm, but large firms in particular patent in a variety of fields which do not necessarily correspond to their main economic activity. These alternative classifications are now examined in some detail.

As patents can be classified by various criteria (sector of origin, main product incorporating the invention, sector of use), matching up with other classifications needs to take that aspect into account. When patents are compared to indicators of scientific activity or R&D, the focus is on the sector of origin of the invention. When patents are used to investigate countries' or firms' performances, the emphasis is on the main product field where production incorporating the invention is carried out. When the contribution of innovation to productivity growth is investigated, for example at sectoral level, attention should be paid to the sectors of origin and of use (although data on the latter are very limited), especially when innovations are hard to protect and widely adopted.

4.4.1 Relations between patent classifications and industrial and trade nomenclatures

Economic analyses, including patent indicators, tend to make use of patents filed in the United States for several reasons:

1) technological activity by industrial countries can be compared on a similar basis from their patent filings in the United States (although data for the United States itself have to be interpreted with care) since the United States is the largest advanced market;

2) in addition to the US office's classification of technology (USPOC), patents are also classified under the Standard Industrial Classification (SIC), from which a correspondence can be established with other economic nomenclatures.

This is possible because the United States Patent and Trademark Office (USPTO) annually updates a correspondence table between its own classification system (USPOC) and the product groups (describing them is pertinent for patent use) based on the Standard Industrial Classification (SIC). It must be borne in mind, however, that the correspondence is made at a relatively aggregated level for industrial classification product fields. As a result, the correspondence is not between class and class: one USPOC class may correspond to several SIC classes. The Technology Assessment and Forecast Office (OTAF) provides two separate reports for the numbers of patents classed by SIC classes, one based on fractional counts (some patents count for less than one), the other based on counting patent by patent.

Table 9 shows the shares of total patents and the specialisation indicators in selected SIC fields for France, Germany and the United Kingdom, based on United States patents in 1989. The RTA index shows positive specialisation by all three countries in aerospace and chemicals, while the United Kingdom has a certain relative strength in pharmaceuticals.

Patent classifications can also be related to nomenclatures comparable to SIC, such as the International Standard Industrial Classification (ISIC), the Standard International Trade Classification (SITC), and NACE. Here again serious problems of concordance arise, although they become less significant at a fairly high level of aggregation.

Work by FhG-ISI in Germany (see Grupp 1991-C) and ENEA in Italy (see Amendola, Guerrieri and Padoan, 1992-C) has developed a correspondence between the US SIC classification and SITC. FhG-ISI has developed a concordance limited to high technology products. ENEA, using a concordance of this type for 38 sectors and considering ten advanced countries, has found that the patterns of trade specialisation are more concentrated than those of technological specialisation, and that both show a strong stability over time. The nature and intensity of the relation varies considerably across countries, however, due to country-specific factors.

In order to rely less on United States patent data and allow greater use of European data, work is currently in hand on establishing correspondences with the IPC classification. In Finland, the Patent Office and the Central Statistical Office have made available a concordance table for converting patent classes (IPC) based on Finnish patent material to industrial classes (SIC of Finland). In Italy ENEA and CESPRI have developed a concordance between IPC and SITC for 46 groups of high technology products. This concordance is shown in Annex IV-A. Research is under way at MERIT, in the Netherlands, to develop a concordance between IPC and ISIC, and at FhG-ISI in Germany on a concordance between IPC and SITC classifications, allowing comparisons between technology on the one hand and production and trade on the other.

4.4.2 The analysis of technological interdependence

Patented inventions can be produced and used in the same firm or sector, or can be relevant for a number of firms and sectors. Patterns of technological interdependence can be studied by matching the sector of origin and the sector of use of the invention, developing the technological equivalent of an input-output table. This makes it possible to identify the fields whose inventions have the most pervasive impact across sectors, those which are more self-sufficient in the generation of new technology, and the major links between suppliers and users of patented innovations. The only institution which systematically collects information on the sector of use of patents is the Canadian Patent Office (17). Annex IV-B presents a table showing the number of patents granted to firms of all countries by the Canadian Patent Office between 1986 and 1989, classified by 31 sectors of production and use (Hanel 1993-C).

4.4.3 Patents and R&D and innovation indicators

a) Patents and R&D

The link between R&D activities -- as measured by indicators of expenditure, number of researchers and personnel involved, and so on -- and patenting is important, as they both represent key aspects of the process for many innovations. While broadly converging results have been found in the distribution of R&D and patents across countries, sectors and firms, some differences should be pointed out. R&D and patent indicators capture different phases and activities of innovation, which are difficult to confine to the definitions of 'input' and 'output' indicators. The type of inventor, the field of activity, the patent policy of a firm and the R&D efficiency and innovation system of a country are all factors which may lead to a greater emphasis and role for one indicator or another. So R&D and patents may well, in some cases, provide diverging pictures of firms' and countries' performance.

Table 9. **Patent shares and specialisation indicators for selected countries in SIC sectors, based on US patents in 1989**

Sector	France		Germany		United Kingdom	
	World %	RTA index	World %	RTA index	World %	RTA index
Aerospace	4.4	1.29	14.3	1.57	4.2	1.27
Electronics	3.3	0.99	4.8	0.63	3.0	0.92
Pharmaceuticals	4.2	1.24	9.0	0.99	6.3	1.90
Machinery-Instruments	3.2	0.96	10.3	1.13	3.3	1.00
Land transport	3.4	1.00	12.9	1.41	3.1	0.94
Chemicals	4.1	1.22	13.1	1.43	4.1	1.24
Other	3.4	1.00	8.5	0.93	3.1	0.93

Source: OST, based on USPTO

One obvious reason for difference is that, as we saw earlier, the classifications of patents and economic sectors are not the same. In addition, firms active in separate fields innovate in classes with different propensities to patent. At country level, differences between R&D and patenting can be due to differences in the institutional system, in the structure of innovative activity and in the pattern of demand (18).

At the country, sectoral, or company level, R&D spending and patent output indicators can be related for the purpose of measuring the economic efficiency of R&D/patent linkages. When attempting international comparisons, variations from one country to another in how R&D operates and is financed can make such measurements hard to interpret. At lower levels allowance has to be made for any special features of particular sectors, for the different propensities to patent which are found across fields, and for the strategies that individual companies may be pursuing. In practical terms, while data on companies' R&D are not always accessible, patents may offer detailed information on firms' innovative activities.

This complex set of links between R&D activities and patenting poses practical problems and raises some theoretical questions as well, especially for the limitations of the R&D-->patents-->market kind of input-output model (19).

b) Patents and innovation surveys

The validity of patent and R&D data can also be tested in innovation counts and surveys (see Archibugi, Cesaratto and Sirilli, 1987-C). Although OECD-Eurostat innovation surveys at firm level do not allow direct linkages between patents, R&D and innovations introduced by companies, case studies do show that in some industries, such as pharmaceuticals, both patents and R&D account for the majority of the innovations introduced.

4.4.4 Patents and indicators of economic performance

The closeness of patents to the outputs of industrial R&D makes their use in economic analysis relevant. For both firms and countries, patent data can be used to investigate technological and economic performances at the aggregate or sectoral level. The case of firms will be discussed in the next section.

At country level, the role of technology as a source of competitiveness can be examined using patent data. Generally, technological efforts, as measured by patents, and economic activity, measured by production or trade, show a broad association both at the aggregate level and in sectoral analyses (20).

4.5. The analysis of patenting activity by firms

4.5.1 Patents and firms' industrial strategies

As we pointed out in Chapter I, patents are applied for when an inventor or firm wants legal protection for the rights to the invention. But there are many other ways in which a firm can secure its position in a market. It may keep its invention secret, or put it too quickly on the market for competitors to have time to react, or price the invention so low as to defy competition, whether for a consumer product or in a professional market. All these may supplement, or substitute for, the protection that patents offer. Firms' stances will depend largely on their protection strategies. Relations between such strategies and patenting can be expressed in a number of ways, of which we now consider three.

The usual reason for taking out a patent is to obtain protection from competition in a given area. Countries to which a firm preferentially applies for patents are the industrial and/or marketing centres it regards as strategic for its activities. This makes it interesting to see which firms apply for patents, first in general across a given system, as in Table 10, then in a specific field (radio transmission, Table 11). Table 10 lists the top 20 patenting firms at the European Patent Office (in the years 1989-91) and at the US Patent Office (in the years 1981-90). While the rankings are rather different, 18 of the 20 firms appear in both lists, providing a consistent picture of the most active firms in international patenting.

In interpreting the data in Table 11 it should be noted that not all firms have the same filing strategy. Considerable discrepancies (such as those between NEC and Sony) clearly reflect different technological strengths and policies. But when the figures are close, very little should be read into the ranking. A list like this, all the same, does give a good picture of the leading firms in a given field. A second point concerns the list of filers: in this sector, and elsewhere, all the subsidiaries of a group have to be considered, not just the parent company.

Table 10. **Leading firms in terms of patents filed with EPO and USPTO**

Applications to EPO (1989-1991)		**Applications to USPTO (1981-1990)**	
SIEMENS (DEU)	1 748	TOSHIBA (JPN)	2 875
IBM (USA)	1 720	GENERAL ELECTRIC (USA)	2 694
TOSHIBA (JPN)	1 426	CANON (JPN)	2 534
CANON (JPN)	1 380	PHILIPS (NLD)	2 348
PHILIPS (NLD)	1 361	GENERAL MOTORS (USA)	2 031
BAYER (DEU)	1 337	SIEMENS (DEU)	1 964
HOECHST (DEU)	1 245	BAYER (DEU)	1 863
BASF (DEU)	1 027	IBM (USA)	1 850
GENERAL ELECTRIC (USA)	884	KODAK (USA)	1 837
MATSUSHITA ELECTRIC (JPN)	846	HOECHST (DEU)	1 618
FUJITSU (JPN)	832	DU PONT DE NEMOURS (USA)	1 528
SONY (JPN)	798	CIBA-GEIGY (CHE)	1 290
KODAK (USA)	762	BASF (DEU)	1 232
HITACHI (JPN)	758	MATSUSHITA ELECTRIC (JPN)	1 019
THOMSON (FRA)	735	ROYAL DUTCH SHELL (NLD)	927
GENERAL MOTORS (USA)	679	SONY (JPN)	864
ROBERT BOSCH (DEU)	652	IMPERIAL CHEMICAL IND (GBR)	911
NEC (JPN)	636	FUJITSU (JPN)	790
DU PONT DE NEMOURS (USA)	636	ROBERT BOSCH (DEU)	708
CIBA-GEIGY (CHE)	622	THOMSON (FRA)	551

Source: OST, based on EPAT-FMN, SPRU-FMN

Table 11. **Firms (and subsidiaries) by applications in radio transmission to the European Patent Office, 1990**

Firm	Patents
NEC CORP.	29
MOTOROLA	28
ERICSSON	25
TELEFON AB L. M. ERICSSON	21
ERICSSON GE MOBILE COMMUNICATIONS HLDG	4
ALCATEL	20
ALCATEL CIT	8
ALCATEL ESPACE	3
ALCATEL NV	3
STAND ELEK LORENZ	3
ALCATEL RADIOTELEPH	1
ALCATEL TESPACE	1
ATFH ALCATEL TRANSM	1
AT&T	13
SONY	5

Source: FhG-ISI, using WPI(L) data

The fields in which a firm takes out patents indicate its technology profile. This can be expressed numerically, as a percentage of the firm's patent filings by technology sector (using an appropriate nomenclature). However, the firm's specialisation profile can usefully be charted by calculating its specialisation indicator in each of these sectors and then seeing how it evolves over time, which will partly reflect the firm's innovation policy decisions or marketing and competition strategies. Figure 7 presents an example of the profile and its trend over time; it is the profile of NEC in the subfield of telecommunications, based on NEC's filings for European patents. The company's technology policy has been fairly constant over time: it is highly specialised in certain subfields, especially radio transmission (RT in Figure 7), but not in others, such as optical transmission core and environment. For terminals, the lack of specialisation between 1981 and 1983 is gradually being offset.

Comparison of fields in which a firm takes out patents and the sectors in which it trades will provide information about its industrial and economic strategy. The difficulties involved have already been mentioned. Comparisons nevertheless give a picture of the "technology content" of the sectors in which the firm trades and, symmetrically, of the "economic weight" of the technology fields. Here, CHI

Research has recently developed a database, TECH-LINE, for 1 100 of the largest firms most actively filing for United States patents in three technology fields, chemicals, electricals and pharmaceuticals. At the level of the firm they propose a wide range of indicators (for more details, see note 21) permitting comparisons of technological and economic dimensions:

- simple counts: numbers of patents, numbers of citations;
- indicators of specialisation (or indexes of activities);
- indicators of the impact of patent citations (CII) which allow identification of the "total technological strength" (TTS) of a firm and also its relative strength;
- indicators of the relationship with science, referred to as "science linkage" (SL), which covers articles cited in patents;
- indicators of the position of the firm; the life cycle of a technology (TCT).

These indicators, initially developed within the framework of TECH-LINE, are also applicable at national, regional or even worldwide level.

Many other paths are being explored to investigate linkages between patent-measured technology and the economy. For example, many investigators have sought to map out areas in which patent-described technologies are circulating. One outcome has been the development of taxonomies for classifying technologies not just in terms of what they themselves do, but by whom they are used and were invented, adopted and disseminated as well. All this suggests that accounting for linkages between patent-described technologies and economies will often involve using a range of indicators.

4.5.2 Patenting and industrial structure

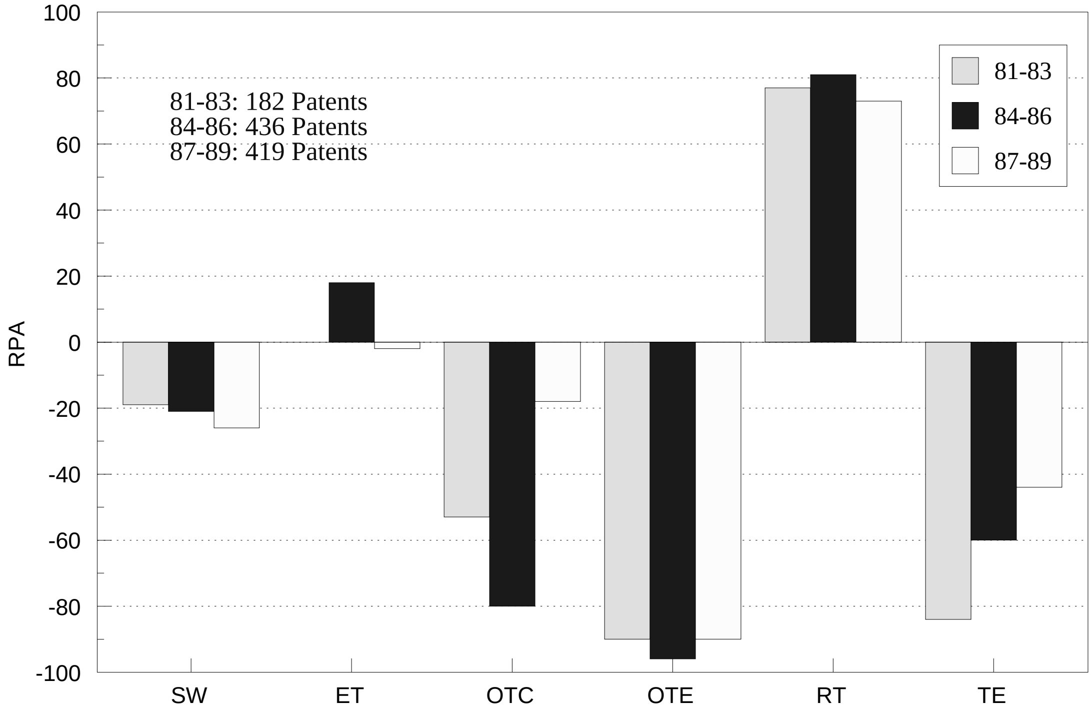
a) Patents and the multi-technology firm

Patents can be particularly helpful in identifying the direction taken by the R&D and innovation effort of a firm, while information on R&D expenditure is rarely available at a disaggregated level and industrial secrecy may protect the specific content of research projects. The patent portfolios of large firms can be investigated in order to study a company's innovation strategy, its technological diversification and how different fields of knowledge are combined in the firm's activity. In fact, most large firms carry out technological activities in a range of fields broader than their production activities in order to explore potential future areas of activity (22).

b) Patenting by type of firm

Patenting activity by firms can be used in studies of particular aspects of industrial structure and performance, including the distribution of innovations according to the size of firms; the degree of concentration of particular markets; the performance of technology-intensive firms; the role of patenting in technology strategies, and so on. Comparing R&D and patenting across firms, small firms have been found to obtain proportionately more patents per unit of R&D expenditure than large firms (23).

Figure 7. **Technology Profile for NEC**
(based on patents at the EPO)



RPA	Index of Revealed Patent Advantage
SW	Switching
ET	Electronic Transmission
OTC	Optical Transmission Core
OTE	Optical Transmission Environment
RT	Radio Transmission
TE	Terminals

Source: Schmoch and others (1992-C).

c) *Patterns of internationalization*

A number of studies have examined how R&D, patenting and production are carried out by large firms across national borders. Work developed in the United Kingdom at SPRU and the University of Reading on several hundreds of the largest world firms has matched data on R&D expenditure, patenting and production, identifying the shares carried out in the home country of the firm and those resulting from R&D, patenting and production carried out abroad. Results suggest that the degree of globalisation of technological activities of large firms is still limited, lower than that achieved by production and confined to particular sectors, countries and groups of firms. In most cases, the production of technology remains close to the home base of large firms (24).

FINAL REMARKS

This Manual sets out basic information on the use of patent data as technology indicators, highlighting their advantages and disadvantages, in the context of current research in this field.

It may be helpful to conclude by stressing two important points:

-- patent-derived data are now available, and the indicators we have described are routinely in use;

-- at the same time, they do have to be used with caution. In particular, attention must be paid to the innovation and industrial property strategies of the firms concerned. A good understanding of such strategy is required in interpreting the indicators discussed.

In addition, methods are now available for analysing patent document content. This offers scope for cross-relating quantitative and qualitative indicators in given technology fields.

Indicators derived from patent documents can be a valuable means for studying the innovation process. Their use in combination with other science and technology indicators is recommended; converging results obtained from different indicators are a key test of the robustness of findings from the analysis of technological activities. Compared to other indicators, a major advantage of patent data is that they make studies at a high level of disaggregation possible, allowing significant flexibility in the criteria for aggregation of data.

Studies on the technological activities of individual inventors, firms, other institutions, sectors, countries or regions can be carried out using patent data. Patent data can be linked, with the appropriate caution, to data on scientific activity, R&D efforts, and economic performance. The variety of these possible applications of patent data makes it impossible to provide here a full discussion of the problems and experiences in these fields, and the relevant literature, starting with that listed in the Patent Bibliography, should be consulted for additional information on the appropriate use of this indicator. As with other OECD Manuals, this first version of the Patent Manual will be improved and refined in the light of users' experience.

Annex I

FRONT PAGES OF PATENT DOCUMENTS FILED IN SELECTED PATENT OFFICES

A - European Patent Office (EPO)

B - International application published under the Patent Co-operation Treaty

C - United States Patent and Trademark Office (USPTO)

D - Japanese Patent Office (JPO)

E - German Patent Office

F - Institut National de la Propriété Industrielle - France (INPI)

G - United Kingdom Patent Office

Annex I - A

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 349 311 A2**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 89306596.1

(22) Date of filing: 29.06.89

(51) Int.Cl.5: **D 21 H 21/02**
// D21H17/69, D21H17/68, D21H17/45, D21H17/67

(30) Priority: 29.06.88 GB 8815515

(43) Date of publication of application: 03.01.90 Bulletin 90/01

(84) Designated Contracting States: AT BE CH DE ES FR GB IT LI LU NL SE

(71) Applicant: ECC INTERNATIONAL LIMITED
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(74) Representative: Bull, Michael Alan et al
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London WC2A 1AT (GB)

(54) **Pitch control.**

(57) There is disclosed a process for controlling the deposition of pitch in a paper-making process, wherein there is incorporated into the paper-making composition a coated inorganic particulate material which comprises a clay mineral coated with (a) a cationic polyelectrolyte which is a water-soluble substituted polyolefin containing quaternary ammonium groups or with (b) an inorganic gel or with (c) a mixture of (a) and (b).

EP 0 349 311 A2

Annex I - B

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G01D 5/26, G01B 3/00 G02B 5/18, B21B 1/22 | A1

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(43) International Publication Date: 8 March 1990 (08.03.90)

(21) International Application Number: PCT/GB89/01019

(22) International Filing Date: 17 August 1989 (17.08.89)

(30) Priority data: 8819723.1 19 August 1988 (19.08.88) GB

(71) Applicant *(for all designated States except US)*: RENISHAW PLC [GB/GB]; Gloucester Street, Wotton-Under-Edge, Gloucestershire GL12 7DN (GB).

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(75) Inventors/Applicants *(for US only)*: LUMMES, Stephen, Edward [GB/GB]; "Alma Place", Beech Knapp, Burleigh, Stroud, Gloucestershire GL5 2PS (GB). HENNING, Brian, Cecil, Robert [GB/GB]; Endrick Cottage, Gillingstool, Thornbury, Avon BS12 2EH (GB). MORRISON, Robert, Boyd [GB/GB]; The Old Bungalow, Lapdown Lane, Tormarton, Nr Badminton, Avon GL9 1JE (GB).

(74) Agents: WAITE, J. et al.; Patents Department, Renishaw plc, Gloucester Street, Wotton-Under-Edge, Gloucestershire GL12 7DN (GB).

(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
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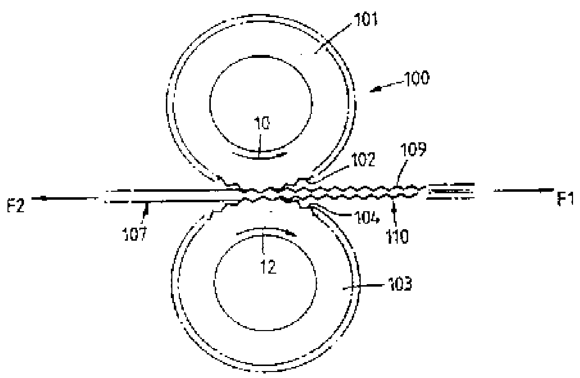
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METROLOGICAL SCALE



(57) Abstract

An optical metrological scale (110) is produced by a rolling method, to give a profiled upper scale surface (109) which is imparted by an embossing roller (101). To prevent uneven strains, which could affect the pitch of the scale, the support roller (103) has a similar embossing profile, so that the lower side of the scale is also given a profiled surface. The embossing roller (101) is freely rotatable, while the support roller (103) is driven.

Annex I - C

United States Patent [19]

Robinson et al.

[11] Patent Number: 4,523,385

[45] Date of Patent: Jun. 18, 1985

[54] LATCH

[75] Inventors: Allan F. Robinson, Sydney; Warwick A. Hunter, Grose Wold, both of Australia

[73] Assignee: Napiotas Pty. Ltd., New South Wales, Australia

[21] Appl. No.: 514,830

[22] PCT Filed: Oct. 26, 1982

[86] PCT No.: PCT/AU82/00173

§ 371 Date: Jun. 27, 1983

§ 102(e) Date: Jun. 27, 1983

[87] PCT Pub. No.: WO83/01493

PCT Pub. Date: Apr. 28, 1983

[30] Foreign Application Priority Data

Oct. 26, 1981 [AU] Australia PF1306

[51] Int. Cl.³ G01C 15/00

[52] U.S. Cl. 33/296; 403/109

[58] Field of Search 33/296, 158, 464, 161; 403/109, 107, 106, 110, 321, 373, 377, 393

[56] References Cited

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3,120,386	2/1964	Janssen	403/107
4,029,279	6/1977	Nakatani	403/109

FOREIGN PATENT DOCUMENTS

1116803 6/1968 United Kingdom 33/161

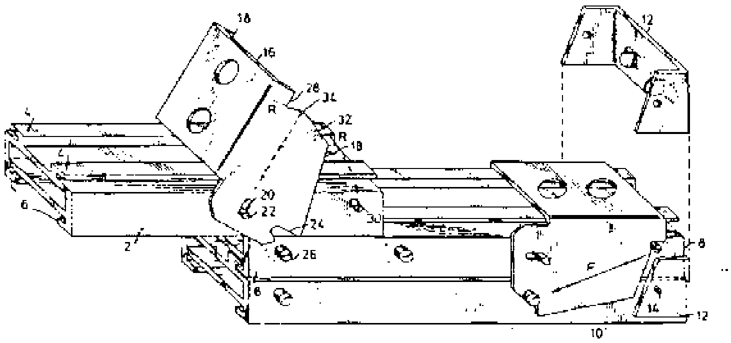
Primary Examiner—Willis Little

Attorney, Agent, or Firm—Hubbell, Cohen, Stiefel & Gross

[57] ABSTRACT

A latch of the over centre type for use inter alia in locking together surveyors rods in order to give reproducible measurements. The latch locks together a first axially slidable member (2) and a second axially slidable member (8) in overlapping disposition; it comprises a pair of latch supporting pivots (22) extruding from the first member, on a first common axis a pair of latch fulcrum pivots (26) extruding from the second member on an axis parallel to the first axis, a latch arrester (30) extruding from the first member, a latch body (16) having a face and sides (18) which extend to or past the latch fulcrum pivots (26) each latch side having an S-shaped recess (24) to engage the associated fulcrum pivot and an elongated slot (20) to engage the elongated latch support pivot. At least one of the sides has an edge protrusion (34) which must be snapped past the latch arrester (30) to complete the latch action. The latch is captive on the first member (2) and slidable with that member to a locking position where the latch is tilted around the fulcrum pivots (26) whereupon the latch causes the distance between the two axes of the members (2, 8) to change locking them together in an over centre action, which action cannot be reversed except by snapping the protrusion (34) past the latch arrester (30).

30 Claims, 1 Drawing Figure



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⑫公開特許公報（A）　平2-25498

⑤Int.Cl.⁵　識別記号　庁内整理番号　④公開　平成2年(1990)1月26日

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A 61 K 31/70　ADP
　　　　　　　ADY
C 07 H 15/26　　7417-4C

審査請求　未請求　請求項の数 22　（全25頁）

⑭発明の名称　新規なα-グルコシダーゼ抑制剤

㉑特　願　平1-139401
㉒出　願　平1(1989)6月2日

優先権主張　㉜1988年6月2日㉝欧州特許機構(EP)㉛88401340.0

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⑭代理人　弁理士　佐々井　弥太郎　外1名

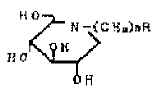
明　細　書

1、発明の名称

新規なα-グルコシダーゼ抑制剤

2、特許請求の範囲

1、式



1

〔式中nはゼロ、1又は2であり、Rは1-3個のヘキソース又はペントース単位を含有するグリコシル基又はエーテル化又はアシル化されたグリコシル基であり、該グリコシル基は任意付加的に末端ヘキソース又はペントース部分のアノマー炭素原子上に位置するヒドロキシル部分のエーテル又はエステル誘導体をもっていることもあり得る〕の1-デオキシノジリマイシン誘導体及び製薬上受入れられるその酸付加塩。

2、Rがグルコシル、ガラクトシル、フコシル、フルクトシル、マンノシル、リボシル、アラビノシル、キシロシル、アロシル、アルトロシル、グロシル、インドシル、タロシル、リキソシル、イソマルトシル、トレハロシル、β-セロビオシル、マルトシル、マルトトリオシル、又はセロトリオシル基である、特許請求の範囲第1項の化合物。

3、Rが6-グルコシル、4-グルコシル、1-フルクトシル、6-フルクトシル、6-マルトシル、4-マルトシル、6-イソマルトシル、又は4-イソマルトシルである、特許請求の範囲第1項の化合物。

4、化合物が1,5-ジデオキシ-1,5-〔(6-デオキシ-1-O-メチル-6-α-D-グルコピラノシル)イミノ〕-D-グルシトールである、特許請求の範囲第1項の化合物。

5、化合物が1,5-ジデオキシ-1,5-〔(6,7-ジデオキシ-1-O-メチル-7-α-D-グルコヘプトピラノシル)イミノ〕-D-グルシトールである、特許請求の範囲第1項の化合物。

6、化合物が1,5-ジデオキシ-1,5-〔(1-デオキ

Annex I – F

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) Patentschrift

(11) DE 39 05 650 C1

(51) Int. Cl. 5:
B 62 D 21/00
B 62 D 25/20
B 62 D 23/00

(21) Aktenzeichen: P 39 05 650.3-21
(22) Anmeldetag: 24. 2. 89
(43) Offenlegungstag: –
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DE 39 05 650 C1

Innerhalb von 3 Monaten nach Veröffentlichung der Erteilung kann Einspruch erhoben werden

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(56) Für die Beurteilung der Patentfähigkeit in Betracht gezogene Druckschriften:

DE-OS 28 47 679

(54) Selbsttragende Kraftfahrzeugkarosserie

Eine selbsttragende Kraftfahrzeugkarosserie, mit äußeren, seitlichen Längsträgern (Schwellern) am Unterboden im Bereich der Fahrgastzelle, und mit zur mittleren Fahrzeuglängsachse versetzten, sich im Fahrzeugvorbau und im Fahrzeugheck befindenden, vorderen und hinteren Längsträgern, die mit einer Abkröpfung an die seitlichen Längsträger anschließen, ist dadurch gekennzeichnet, daß am Unterboden der Karosserie Streben festgelegt sind, die mit einem Ende an einem seitlichen Längsträger befestigt, gegen einen Fahrzeugmittenbereich gerichtet, und mit ihrem anderen Ende wiederum am Unterboden der Karosserie befestigt sind, wobei jeweils eine Strebe von beiden seitlichen Längsträgern in den Fahrzeugvorbau oder/und jeweils eine Strebe von beiden seitlichen Längsträgern in das Fahrzeugheck geführt ist, und jede Strebe zur Fahrzeuglängsachse mit annähernd einem 45° Winkel ausgerichtet, entlang dem Unterboden zumindest bis in den Fahrzeugmittenbereich verläuft.

DE 39 05 650 C1

Annex I - F

(19) RÉPUBLIQUE FRANÇAISE

INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE

PARIS

(11) N° de publication : **2 558 339**
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(21) N° d'enregistrement national : **84 00841**

(51) Int Cl⁴ : A 21 C 11/00.

(12) DEMANDE DE BREVET D'INVENTION A1

(22) Date de dépôt : 20 janvier 1984.

(30) Priorité :

(43) Date de la mise à disposition du public de la demande : BOPI « Brevets » n° 30 du 26 juillet 1985.

(60) Références à d'autres documents nationaux apparentés :

(71) Demandeur(s) : *JOUAS Claude Marie Philippe.* — FR.

(72) Inventeur(s) : Claude Marie Philippe Jouas.

(73) Titulaire(s) :

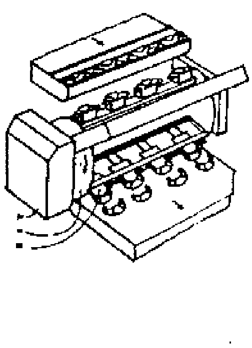
(74) Mandataire(s) :

(54) Machine automatique pour la mise en forme d'articles, notamment d'articles alimentaires.

(57) L'invention concerne une machine automatique permettant la mise en forme d'articles alimentaires.

Elle est constituée de rangées de supports de produits alimentaires montés sur un barillet et qui par une succession de rotations présentant les produits en face de postes de travail où les opérations successives suivantes sont exécutées : entrée du produit, mise en forme, blocage en forme et éjection du produit sur une bande transporteuse de sortie.

La présente machine selon l'invention est particulièrement destinée au cintrage de produits alimentaires de boulangerie et de charcuterie tels que croissants, etc.



FR 2 558 339 - A1

(12) UK Patent Application (19) GB (11) 2 151 444 A

(43) Application published 24 Jul 1985

(21) Application No 8431842

(22) Date of filing 17 Dec 1984

(30) Priority data
(31) 8333858 (32) 20 Dec 1983 (33) GB

(71) Applicant
National Research Development Corporation (United Kingdom),
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(72) Inventor
Harry James Nation

(74) Agent and/or Address for Service
D W Trevor-Briscoe,
Patents Department, National Research Development Corporation, 101 Newington Causeway, London SE1 6BU

(51) INT CL⁴
A01C 23/00 A01D 67/00

(52) Domestic classification
A1D 3A7
A1F 210 212 FB

(56) Documents cited
None

(58) Field of search
A1D
A1F
B7D

(54) Suspension assembly

(57) The blowing, metering and distributing assembly 4 of a liquid or air flows solids distributor comprises extended distribution members suspended from the chassis 1 by four downwardly converging rigid links 5, each having ball swivel joints 6 at its two ends. Due to the high polar inertia of the suspended assembly, it will not respond to transient yawing, rolling or pitching movements of the chassis but if such movements are sustained, the assembly will re-align to some new rest position. In other embodiments, the number and/or direction of convergence of the suspension links is varied from those shown in Fig. 3. The assembly is particularly useful in certain types of agricultural machinery where the operative part of the machine has to be suspended from the body portion of the machine.

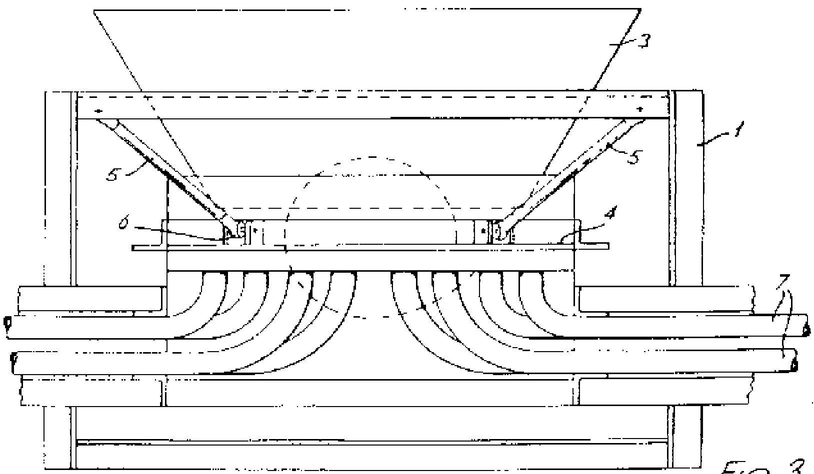

Fig. 3

GB 2 151 444 A

Annex II

SPECIMEN INFORMATION AVAILABLE FROM LEADING PATENT DATABASES

A - WPI(L)

B - EPAT

C - US PATENTS

D - CLAIMS

E - JAPIO

Annex II-A

WPI(L)

AN	91-317683/43
XRAM	C91-137383
TI	Purificn. of human granulocyte-specific colony stimulating factor -- by addn. of sodium chloride to aq. soln. contg. more than 1 mg per ml hG-CSF
DC	A89 B04 D16
PA	(SASS/) SASSENFELD H
SASSENFELD H	
NP	1
PN	US5055555-A 91.10.08 (9143)
LA	E
PR	89.01.05 89US-293907
AP	89.01.05 89US-293907
IC	C07K-003/24
AB	(US5055555) Method of purifying humant granulocyte-specific colony stimulating factors (hG-CSF) (I) from an aq. soln. comprises adding NaCl to the aq. soln. contg. more than 1 mg/m1L hG-CSF to selectively ppte. (I) and isolating the ppte. from the soln. Pref. the aq. soltn. is concd. to more than 1 mg/ml by cation exchange chromatography. The following purificn. process is also claimed. (a) cells capable of expressing (I) are cultured in an aq. culture medium; (b) (I) is recovered from the medium; (c) (I) is concd. to more than 1 mg/ml by absorption to a cation exchanger; (d) (I) is eluted from the cation exchanger; (e) the pH is adjusted to 4-7; (f) NaCl is added to the concd. soln., and (g) the ppte. is isolated from the soln.
USE/ ADVANTAGE	(I) Has potential clinical utility as a stimulator of granulocytic cell precursors. E.g. (I) could be employed to potentiate immune responsiveness to infectious pathogens, or to assist in reconstituting normal blood cell populations following radiation or chemotherapy-induced haematopoietic cell suppression. (I) may also find applicn. in the treatment of certain leukaemias, due to its ability to cause differentiation of certain neoplastic cells of haematopoietic lineage. The purificn. process is highly selective and simple and gives high yield. (12pp Dwg.No.0/3).

****

TI:	Title established by Derwent from basic patent
PA:	Name(s) of applicant(s)
IN:	Name(s) of inventor(s)
NP:	Number of patent documents in the family
PN:	Publication number(s) of patent document family
PR:	Date(s), country(ies) and number(s) of priority filing
IC:	IPC codes for family patent document
AB:	Abtract derived by Derwent from family patent documents, in principle an abstract of the basic patent. If an equivalent patent makes some claim other than in the basic patent, a second abstract may be introduced into the database.
USE/ ADVANTAGE:	Item derived by Derwent showing uses or advantages of the invention as they emerge from the patent abstract.

Annex II-B

EPAT

PN	EEP420766 A2 910403
AP	EP90402697 900928
PR	JP25403389 890929
BPN	9114
ET	Blood purification apparatus and method for cleaning blood therewith.
FT	Appareil pour la purification du sang et procédé d'utilisation de l'appareil.
GT	Blutreinigungsgerat und Verfahren um damit Blut zu reinigen.
AB	A blood cleaning apparatus for selective removal by absorption of an unwanted substance from blood, which apparatus is characterized by being provided with an electrically polarized solid surface (11) as an adsorbent carrier, and means (22, 15a-15b-15c, 17-18) for electrically polarizing the solid surface. The invention deals with said blood cleaning apparatus and a method for blood cleaning.
ICI	A61M-001/38
DS	BE DE FR GB IT NL SE
PNDS	BE DE FR GB IT NL SE
PA	TERUMO KABUSHIKI KAISHA / No. 44-1, Hatagaya 2-chome, Shibuya-ku/Tokyo 151 (JP)
IN	-- Yura, Yoshifumi, c/o Terumo K. K. / 1500, Inokuchi, Nakai-cho/Ashigarakami-gun, Kanagawa-ken (JP) -- Nagoya, Masako, c/o Terumo K. K. / 1500, Inokuchi, Nakai-cho/Ashigarakami-gun, Kanagawa-ken (JP) -- Okawara, Junichi, c/o Terumo K. K. / 1500, Inokuchi, Kanai-cho/Ashigarakami-gun, Kanagawa-ken (JP) -- Yamamoto, Yuichi, c/o Terumo K. K. / 1500, Inokuchi, Nakai-cho/Ashigarakami-gun, Kanagawa-ken (JP)
RP	Gillard, Marie-Louise, *et al.*/ Cabinet Beau de Lomenie, 55, Rue d'Amsterdam/F 75008 Paris (FR)
DRR	911009 Search report (Updated 9141)
RR	EUROPEAN SEARCH REPORT -- EP173631(A)(Cat. A) -- BIOLOGICAL ABSTRACTS, vol. 64, abstract No. 36983, Philadelphia, PA US; S. MOORJANI *et al.* "Extracorporeal removal of plasma lipoproteins by affinity binding to heparin agarose", CLINICA CHIMICA ACTA 77(1), 1977, pages 21-30 (CAT. A)
BRR	9141 (Updated 9141)
DREX	901004 Request for examination (Updated 9114)
PNL	En
APL	En
PCL	En

****

PN:	Number and date of publication of European patent
AP:	Number and date of filing the European application with EPO
PR:	Number and date of first filing (priority number)
ET:	Patent title in English
FT:	Patent title in French
GT:	Patent title in German
DS:	States designated in patent
DRR:	Date of search report
RR:	List of documents cited in search report
DREX:	Details of patent's legal history

Annex II-C

US PATENTS

PN	US5063053
TI	Isolation and purification of the R18 antigen of HTLV-III
IN	Wong-Stal, Flossie, Rockville (MD) US; Chanda, Pranab K., Paoli (PA) US ; Ghrayeb, John, Thorndale (PA) US
PA	The United States of America as represented by the Department of Health & Human Services, Washington, DC, US
PD	91.11.05
AP	90.07.25 9OUS-556999, Division of 920780 Filed 86.10.20 (Now patented US4963497, Issued 91.09.16)
NO	3 Claims, Exemplary Claim 1, 2 DRAWINGS, 2 Figures Examiner: Moskowitz, Margaret; Feissee, Lila Atty/Agent: Jain, Mishrilal
PCL	424/089.000, Cross Refs: 530/387.000 X, 530/350.000 X, 424/086.000 X
IC	A61K-039/21, A61K-039/42, C07K-015/06
FLD	530/387.000, 530/350.000, 424/085.800, 424/088.000, 424/086.000, 424/089.000
DT	INVENTION PATENT
FS	To US Government
CT	US4912030, 3/1990, Weiss *et al.*, 435/5. Pescador *et al.*, Science vol. 227, 484-492.
AB	The isolation and purification of a newly discovered gene of the AIDS virus, HTLV-III, which encodes a protein which is immunogenic and recognized by sera of some HTLV-III seropositive people. Furthermore, the gene is highly conserved among all known HTLV-III isolates and exhibits a polymorphism at the 3' end which distinguishes molecular clones of the HTLV-IIIB cell line from viral genomes of related viruses.
MCLM	We claim: 1. An isolated, more than 95 per cent pure R 18 antigen encoded by the R gene of HTLV-IIIB virus as shown in FIG. 1A.

****

NO:	Number of claims
DT:	Type of patent document
PCL:	United States classification codes (main code)
FLD:	United States classification codes (supplementary codes)
CT:	List of documents cited in search report
MCLM:	First or main claim

Annex II-D

CLAIMS

AN	2207140
CHAN	9128323
PN	US5071959
TI	NOVEL LYMPHOKINE FOR SUPPRESSING PLATELET ACTIVATION
IN	Auriault Claude (FR) ; Capron André (FR) ; Joseph Michel (FR) ; Pancre Véronique (FR)
PA	Institut Pasteur de Lille FR; Institut National de la Santé et de la Recherche Médicale INSE FR (25743)
PD	91.12.10
AP	88.03.01 88US-168009
PR	86.05.21 86FR-007194, FR 7194
PCL	530351000, CROSS REFS: 424085100, 530413000, 530417000
IC	C07K-015/00, CROSS REFS: C07K-015A/02, C07K-003/20, C07K-003/28
PT	C (Chemical)
DT	UTILITY
AB	PCT No. PCT/FR87/00164 Sec. 371 Date Mar. 1, 1988 Sec. 102(e) Date Mar. 1, 1988 PCT Filed May 19, 1987 PCT Pub. No. W087/07303 PCT. Pub. Date Dec. 3, 1987. New lymphokine and its isolation and purification process. Said lymphokine is comprised of a factor obtained from T cells stimulated by concanavaline A or by an antigen capable of inhibiting the IgE-dependent platelet citotoxicity with respect to young larvae of S. Mansoni, of strongly reducing the chemiluminescence of blood platelets in a reaction IgE anti-IgE, which is a correlate of the anti parasite cytotoxicity, and of inhibiting the platelet activation in non-IgE dependent intolerances. Application as suppressor agent for suppressing platelet activation and as immunomodulator medicament of allergies.
CLM	1. An essentially pure lymphokine, wherein said lymphokine: a) isobtained from the supernatant of T OKT8+ lymphocyte cultures after mitogenic or antigenic stimulation; b) inhibits IgE-dependent platelet cytotoxicity with respect to young larva of Schistosomia mansoni; c) inhibits platelet activation in non-IgE dependent intolerances; d) has a molecular weight in the range of about 15-20 kDa; and e) has a pI of about 3.7-5.0.

Annex II-E

JAPI0

AN 91-093727
TI BLOOD FLOW IMPROVER
PA (2000445) HITACHI CHEM CO LTD
IN AZUMA, RIYOUJI; NOGUCHI, KEIICHI; YAMAZAKI, YOSHIO
PN 91.04.18 J03093727, JP 03-93727
AP 89.09.05 89JP-230170, 01-230170
SO 91.07.10 SECT. C, SECTION NO. 848; VOL. 15, NO. 271, PG. 123.
IC A61K-037/24
JC 14.4 (ORGANIC CHEMISTRY--Medicine); 14.1 (ORGANIC CHEMISTRY-Organic Compounds)
FKW R002 (LASERS); R019 (AEROSOLS)
AB PURPOSE: To obtain a blood flow improver having durable and strong effects free from side effect, comprising Epidermal Growth Factor(EGF) or a salt thereof as an active ingredient. CONSTITUTION: A blood flow improver containing EGF such as .beta.-urogastrone [hEGF(sub 1)-(sub 53)] having an amino acid sequence shown by the formula (dotted line is disulfide bond), .beta.-urogastrone [hEGF(sub 1)-(sub 52)] which is deficient in one amino acid from C end of .gamma.-urogastrone or other EGFs wherein these constituent amino acids are partially replaced with other amino acids or pharmaceutically acceptable salt thereof. The EGF is produced by extraction from human urine and purification or gene recombination technology.

Annex III

A - An example of how the IPC classification can be built upon: the OST-INPI/FhG-ISI technology nomenclature

B - An extract from the IPC classification

Annex III - A
An example of how the IPC classification can be built upon:

the OST-INPI/FhG-ISI TECHNOLOGY NOMENCLATURE

AREA	IPC CODE
I. Electricity - Electronics	
1. Electrical devices - electrical engineering	F21;GO5F;HO1B,C,F,G,H,J,K,M,R,T;H02;H05B,C;F,K
2. Audiovisual technology	G09F,F;G11B;H03F,G,J;H04,-003,-005,-009,-013,-015,-017,R,S
3. Telecommunications	G08C;H01P,Q;H03B,C,D,H,K,I,M;H04B,H,J,K,L,M;H04B,H,J, K,L,M,N -001,-007,-011,Q
4. Information technology	G06;G11C;G10L
5. Semiconductors	H01L
II. Instruments	
6. Optics	G02;G03B,C,D,F,G,H;H01S
7. Analysis, measurement, control	G01B,C,D,F,G,H,J,K,L,M,N,P,R,S,V,W;G04;G05B,D;G07; G08B,G;G09B,C,D,;G12
8. Medical engineering	A61B,C,D,F,G,H,J,L,M,N
III. Chemicals, pharmaceuticals	
9. Organic fine chemistry	C07C,D,F,H,J,K
10. Macromolecular chemistry, polymers	C08B,F,G,H,K,L;C09D,J
11. Pharmaceuticals, cosmetics	161K
12. Biotechnology	C07G;C12M,N,P,Q,R,S
13. Materials, metallurgy	C01;C03C;C04;C21,C22,B22
14. Agriculture, food	A01H;A21D;A23B,C,D,F,G,J,K,L;C12C,F,G,H,J;C13D,F,J,K
IV. Process engineering	
15. General technological processes	G10B,D (whithout -046 to -053), F,J,L; B02C;B03;B04;B05B;B06;B07;B08,F25J;F26
16. Surfaces, coating	B05C,C,D;B32;C23;C25;C30
17. Material processing	A41H;143D;A46D;B02B;B26;B29;B31;C03B;C08J;C14;D01; D02;D03;D04B,C,G,H,J,L,M,P,Q;D21
18. Thermal processes and apparatus	F22;F23B,C,D,H,K,L,M,N,Q;F24,F25B,C,J;27;F28
19. Chemical industry and petrol industry, basic materials chemistry	A01N;C05;C07B;C08C;C09B;C,F,G,H,K;C10B,C,F,G,H,J,K,L, M;C11B,C,D
20. Environment, pollution	A62D;B01D -046 to -053;B09;C02;F01N;F23G,J

AREA	IPC CODE
V. Mechanical engineering, machinery	
21. Machine tools	B21;B23;B24;B26D,F;B27;B30
22. Engines, pumps, turbines	F01B,C,D,K,L,M,P;F02;F03;F04;F23R
23. Mechanical elements	F15;F16,F17,G05G
24. Handling, printing	B25J;B41;B065B,C,D,F,G,H;B66;B67
25. Agricultural and food machinery and apparatus	A01B,C,D,F,G,J,K,L,M;121B,C;A22;A23N,P;B02B;C121;C13C, G,H
26. Transport	B60;B61;B62;B63B,C,H,J;B64B,C,D,F
27. Nuclear engineering	G01T;G21;H05G,H
28. Space technology, weapons	B63G;B64G;C06;F41;F42
VI. Consumer goods, civil engineering	
29. Consumer goods and equipment	A24;A41B,C,D,F,G;A42;A43B,C;A44;A45;A46B;A47;A62B,C; A63;B25B,C,D,F,G,H;B26B;B42;B43;B44;B68;D04D;D06F,N; D07;F25D;G10B,C,D,F,G,H,K
30. Civil engineering, building, mining	E01;E02;E03;E04;E05;E06;E21

International Patent Classification

Fifth Edition (1989)

Volume 1

Section A
Human Necessities

World Intellectual Property Organization

Carl Heymanns Verlag KG München

SECTION A — HUMAN NECESSITIES

CONTENTS OF SECTION (References and notes omitted)

Subsection: AGRICULTURE

Subsection: FOODSTUFFS; TOBACCO

Subsection: PERSONAL OR DOMESTIC ARTICLES

Annex IV

A - Concordance between IPC and SITC for 46 high technology product groups developed by ENEA, CESPRI and Politecnico di Milano

B - Matrix of production and use of the invention based on Canadian patents granted to companies classified by industry of manufacture and industry of use, 1986 to 1989.

Annex IV - A

Concordance between IPC and SITC for 46 high technology product groups developed by ENEA, CESPRI and Politecnico di Milano

Research funded by ENEA (Italy's Agency for New Technologies, Energy and the Environment) and carried out at CESPRI (Centro studi sui processi di internazionalizzazione), Bocconi University, Milan, has established a concordance between the technology-based IPC classification used for patents and the trade classification SITC used for international trade statistics. The concordance is limited to 46 high technology product groups and does not cover the whole list of IPC and SITC classes. The main source for this work is ENEA (1993-C).

CESPRI's classification of patents in high technologies was constructed as part of broader research performed in 1992-93 by CESPRI, ENEA and Politecnico di Milano in order to assess Italy's international performance in high technology industries by combining patent, international trade and foreign direct investment indicators.

CESPRI's classification is not a pure technology classification or an exhaustive representation of all existing high technology industries, for three reasons.

First, the definition of high technology industries is quite subjective, of course, and will depend on the indicators used and the purpose of the empirical analysis.

Second, in their definition of high technology industries CESPRI, ENEA and Politecnico di Milano include activities with low R&D intensity but a high rate of innovation (such as machine tools) as well as R&D-intensive activities.

Third, and most important, given that the main object of the research by CESPRI, ENEA and Politecnico di Milano was the assessment of Italy's international performance in high technology industries, CESPRI's aim was to create a classification which could be linked with the SITC classification regarding foreign direct investment. As a consequence, the IPC classes, subclasses, groups and subgroups selected by CESPRI fulfill the basic research goal of creating a joint patent-trade-investment classification. The indicators are not pure technology indicators, therefore, but include production and trade dimensions as well.

The empirical work was carried out using patents filed in the European Patent Office. In building the classification of high technology patents based on IPC, CESPRI faced three types of problems in particular:

i) problems related to the distinction between what is considered "high technology" and what, from a purely technical standpoint, is not. In addition, patents often refer to "system" innovations, making it difficult to separate high-tech parts or components;

ii) problems related to the fact that high-tech innovations are often classified by EPO in the same technical class as other innovations which do not refer to high-tech fields;

iii) problems related to the creation of a classification which aims to provide a satisfactory concordance between technological (IPC), trade (SITC) and production (SIC) dimensions.

In order to overcome these problems, in part at least, CESPRI submitted the IPC classification to a panel of experts, asking them to select high-tech classes. After identifying broad technological areas in which high-tech innovations are likely to be found, CESPRI contacted experts for each area: not only technical experts -- engineers, chemists, and so on -- but also people involved in the legal practice of patenting at EPO. Further helpful suggestions and guidance were provided by officials working at EPO in Munich and Vienna.

With the help of these experts, CESPRI carried out widespread analysis of the IPC classes, using various instruments:

a) EPO publications describing the classification itself (1). They provide information about the criteria used to assign patents to IPC classes;

b) the list of IPC classes, subclasses, main groups and subgroups (2);

c) the titles of some selected patents for each subgroup.

In sum, CESPRI's classification of high technology patents has positive aspects and, to a certain extent, unavoidable shortcomings. A number of particular points should be noted:

i) the most reliable and "ready-to-use" classes are those relating to pharmaceuticals and chemicals (classes 1 to 16 in the list enclosed). As CESPRI's analysis demonstrated, high-tech patents for these technologies are often found in a narrower set of IPC groups and subgroups than for other technologies. This feature makes them more readily identifiable;

ii) elsewhere, and especially in mechanical and electronic technologies (classes 17 to 34), the task of achieving a satisfactory aggregation of patents appears much less feasible, given that high-tech patents are often spread among a much broader spectrum of classes.

As we mentioned, the methodology which CESPRI used to build a classification based on European patents in high technology is by no means exhaustive or comprehensive. The outcome is in fact a compromise between a precise technology-based system and a rougher but more flexible general-purpose scheme of classification. More precisely, CESPRI's classification should be read:

i) as a first attempt at differentiating between what is considered high technology and what is not;

ii) as pioneering work which should stimulate discussion, suggestions and collaboration among a wide number of people -- experts in the field, technologists, economists of innovation, users, and so on -- in order to make significant improvements in this classification.

NOTES

(1) See for instance Vijers, W.G., "The International Patent Classification as a Search Tool", *World Patent Information*, Vol. 12, No. 1, pp. 26-30, 1990; Official Catchword Index to the fourth edition of the *International Patent Classification*, Carl Heymans Verlag KG, Munich, 1984; International Patent Classification, Vol. 9, Guide, Survey of Classes and Summary of Main Groups, Carl Heymanns Verlag KG, Munich, 1984.

(2) The IPC classification is hierarchically subdivided into sections, classes, subclasses, main groups and subgroups (see Table 2, Main Characteristics of IPC). The sections are designated by capital letters A through H. Each section is then subdivided into classes designated by the section symbol followed by a two-digit number (e.g. C07). Each class comprises in turn one or more subclasses, each of which identified by the class symbol followed by a capital letter (e.i. C07C). Finally, each subclass is broken down into subdivisions referred to as groups and subgroups and designated by the class symbol followed by a one- to three-digit number, an oblique stroke and at least two further digits (e.g. C07C1 19/055).

Annex IV A

Concordance between IPC and SITC for 46 high technology product groups developed by ENEA, CESPRI and Politecnico di Milano

1 - Table A

	SITC	IPC
1.	541.1 541.3 541.2	**C07C**: 50/14, 235/12, 401/00, 403/00 **C07D**: 213/66, 213/67, 217, 311/72, 339/04, 401, 415/00, 451, 453, 455, 457, 475/14, 477, 489, 495/04, 499, 501, 519 **C07M**: 23/00 **C07G**: 5, 11, 13 **C12P**
2.	541.5 542.2 516.91	**A61K**: 37 **C07G**: 15
3.	541.63 541.64 598.67	**A61K**: 39 **C12N**: all except C12N15 **C12M**: 3
4.	541.92 541.93 541.99 598.69	**A61K**: 41, 43, 49
5.	541.61 541.62 542.1 542.3 542.9	**A61K**: 31, 33, 45, 47
6.	574.2 575.44 574.31 575.45 574.33 575.93 575.3	**C08F**: 283, 299 **C08G**: 18 **C08L**: from 68 to 87
7.	571 575.2 572 575.91 573.1 575.92 573.9 575.1	**C08F**: except 120,122,126, 128,283,299 **C08L**: from 23 to 57
8.	574.1 575.42 574.32 575.43 574.34 574.39 575.41	**C08G**: from 2 to 16 **C08L**: 59, 61
9.	231 232	**C08L**: from 7 to 21
10.	597	**C10M**: from 125 onwards
11.	598.8	**B01J** **C08F**: 4
12.	531	**C09B**
13.	553.2	**A61K**: 7
14.	882	**G03C**
15.	591	**A01N**
16.	592.27 592.29 598.5 598.9	**C09J**
17.	731 733	**B23**: except B23K, including B23K26, B25J
18.	751.2 752.2 759.95 759.97 752.1	**G06**
19.	752.3 752.6 752.7 752.9	**G11**: except G11B

1 - Table A (continued)

	SITC	IPC
20.	751.3 759.1	**B41M**
21.	751.9 759.93	**B41L**
22.	763	**H04S** **H04N** **H04N** **G11B** 5- H04N5/225- /247 (under H04N); 9 (under H04N); except 1,21,23, 5,7,9 (under G11B)
23.	764.2 764.92	**H03F** **H03G** **H04R**
24.	761 762 764.3 764.81	**H04N** **H04B** except H04N5 and H04N9
25.	764.82	**H04N** 5 from /225 to /247
26.	764.11	**H04M**
27.	764.15	**H04Q** **H03M**
28.	764.83	**G01S**
29.	764.13 764.17 764.19 764.91 764.93 764.95	**H04L** **H03D** **H03C**
30.	774.1	**A61B**
31.	774.2	**H05G** **H61N**
32.	772.2 772.3	**H05K** **H01C**
33.	776.1 776.2	**H01J**
34.	776.3 776.4 776.8	**H01L**
35.	792.1 792.5 792.2 792.83 792.3 792.9 792.4 714	**B64C** **B64D** **B64G**
36.	874.1	**G01C** **G01V** **G01W**
37.	874.2	**G01B**
38.	874.4	**G01N** **G01K** **G01J** **G01H** except G01N3
39.	874.5	**G01M** **G01N3**
40.	874.6	**G05B**
41.	874.7	**G01R** **G01T**
42.	874.3 874.9	**G01F** **G01L**
43.	773.18 874.19	**G02B** 6
44.	884.11 884.15 884.17 884.3	**G02C** **G02B** except G02C13 (G02C); except those included in sector 45 (G02B)
45.	871	**G02B** 19 21 23 25 26 27
46.	881	**G03B**

Source: ENEA, Primo rapporto sulla competitività dell'Italia nelle industrie ad alta tecnologia, Energia e innovazione, n° 5-6, 1993.

Annex IV - A

Concordance between IPC and SITC for 46 high technology product groups developed by ENEA, CESPRI and Politecnico di Milano

2 - List of the 46 high technology product groups shown in Table A

PHARMACEUTICALS

1) Vitamins; pro-vitamins; antibiotics (not medicines); vegetal, natural and synthetic alkaloids and their derivatives.

2) Hormones and other medical preparations.

3) Serums; vaccines; maintaining and propagating micro-organisms.

4) Reagents and preparations for diagnostic purposes.

5) Other medical preparations.

PLASTICS, ELASTOMERS AND FIBERS

6) Polymers.

7) Thermoplastics.

8) Polyacetals and other rubbers.

9) Natural and synthetic rubbers.

FINE CHEMICALS AND SPECIALITIES

10) Mineral fuels additives.

11) Catalysts.

12) Dyes.

13) Cosmetic preparations with high technological content.

14) Photosensitive materials for photographic and cinematographic purposes.

15) Agricultural chemicals.

16) Adhesives, chemical products for electronics and additive compounds for industrial purposes.

INDUSTRIAL AUTOMATION

17) Machine tools, numerical control and industrial robots.

OFFICE MACHINES

18) Computers and office machines.

19) Memories.

20) Photocopying machines.

21) Other office machines.

CONSUMER ELECTRONICS AND TELECOMMUNICATIONS

22) Video and/or audio signals, recording and reproducing.

23) Microphones and loudspeakers.

24) Radio and television (receivers and transmitters).

25) TV cameras.

26) Telephone sets.

27) Switching apparatus.

28) Devices and systems for radio-localisation, radar, radio-navigation and radio-control.

29) Other telecommunication devices and parts.

ELECTROMEDICAL INSTRUMENTS

30) Electrodiagnosis apparatus.

31) X-ray machines and similar.

ELECTRONIC COMPONENTS

32) Printed circuits and other electronic components.

33) Cathode ray tubes and other electric valves.

34) Active electronic components.

AEROSPACE

35) Helicopters, aeroplanes and their components; missiles and space vehicles; aerospace engines.

PRECISION DEVICES; MEASUREMENT AND CONTROL APPARATUS

36) Devices and systems for navigation, hydrology, geophysics and meteorology.

37) Devices for drawing, calculating and 3-D measuring.

38) Devices and systems for physical and chemical analyses.

39) Other devices and measurement/control apparatus.

40) Devices and systems for regulation and automatic control.

41) Devices and apparatus for measuring and controlling electrical variables and radioactivity.

42) Precision devices; measurement and control apparatus for liquid and gases; parts and components.

OPTICAL ELEMENTS, SYSTEMS AND APPARATUS

43) Optical fiber wires; optical fibers.

44) Lenses, prisms, mirrors and other optical elements.

45) Optical devices for precision work.

46) Photographic, cinematographic apparatus; other apparatus.

Annex IV - B
Matrix for production/use of invention based on Canadian patents granted to business corporations, 1986-89

1. Table B

		Sectors of Use														
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
	0	0	124	290	319	298	117	24	138	203	234	266	172	8	64	23
S	**1**	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0
e	**2**	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
c	**3**	285	0	0	202	0	0	0	1	0	0	2	0	0	0	0
t	**4**	570	1	1	65	502	9	2	14	3	2	16	40	5	126	0
o	**5**	52	0	0	6	9	189	0	4	0	0	1	6	0	8	0
r	**6**	11	1	1	1	0	0	22	0	0	0	0	0	0	0	0
s	**7**	164	0	0	51	2	1	1	107	0	0	0	2	0	0	0
	8	2	1	5	0	1	0	0	0	50	0	39	28	2	16	0
	9	3	0	1	0	3	1	0	0	2	67	27	23	3	7	0
	10	484	5	20	22	46	6	4	4	48	20	611	173	12	68	0
of	**11**	440	144	519	726	393	120	120	304	287	145	416	2953	17	366	0
	12	1	0	0	0	0	0	0	0	0	0	1	0	58	0	0
	13	44	2	12	2	1	0	1	0	1	0	1	13	4	1428	0
	14	34	0	0	0	0	0	0	0	0	0	0	0	0	4	634
	15	37	0	0	1	0	1	0	0	0	0	4	6	1	17	151
P	**16**	67	4	89	8	1	1	3	5	2	2	21	106	36	109	102
r	**17**	79	2	1	10	1	1	1	0	1	0	0	17	10	16	11
o	**18**	388	7	23	13	5	3	1	11	26	27	115	334	29	249	62
d	**19**	37	3	8	1	2	3	2	2	39	20	19	26	3	18	6
u	**20**	6	2	1	1	0	1	1	2	1	1	9	18	0	43	0
c	**21**	42	0	2	82	0	1	0	0	0	0	0	0	0	0	0
t	**22**	582	44	146	260	743	143	43	98	20	8	256	43	5	80	2
i	**23**	139	5	118	32	9	1	1	7	9	6	30	234	21	46	6
o	**24**	830	1	11	38	2	8	1	2	4	0	0	0	0	0	0
n	**25**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	29	1	0	0	7	0	0	0	0	3	1	0	0	0	0	0
	Sum	4298	350	1255	1847	2018	606	277	699	702	533	1846	4292	219	2691	997

Source: Hanel (1993-C)

continued on following page

1. Table B continued

Sectors of production	Sectors of Use															
	15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**Sum**
0	359	46	43	130	197	568	529	2449	38	138	165	55	0	34	272	7303
1	0	0	0	0	0	0	0	1	0	0	6	2	0	0	0	16
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8
3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	31	522
4	10	4	7	45	11	0	10	52	11	28	24	0	0	1	242	1801
5	1	96	3	13	5	1	0	1	0	17	4	1	0	0	40	457
6	0	0	0	0	0	0	0	0	0	2	0	0	0	1	49	88
7	1	0	2	3	1	0	2	1	2	25	4	0	0	0	99	468
8	1	0	0	7	0	0	0	7	0	1	39	0	0	0	87	286
9	6	1	2	19	0	0	0	4	0	4	1	0	0	0	6	180
10	11	9	10	35	30	13	0	23	6	45	171	32	0	2	678	2588
11	42	39	27	108	180	156	23	409	20	369	399	115	2	4	716	9559
12	0	0	0	0	0	0	0	0	0	0	6	0	0	0	2	68
13	0	0	0	1	2	0	0	3	0	1	37	0	0	0	41	1594
14	2	5	2	4	0	0	0	0	2	0	18	0	0	1	3	709
15	716	1235	527	359	0	0	0	4	48	4	6	4	1	10	26	3158
16	10	2114	106	148	6	1	0	5	21	12	37	31	0	83	156	3286
17	1	14	853	14	0	0	0	7	26	26	41	4	8	2	329	1475
18	14	181	38	2213	9	1	1	71	51	39	25	217	0	17	480	4650
19	10	69	1	13	232	2	1	11	13	6	14	3	0	1	196	761
20	1	1	0	6	1	31	0	2	0	0	13	3	0	0	10	154
21	0	0	0	0	0	4	255	22	2	1	6	0	0	1	1432	1850
22	93	10	17	93	56	219	2214	3306	103	124	53	33	0	2	321	9117
23	28	31	15	31	6	3	22	11	1121	171	38	42	1	668	1046	3898
24	1	16	43	21	3	1	0	5	0	293	15	0	1	7	543	1987
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	2
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7	22
Sum	1307	3871	1697	3263	739	1000	3058	6394	1464	1306	1125	542	14	834	6813	56007

Annex IV - B
Matrix for production/use of inventions based on Canadian patents granted
to business corporations, 1986-1989

2. List of sectors shown in Table B

1. Mines
2. Crude petroleum
3. Food, beverages and tobacco
4. Rubber and plastic
5. Textiles
6. Wood
7. Pulp and paper
8. Primary metals (ferrous)
9. Primary metals (non-ferrous)
10. Metal products
11. Machinery
12. Aircraft and parts
13. Other transportation equipment
14. Telecommunications equipment
15. Electronic parts and components
16. Other electronic equipment
17. Business machines
18. Other electrical equipment
19. Non-metallic mineral products
20. Petroleum refining
21. Drugs and medicines
22. Other chemical products
23. Scientific materials
24. Other manufacturing products
25. Transport and other
26. Electric power
27. Computer services
28. Engineering services
29. Other services

0 In the case of sector of use (columns), "0" relates to the general use of consumer goods. In the case of sector of production (rows), "0" relates to process patents.

Food includes Agriculture, Fishing and Trapping.
Wood includes Forestry.

Source: Hanel (1993-C)

NOTES

(1) See for example Trajtenberg (1990-B), Hall, Griliches and Hauseman (1986-C), and Freeman (1982-C).

(2) See for example Grupp and others (1992-B), Schmidt-Tiedemann (1982-C), Kline (1985-C), and Sirilli (1990-B).

(3) The model is based on the findings of Schmoch and others (1993-B); the report compares a variety of innovation models in detail.

(4) See Mansfield (1985-C), Bertin and Wyatt (1988-C), Tagger (1989-B), and Harabi (1991-B).

(5) Schankerman and Pakes (1986-C), Griliches (1990-C).

(6) Pavitt (1988-B), Scherer (1983-B).

(7) See Chapter IV for further details; also Pavitt (1988-B), Grupp and Schmoch (1991-C), and Schmoch and others (1988-B).

(8) It is not possible to give an exhaustive list of relevant articles, but see the Bibliography, and the review articles by Pavitt (1988-B), Griliches (1990-C), and Archibugi (1992-B).

(9) For a full description of the coding rules, see Volume 9 of the International Patent Classification (5th Edition).

(10) For the purpose of conducting prior art searches the European Patent Office has further subdivided the IPC entries, developing the ECLA system (IPC and ECLA classifications can be retrieved on-line via the QUESTEL server -- ask for IPC and ECLATX) based on IPC but with more than 100 000 entries. This is an internal system intended to reduce the number of documents to be consulted for each entry. European patent publications now include this classification system as well. ECLA is revised every month to take account of technological trends. Patents are reclassified automatically whenever the classification system is altered.

(11) Different patent offices have their own grant procedures, and patent documents grouped together as a family may or may not refer to patents that have actually been granted. So WPI(L), like other databases, uses a computer code to indicate whether a document refers to an application or to a patent granted.

(12) Mansfield (1986-C), using a sample of US firms, has found that firms apply for a patent for 66 to 87 per cent of their patentable inventions. Scherer and others (1959-C), Sanders (1964-C) and Napolitano and Sirilli (1990-C) have found that the share of patents actually used by firms ranges from 40 to 60 per cent of total applications.

(13) Electronics is one of the fields in which defence ministries vigorously exercise their entitlement to oppose the grant of a patent.

(14) The most frequently used indicators for patent counts are total external patent applications: patents at the European or US patent offices.

They can be generally related to the following variables:

-- patents per population;
-- patents per GDP;
-- patents (extended abroad) per value of export;
-- patents per total (or business enterprise) R&D expenditure;
-- patents per total (or industrial) researchers.

(15) Raw figures for these indicators must be interpreted cautiously, especially for international comparisons. A country with a very large total patent output will tend to have all its RTAs in the neighbourhood of 1, whereas indicators for a country with a low output of patents will have a very high value for those fields in which its output is slightly higher than the average for the country.

(16) A considerable amount of analysis of national strengths and weaknesses in technology fields has been carried out. For international comparisons see Soete (1987-C), Patel and Pavitt (1987a-B; 1991a-C), and Archibugi and Pianta (1992-B). Major country studies, nearly all listed in part B of the Bibliography, include Narin and Olivastro (1987b), Slama (1987), Grupp and Legler (1989), Legler and others (1992-C), Patel and Pavitt (1989) for Germany; Patel and Pavitt (1987b), Narin and Olivastro (1987a), Cantwell and Hodson (1991) for the United Kingdom; Pavitt and Patel (1990) for France; Malerba and Orsenigo (1987), Archibugi (1988), Sassu and Paci (1989), Pianta and Archibugi (1991), Boitani and Cicioti (1992) for Italy; CHI Research (1988) and Narin and Olivastro (1988a) for Japan; Basberg (1983) for Norway; Engelsman and Van Raan (1990) for the Netherlands; and Archibugi and Moller (1993) for Denmark.

(17) Pioneering work in this field was carried out by Schmookler (1966-C) and Scherer (1982-C). Work based on Canadian data on sector of use includes Seguin-Dulude (1982-C), Ducharme (1987-C) and Hanel (1993-C).

(18) Different propensities to patent across technological fields or industries emerge clearly when data for R&D and patents are compared. Griliches (1989-C) has shown that the number of patents in the United States per million US dollars of applied R&D ranged from about 11 in metal working machinery (a class with a high propensity to patent) to 0.01 in guided missiles (a class where inventions are mainly protected by secrecy). Empirical studies on differences at firm level have been carried out, among others, by Mueller (1986-C), Pavitt (1982-C), Griliches (1984-C) and Schwitalla (1993-C). In his survey, Griliches (1990-C) has examined at length this and several other aspects of the use of patent data as economic indicators.

(19) While patent data are linked closely with R&D, they are only indirectly associated to production and international trade. The R&D and marketing stages are on the whole quite distinct. The R&D curve has peaked before the product cycle reaches its peak. Production or sales figures and patent figures tend to correlate directly only during the first stage of a product's life cycle.

(20) Soete (1981-C, 1987-C) has regressed data on patents in the United States by SIC classes to countries' export shares. A positive association has emerged between exports and patenting in the majority of sectors, although the role of innovation is less relevant in the fields associated to natural resources. The link between technology and trade has also been investigated by Fagerberg (1987, 1988-C), Cantwell (1989-C), Dosi, Pavitt and Soete (1990-C), Amendola, Dosi and Papagni (1991-C), and Grupp (1992-C).

A more precise concordance between patent classes and international trade sectors has been developed by Amendola, Guerrieri and Padoan (1992-C), as mentioned.

(21) Here are the formulas for the indicators provided by CHI Research:

- Activity index (expected = 1.0) = $\frac{\text{\% company patents in product group}}{\text{\% industry patents in product group}}$

- Current impact index-CII (expected = 1.0) = $\frac{\text{citation count to company patents}}{\text{citation count to industry patents}}$

- Total technological strength (TTS) = number of patents multiplied per CII

- Relative technological strength (RTS) = $\frac{\text{TTS for company}}{\text{Industry average TTS}}$

- Technology cycletime (TCT) = median age of US patents cited

- Science linkage (SL) = average number of science papers cited.

(22) For studies on this topic see, among others, Kodama (1986-C), Jaffe (1986-C), CHI Research (1988-B), Archibugi (1988-B), Patel and Pavitt (1991-C), Niwa (1992-C), Schmoch and others (1992-C), and Von Tunzelman and others (1993-C).

(23) On patents and firms size see Scherer (1965-C), Soete (1979-C), Griliches (1990-C), and Patel and Pavitt (forthcoming-C).

(24) See in particular Bertin and Wyatt (1988-C), Casson (1991-C), Cantwell and Hodson (1991-C), Patel and Pavitt (1991-C), and Patel (forthcoming-C).

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