

Forecasting the number of European patent applications at the European Patent Office

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1. Introduction

The European Patent Organisation was set up by the Munich Conference in 1973, where the European Patent Convention (*EPC*) was signed and established a centralised patent granting procedure in Europe. The European Patent Office (*EPO*) and the Administrative Council (*AC*) are the two components of the Organisation. While the Office administers and examines patent applications, the Council represents the legal and political authority of the Contracting States on the *Office*. From 8 member countries in October 1977, the European patent system has expanded, and as of today the organisation counts 27 contracting countries. The EPO received its first application in June 1978, and 25 years later recorded 165 000 patent applications filed in 2002.

Initially the European patent [*EP*] system was expected to receive the subsequent filings of those applicants who wished to expand patent protection in more European countries, with the advantage of a unique centralised granting procedure [1]. But the success of the EPO went far beyond expectations, after a period during which applicants learnt how to use the EP system, the centralisation effect period, they now fully use it as an one choice among others to protect their invention in Europe, including in some cases by filing at the EPO some of their initial patent applications to protect their inventions.

The European patent grant procedure is a two step process. Firstly the EPO performs a state of the art search and then, on request, a patentability examination. This can be followed by an opposition and a appeal procedure. Additionally, the EPO acts as International Searching Authority and International Preliminary Examining Authority under the Patent Cooperation Treaty (*PCT*) [2]. The EPO has to establish a plan of its future activities and to prepare a budget, with the budget subject to approval of the Administrative Council.

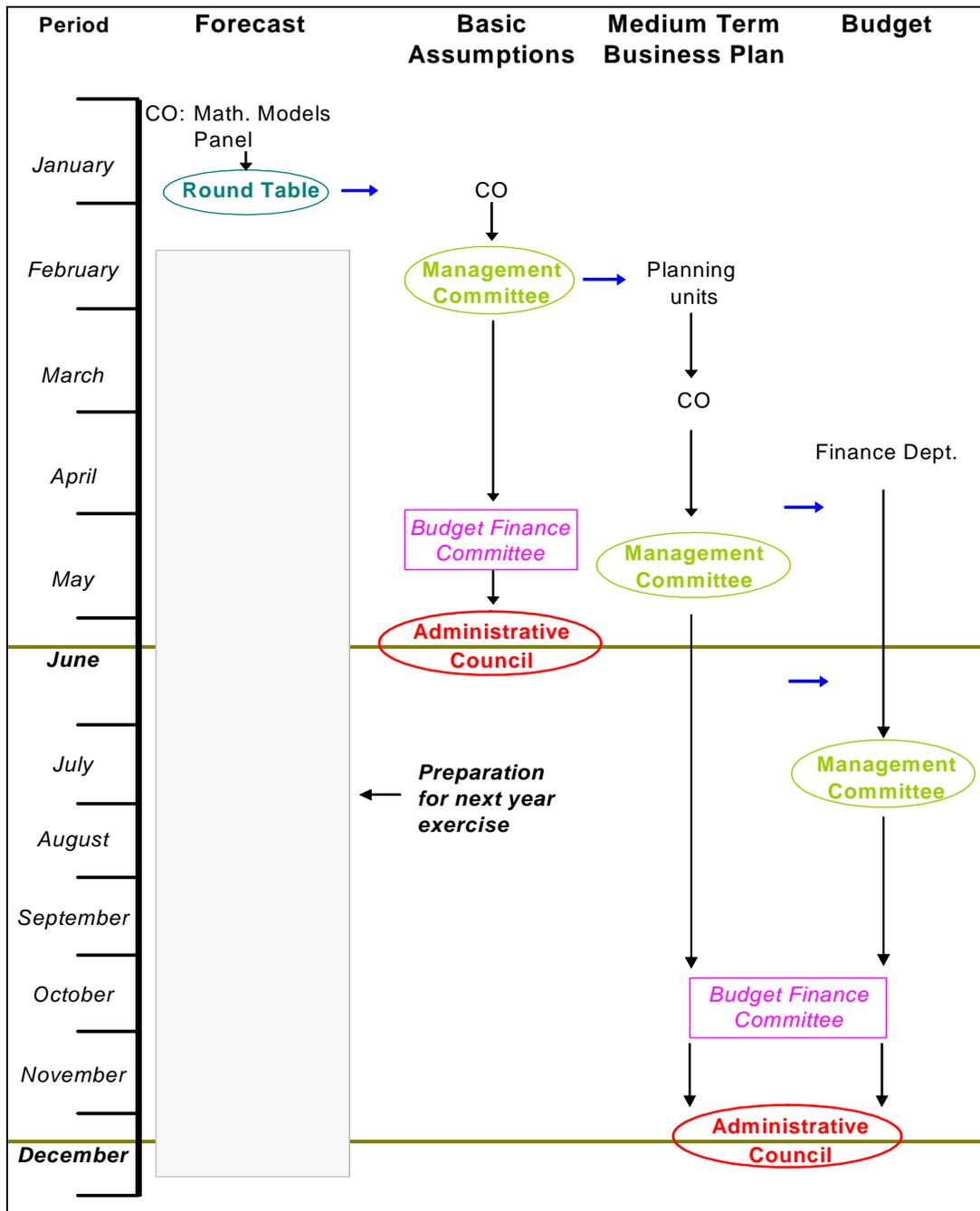
Various actors are involved in the process of planning and budgeting at the EPO, and due to the constraints generated by the international dimension of the Organisation, the process takes almost a full calendar year to be completed. Figure 1 describes the planning and budgeting time frame that is currently in use. The first phase of the planning exercise consists of a forecasting phase. After a series of decisions, the detailed planning precedes the preparation of the budget. The EPO submits to the AC a Medium Term Business Plan (*MTBP*), a budget and a financial plan each year to cover the following five years.

The need for resources at the EPO is linked to the type and amount of work to be performed. As a granting authority in Europe, the EPO should employ an adequate

number of qualified staff to perform the search, examination, opposition and appeal tasks, as well as administrative tasks and other supporting tasks related to the core activities.

Reflecting the structure of the granting procedure at the EPO, the business plan is based on an estimation of the number of applications filed for European patent. The other activities depend to a large extent to the workload generated by the applications.

Figure 1 - Planning and budgeting Time Frame at the EPO



The MTBP and therefore the budget are based on initial forecasts of the numbers of European patent applications that will be filed during the next five years, and on the prediction of some other key parameters. At the EPO, the Controlling Office is in charge of

forecasting, and prepares material for a discussion in a *Round Table* of internal planning experts in order to submit to management a planning scenario to serve as a basis for the budget and the financial plan.

The present paper explains which methods are used by the EPO to forecast the number of applications, and gives some insight into the context in which this exercise takes place and the developments expected in the near future.

After a description of the patenting context in Europe, the role of the EPO is briefly stated. The forecasting methods are described in the third part. The fourth part describes the various projects conducted by the EPO to improve these methods, and discusses some challenges that the Controlling Office will have to face in the near future.

2. Patenting in Europe

Until the introduction of the European Patent System, a company or an inventor wishing to protect an innovation or an invention in Europe had to apply for a patent in every country in which he wanted to protect his invention, and he had to deal with a different procedure in each country. To overcome the burden of multiple procedures, the EPC established a centralised unique granting procedure, with an Office in charge of the delivery of the patent on behalf of the member states.

The model used 30 years ago assumed that, after filing the first application in his own country, the applicant would use the EP system for the applications worth protecting abroad in Europe. It was assumed that there would be a maximum of 30 000 EP applications per year once the system reached its steady state [3]. However the reality proved to be different and, during the first 10 years of existence of the EPO, the number of applications filed to the EPO grew regularly, so that in 1990, more than 70 000 applications were filed. Then, after a period of lower growth, the number of applications filed grew strongly again during the late 1990s, to reach 165 000 in 2002.

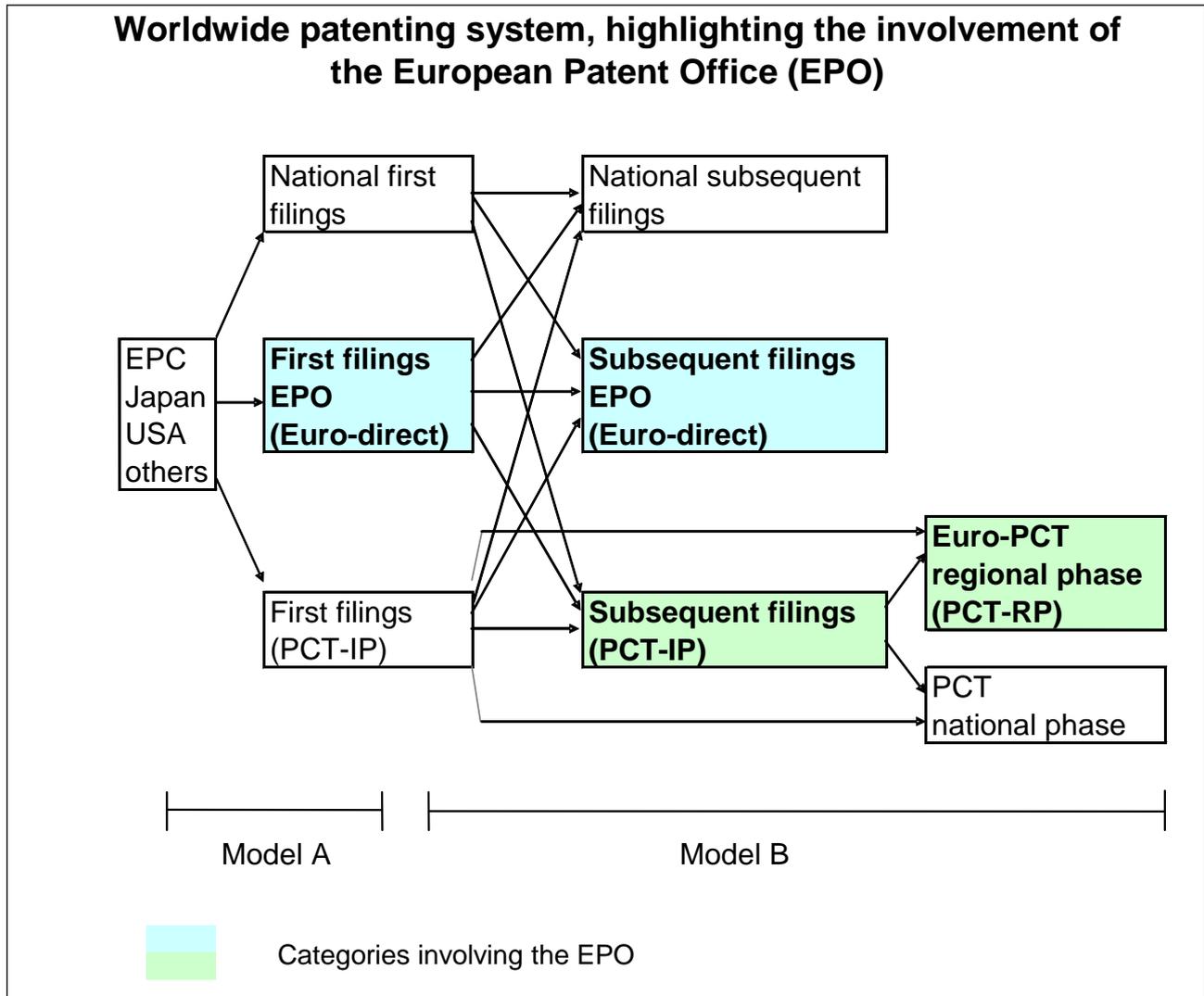
Figure 2 describes broadly the process and the options for patenting in Europe.

Inventors from all over the world tend to file a first patent applications locally to secure their invention and on the basis of the Paris Convention this establishes their priority rights to apply subsequently in other countries within 12 months from the date of the first application. This constitutes "Model A" in Figure 2. The decision to apply for a first patent application is driven by several external factors (research activities of the company, type of patent system existing, propensity to patent, industrial or technological sector of activity of the applicant, ...), and reflects the extent of innovation activity.

First filings are made mainly to the national offices, but an increasing proportion are directly made at the EPO or under the PCT, that allows the applicant to provisionally request patent protection in the 122¹ member states of the PCT Union.

¹ As of 1 August 2003

Figure 2 - Patenting model



Then, based on additional research and on further economic developments, most of applicants decide to apply for patents abroad to cover more countries. According to the Paris Convention, applicants have one year to benefit from their initial applications to keep the lead in exploiting their innovation. Various options do co-exist in Europe: the national procedures, the European procedure and their combinations with the PCT procedure. This constitutes “Model B” in Figure 2 and reflects the internationalisation or globalisation of the market for protection.

Figure 2 also highlights the types of applications the EPO will have to handle at some time in the process.

This modelling of the patent process in Europe has some impacts on the forecasting approach of the EPO. As a supranational office, the EPO is more confronted with subsequent filings (Model B) than with first filings (Model A). Therefore some of the usual concepts used in modelling the econometrics of patenting do not apply naturally, or may not be as successful as for modelling patent filings in a country that is not subject to supranational patent filings.

The European patent applications are of two types.

1. An application filed under the European Patent Convention is called a *Euro-direct application*. This is an application for a European patent to obtain protection in a set of selected EPC contracting states: the designated countries. The application is entirely treated by the EPO. A search is first conducted to establish the state of the art and leads to a search report, usually published together with the application at a point 18 months after the priority filing. On request of the applicant, the application is then examined according to three criteria: novelty, patentability and industrial applicability. Once granted and published by the EPO, the patent becomes a bundle of national patents, which are further administered in each designated country.

2. Another way to apply for a European patent is to make a *Euro-PCT application*. An application filed under the Patent Cooperation Treaty may be valid in any member state of the PCT Union and in any of the regional patent organisation such as the EPO, via a designation system. After an *international phase*, during which a search is conducted and also possibly an optional preliminary examination, the PCT application enters the *national (or regional) phase* in any country or region in which the applicant wishes to get protection. A PCT international application designating the EPO is called a Euro-PCT application in the international phase and is treated as a valid European patent application (equivalent in right to a direct European patent application). In the second phase, a PCT application entering into substantive examination at the EPO is said to enter the regional phase.

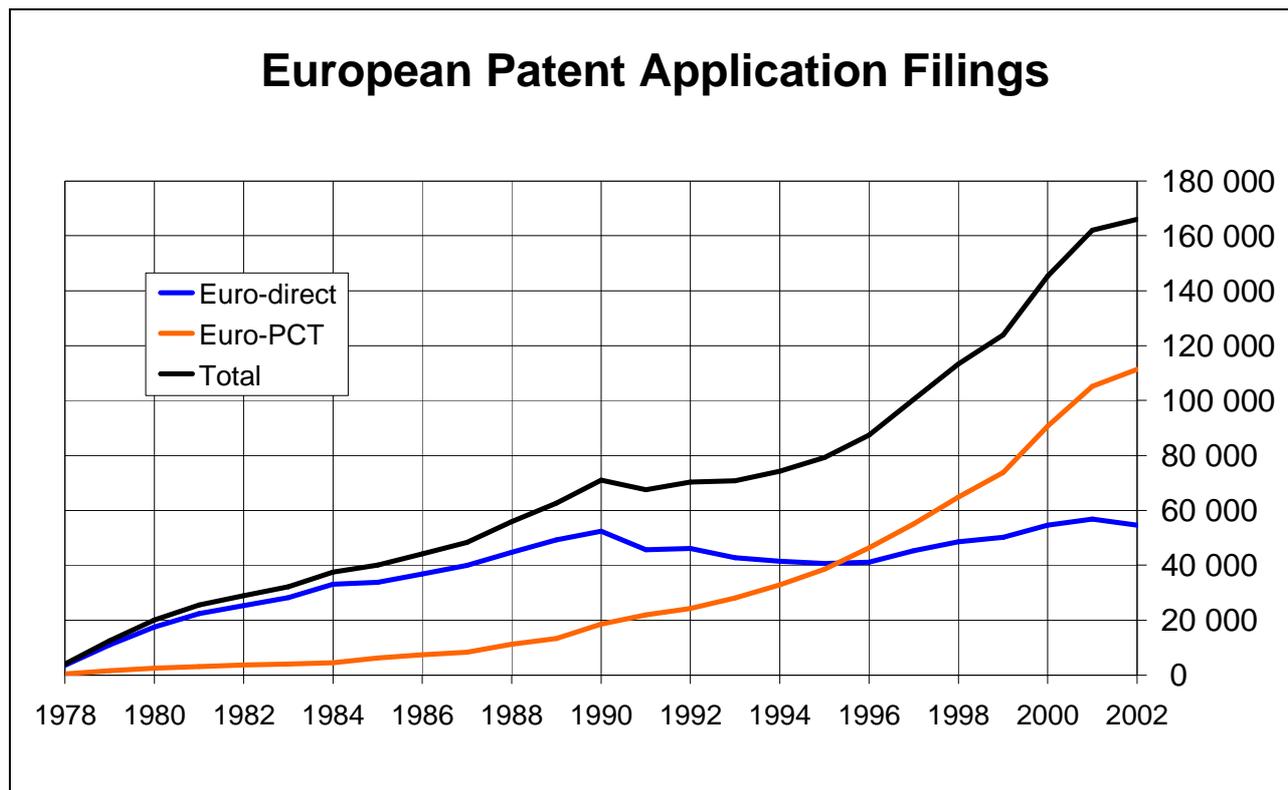
Since the major part of the workload of the EPO is generated by these two kinds of applications, forecasting their numbers for each year of the planning period is a critical step to elaborate the business plan of the EPO. In addition, among the nine offices recognised by the PCT Assembly to perform the search and the preliminary examination during the international phase of the PCT procedure, the EPO receives the largest number of files to treat. This constitutes other workload items to be forecasted.

3. Forecasting methods at the EPO

The EPO experienced some changes in the trend of total filings, no doubt due to changes in the patenting behaviour as well as changes of the patenting environment, such fee increases or decreases, legal modifications in the patent laws or regulations, or economic or political changes. The 1991 decline of the EP filings had not been foreseen, and the number of applications filed remained stable or growing at a low pace during several years, before the upward trend reappeared in the late 1990s. In 2001, statistics on filings during the last quarter were affected, and render the 2002 forecasting exercise difficult. In 2002, the number of EP filings grew marginally over 2001, but again figures might still be updated, making forecast difficult. This might be the end of a period of large increase in filings.

As shown in Figure 3, the applicants for EP patents slowly but steadily changed their preference from the Euro-direct route to the Euro-PCT route, especially since 1990.

Figure 3 - Development of the number of European applications



Originally, the EPO prepared its forecasts with a limited investment of resources. A few extrapolations and regressions were performed in order to provide one set of forecasts for the planning period. On the basis of this proposal, the management decided on a filing scenario to serve as a basis for the MTBP and the budget.

Over the last decade, the process has been further developed by looking at different ways of forecasting, but simple *trend analyses* are still intensively used (Section 3.1). Another modelling concept was elaborated on the basis of the scheme described above. The *transfer model* extrapolates the EP subsequent filings on the basis of the expected development of worldwide first filings (Section 3.2). The third method used by the EPO to predict filings uses the results of an applicant survey (Section 3.3).

The results presented hereafter, summarise the forecasting work that was done in January 2003 with a partial updated in August 2003.

3.1 The trend analyses

The principle is to extrapolate into the future the observed historical trend of total filings. This approach assumes a stable process, and this has not necessarily been the case in actual fact. The extrapolations are applied to series of various length and compared.

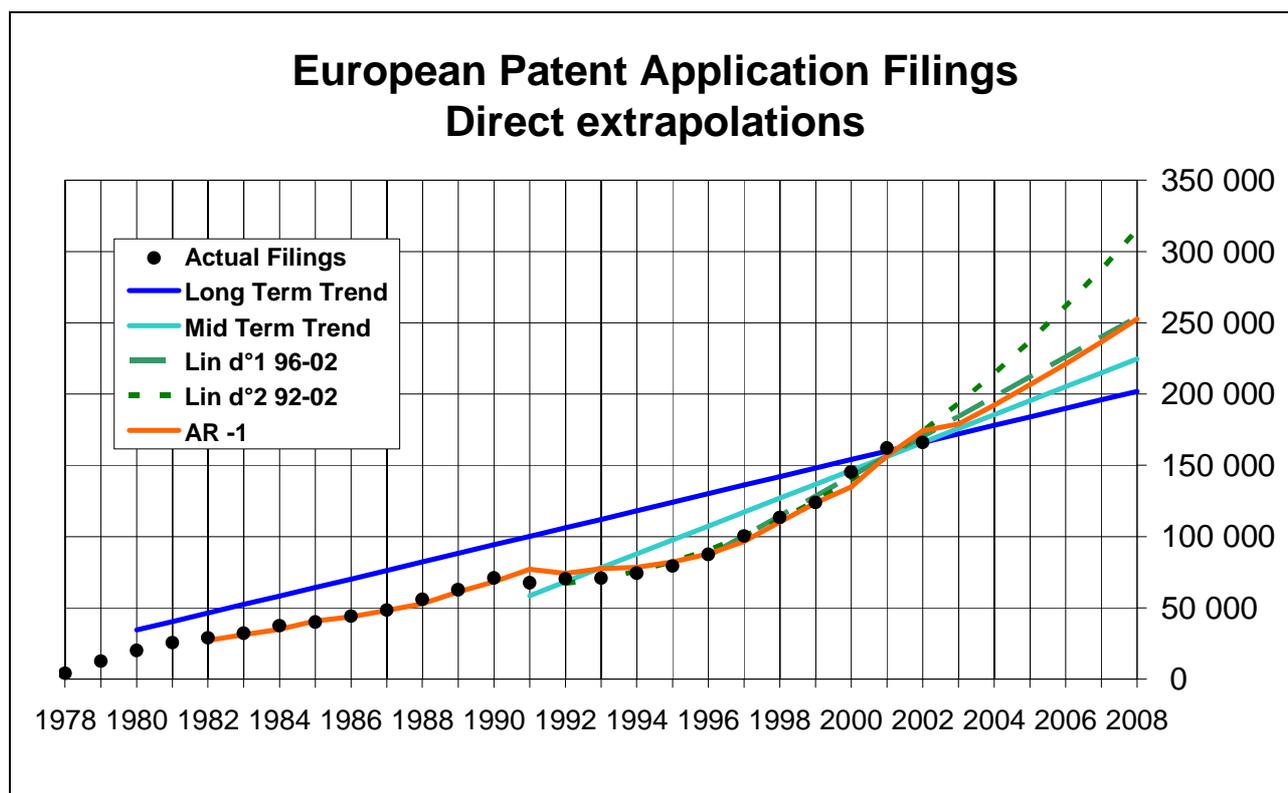
The changes in the trend, as in 1991, could not be predicted by simple extrapolations, and during the late 1990s and up to 2000, the EPO recorded systematically more filings than had been planned. Nevertheless, trend analyses are used as references of annual average growth and are taken into account when making consolidated forecasts.

When preparing the forecast in January, the previous year's data are not yet known exactly, but an estimate is available that is based on counts in the receiving sections of the EPO. During the following 18 months, statistics on the number of applications filed during the previous year, are regularly updated until all the filed applications are registered in the EPO database. This relatively long period is mainly caused by lags due to the reporting of Euro-PCT international phase filings.

In 2003, trend analyses were performed on data covering three different periods: 1980-2002, 1992-2002 and 1996-2002. Linear models over time that involved first or second degrees polynomials were applied. The goodness of fit was assessed using the Root Mean Square Error to evaluate the results. A simple autoregressive model on the series lagged by one year was also fitted.

Figure 4 presents the resulting forecasts up to 2008 of the total number of European patent application filings. The "long term trend" line reflects observed trend over the period 1980-2002, applied to the 2002 observed value. The "medium term trend" line reflects the trend observed over the period 1992-2002, again applied to the 2002 observed value. This shows the results obtained in August 2003, based on revised figures for filings in 2002.

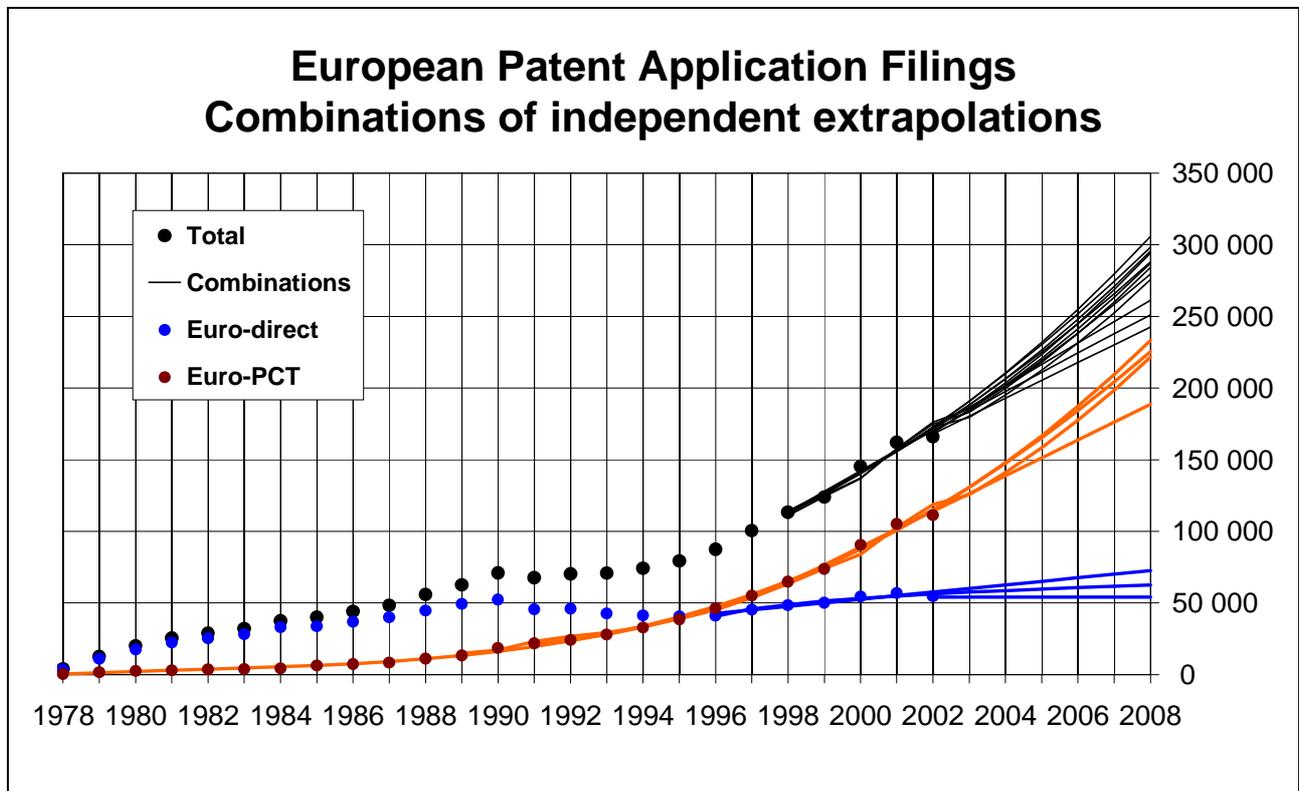
Figure 4 - Trend analysis of the total filings



The split between the direct European applications and the Euro-PCT is obtained from an extrapolation of the proportion of the Euro-PCT applications using a sigmoid curve such as the logistic function to represent the saturation effect over time.

Similar trend extrapolations are applied independently to the series of Euro-direct applications and the series of Euro-PCT applications. A simple consolidation by summing up the results gives another set of forecast. This is shown in figure 5.

Figure 5 - Combinations of independent forecasts



This approach does not take into account any possible correlation between the two series. Controlling Office tends to believe that the two types of applications are alternative ways for applying for a patent in Europe. The first decision taken by a firm is that of the need for a patent; the choice of the route comes later depending of the strategy to seek also protection outside Europe. It is unlikely that the two processes co-exist independently. Therefore it may not be surprising that modelling the two series independently leads to higher estimations of the total number of applications.

3.2 The transfer model

The basic transfer model is a three step forecasting process that tries to take into account the patenting pattern described in Figure 2. More than 80% of the worldwide first filings are applied for in Europe, Japan and the USA, and about 90% of the EP filings are subsequent applications based on priority applications filed in Europe, Japan or the USA. The filings originating in the rest of the world represent a small but increasing proportion of the European patent applications, which went from 3% in 1978 to 10% in 2002.

The transfer model assumes a one year lag between first filings and subsequent filings at the EPO, in accordance with the specification of the Paris Convention.

In the first step of the development of the basic *global transfer method*, total first filings worldwide are estimated on the basis of the observed trend in total first filings in Europe, Japan and the United States of America. So far, very few statistics on first filings are available. The EPO made a working assumption that the statistics on national domestic applications all over the world were the best estimates of the numbers of first filings, and these were therefore used in the transfer model. But, the EPO, JPO and USPTO have now started to exchange filing statistics on recent national patent applications, broken down into first filings and subsequent filings. Similarly, available data on first in the EPC states are used to extrapolate the total number of first filings in the EPC area. (These figures are given in the *Trilateral Statistical Report*, a joint publication of the EPO, JPO and USPTO [4].)

In a second step, the transfer rate of these first filings to subsequent EP filings is calculated as the ratio of the number of subsequent EP filings to the number of first filings one calendar year before.

The observed trends for first filings are extrapolated to the future, and in step 3 a combination of steps 1 and 2 delivers an estimation of the number of future subsequent patent filings at the EPO, originating from the three regions.

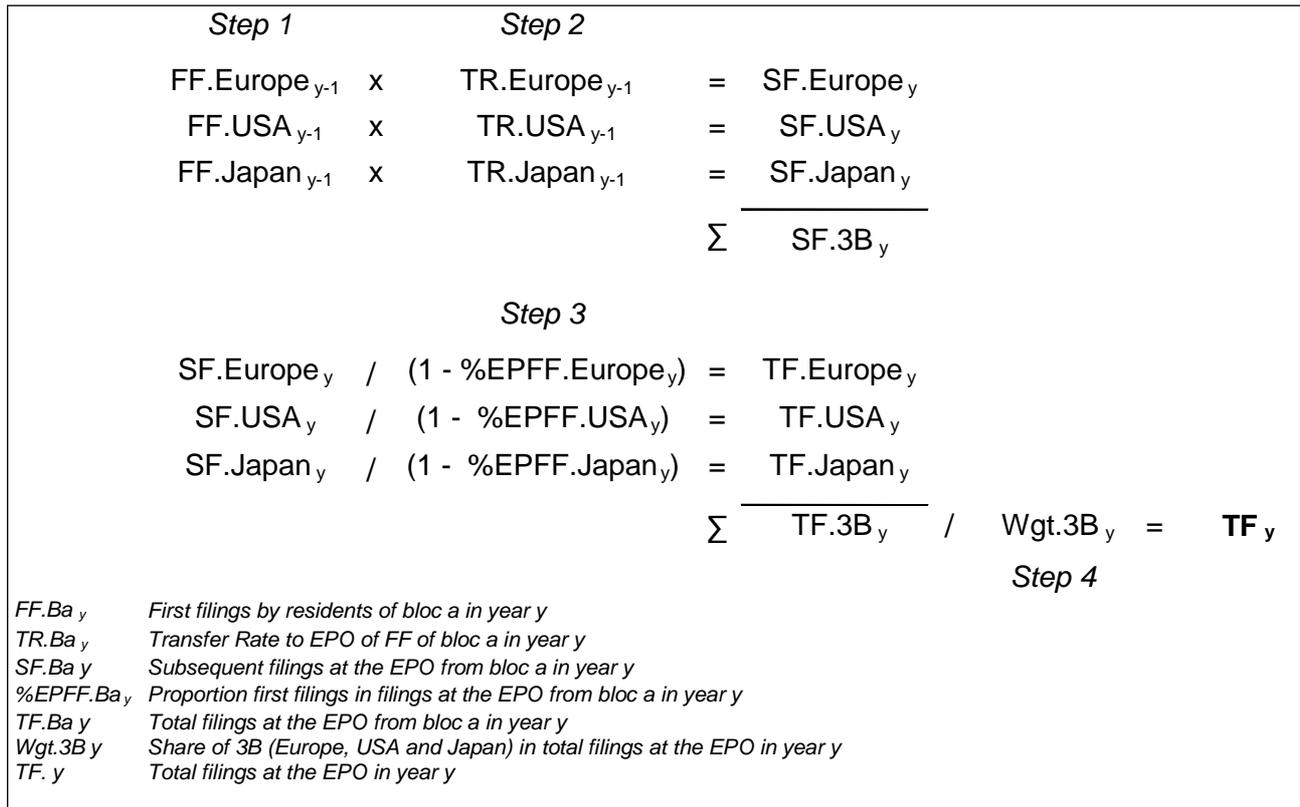
The final step consists of an estimation of the number of the other filings made at the EPO. These are first filings made directly at the EPO and all the patent applications at the EPO originating from outside the trilateral area. Again an extrapolation of the trend in the proportion of the other filings allow to correct the second step result, to obtain a forecast of the total number of patent to be applied at the EPO in the coming years.

This method has been refined to take into account each region's specific development. As the EPO was looking to improve the accuracy of the forecast, and as prediction of the numbers of national applications in Japan and the USA became available through an active cooperation [see under 4.1], it was assumed that using more detailed modelling of first filings and of the transfer rates might help towards this goal. An alternative model has been developed, called the *bloc-wise transfer model*. It applies the same methodology, but estimates separately, the various parameters for each of the three regions and requires a fourth step. Step 1 is identical, steps 2 and 3 are applied independently for Europe, Japan and the US, and a fourth step accounts for the number of applications originating from the rest of the world.

Figures 6 summarises the 4 steps process of the method.

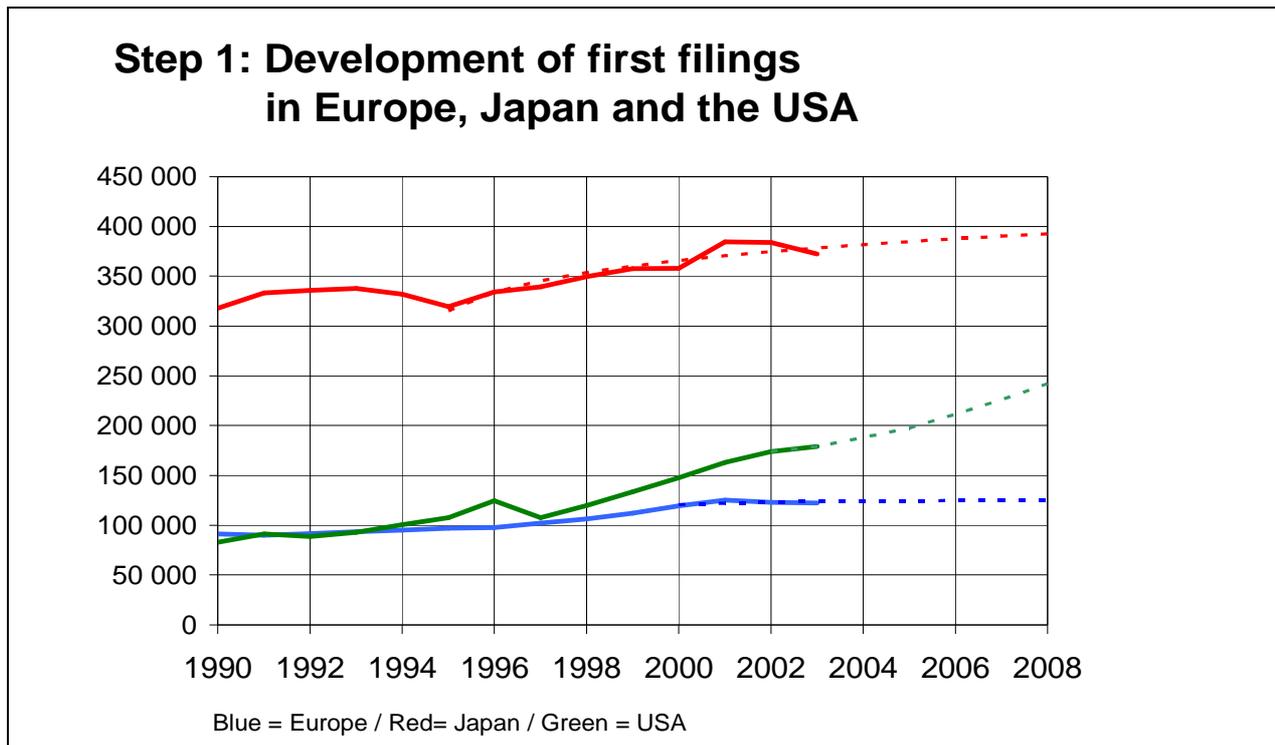
The bloc-wise transfer method has gained credibility recently in the realm of the EPO Round Table discussions, though no formal assessment has yet been made of it's performance compared to the global transfer model.

Figure 6 - The bloc-wise transfer model



The following figures describe the latest results obtained in January 2003 with the bloc-wise transfer model. The number of first filings has been steadily growing over time (Figure 7).

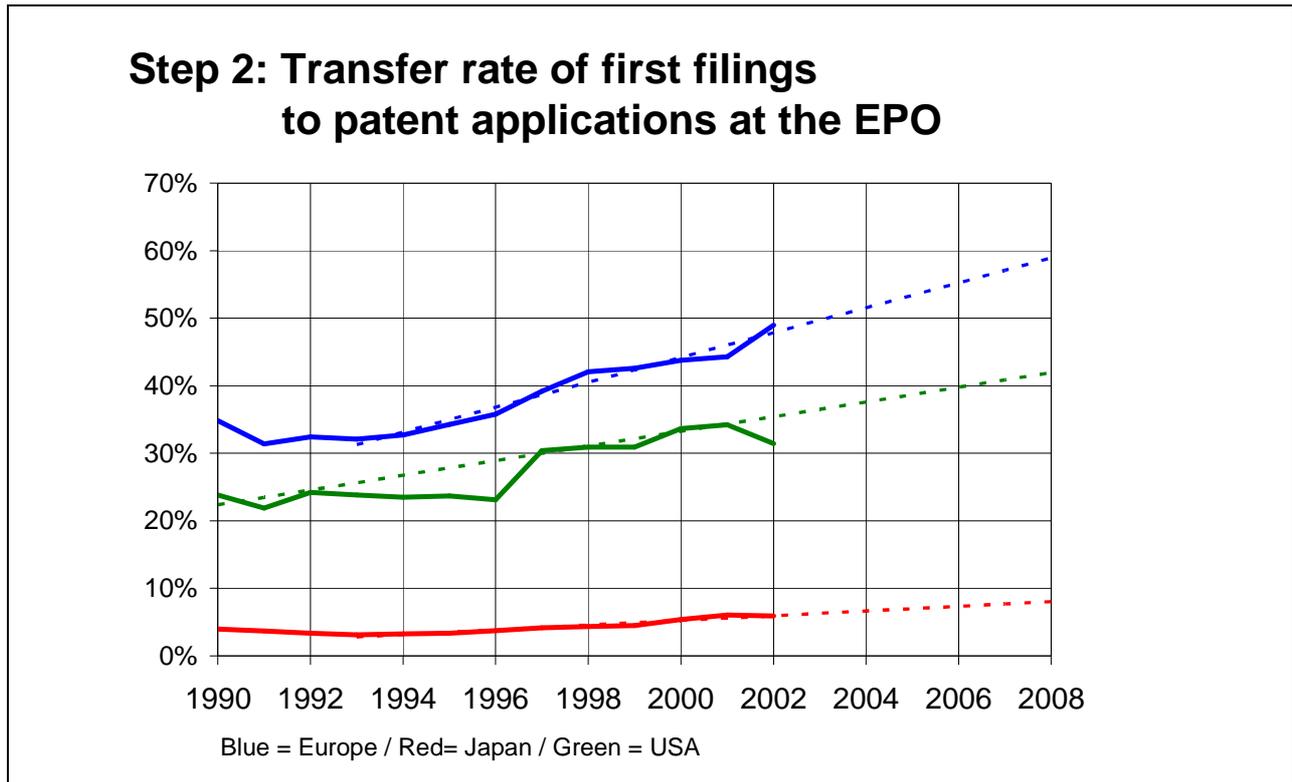
Figure 7 - Transfer model - first filings



The upward trend over the last decade can easily be extrapolated.

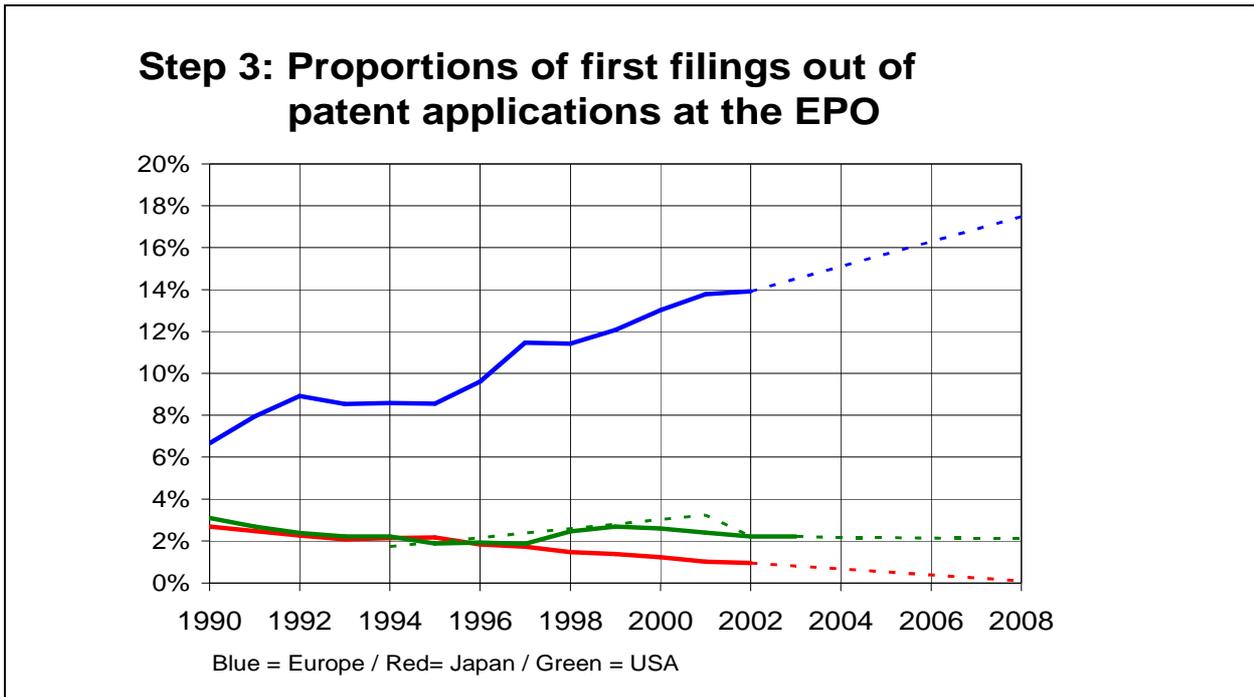
The transfer rates have shown different patterns over the last decade (Figure 8). On the one hand, the transfer rate from first filings in Europe grew at a regular pace to reach almost 50% in 2001, and that from Japanese first filings remained much lower because of the high number of first filings there. On the other hand, the transfer of US first filings to European subsequent applications has shown higher variability, with a particularly sudden increase in 1996 (corresponding to first filings in 1995).

Figure 8 - Transfer model - transfer rates



Applicants may file their first filings directly at the EPO. This can be particularly attractive to European applicants. Since the late 1980s a growing proportion of them have used this possibility, and the proportion of first filings out of the total number of patent filings at the EPO has doubled since 1990 for European applicants. The corresponding proportion for American applicants remained stable at a much lower level, and that of Japanese applicants declined slightly (Figure 9).

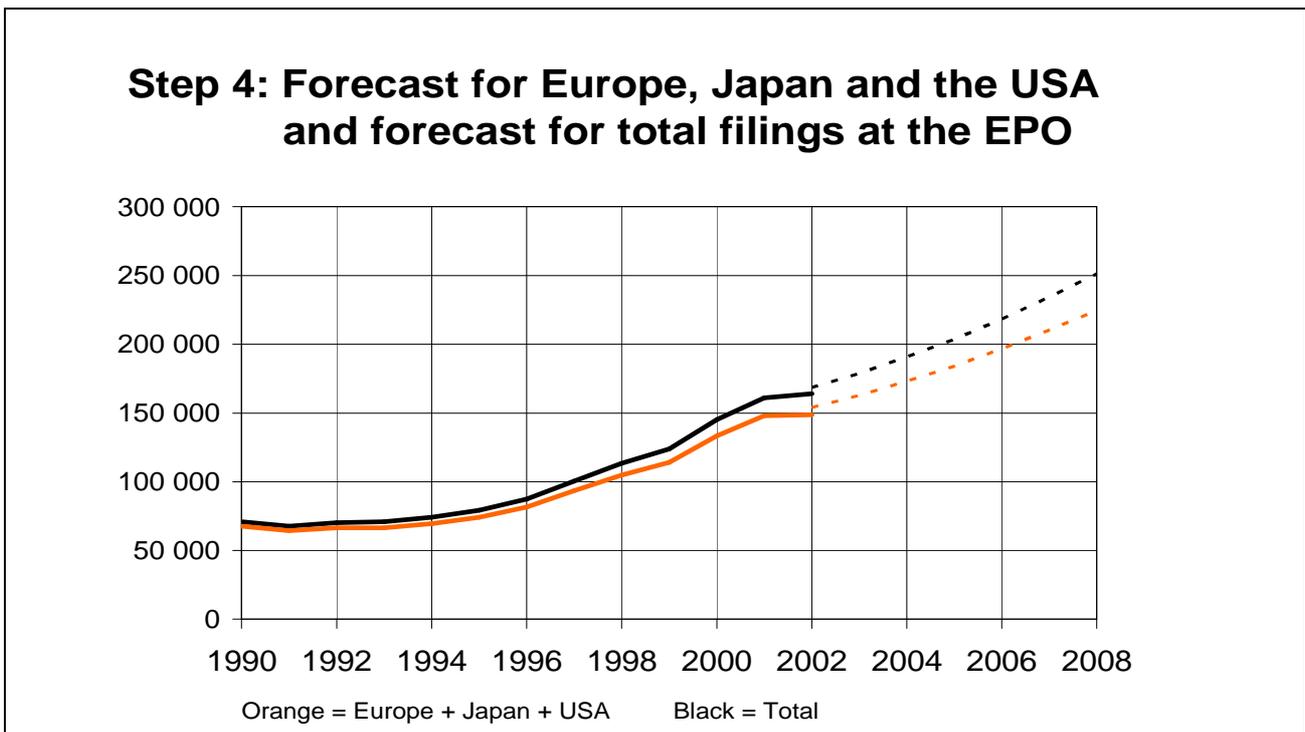
Figure 9 - Transfer model - Subsequent filings as part of total filings



The last component in the model, consists in an estimation of the number of filings from outside the three major bloc of origin. This is made by extrapolating their proportion out of the total number of applications.

Figure 10 shows the resulting forecasts of EPO filings before and after compensating for filings from outside the trilateral blocs.

Figure 10 - Transfer model - forecast total filings



3.3 Applicant survey

Each year the EPO conducts a survey among its applicants in order to receive information on their intention for filings at the EPO for the current year and the next two years. The questionnaire also covers filing intentions in other major patent offices and questions on the procedure to be used for these filings.

The survey has been carried out annually since 1996. Applicants may give quantitative answers on their future filings or qualitative evaluation of their intention in comparison to a reference year. About 2000 applicants are randomly selected (*Random Group*) with a probability proportional to the number of applications filed in the previous *reference year*. A second group is composed of the top 400 applicants in the reference year (*Biggest Group*). The main objective of the survey is to measure a growth index for the following two years, that can be applied to the observed number of applications filed in the reference year.

The Biggest Group consists of regular systematic applicants and is expected to be more reactive to any environmental changes, while the *Random Group* allows an evaluation of the overall trend with confidence intervals on the estimated numbers of filings.

Typically, the survey is conducted in the third quarter of the year, and the analysis follows so that the preliminary results are available at the time of the discussions in the Round Table in January.

In the 2002 survey, the applicants were asked to give their filing intentions for 2002, 2003 and 2004 on the basis of their filings in 2001 as reference year. The results for the current year (i.e. 2002) may be used later in a survey evaluation process which allows for a better exploitation of these results, for example by comparing the forecast performances of the Biggest Group to that of the Random Group.

The following figures give the main results and forecasts issued from the 2002 survey [5].

In a first analysis, growth indices on total filings, European direct filings and Euro-PCT filings are calculated for the Biggest Group and for the Random Group. Figure 11 shows the forecasted number of filings according to the composite index of Biggest Group. The composite index is calculated as follows:

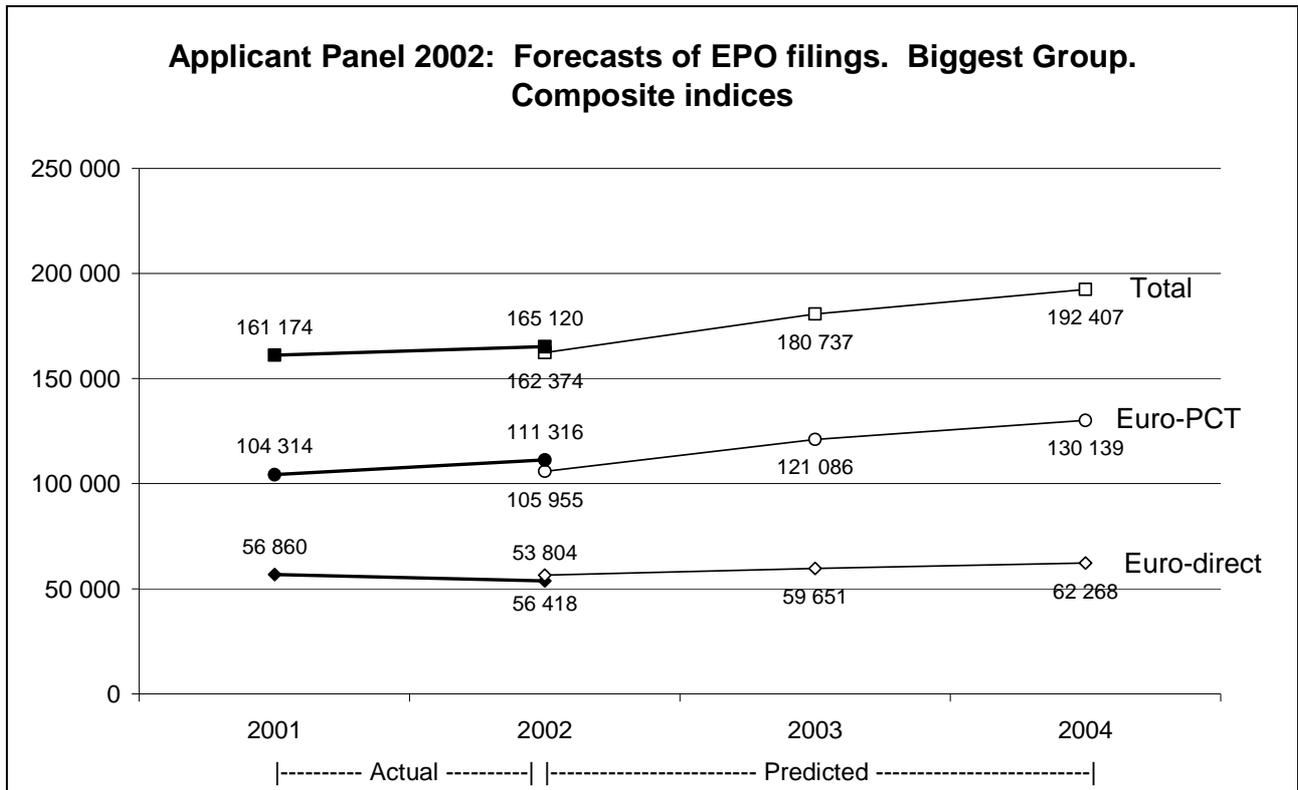
$$CI = \frac{\sum_{i=1}^n x_i}{\sum_{i=1}^n A_i}$$

Where n is the number of applicants in the sample, and summation is taken over the sample members $i = 1, \dots, n$.

x_i is the intended number of filings reported by the i th sampled applicant in 2002.

A_i is the known number of applications made by the i^{th} sampled applicant in 2001.

Figure 11 - Applicant survey - Biggest group forecasts



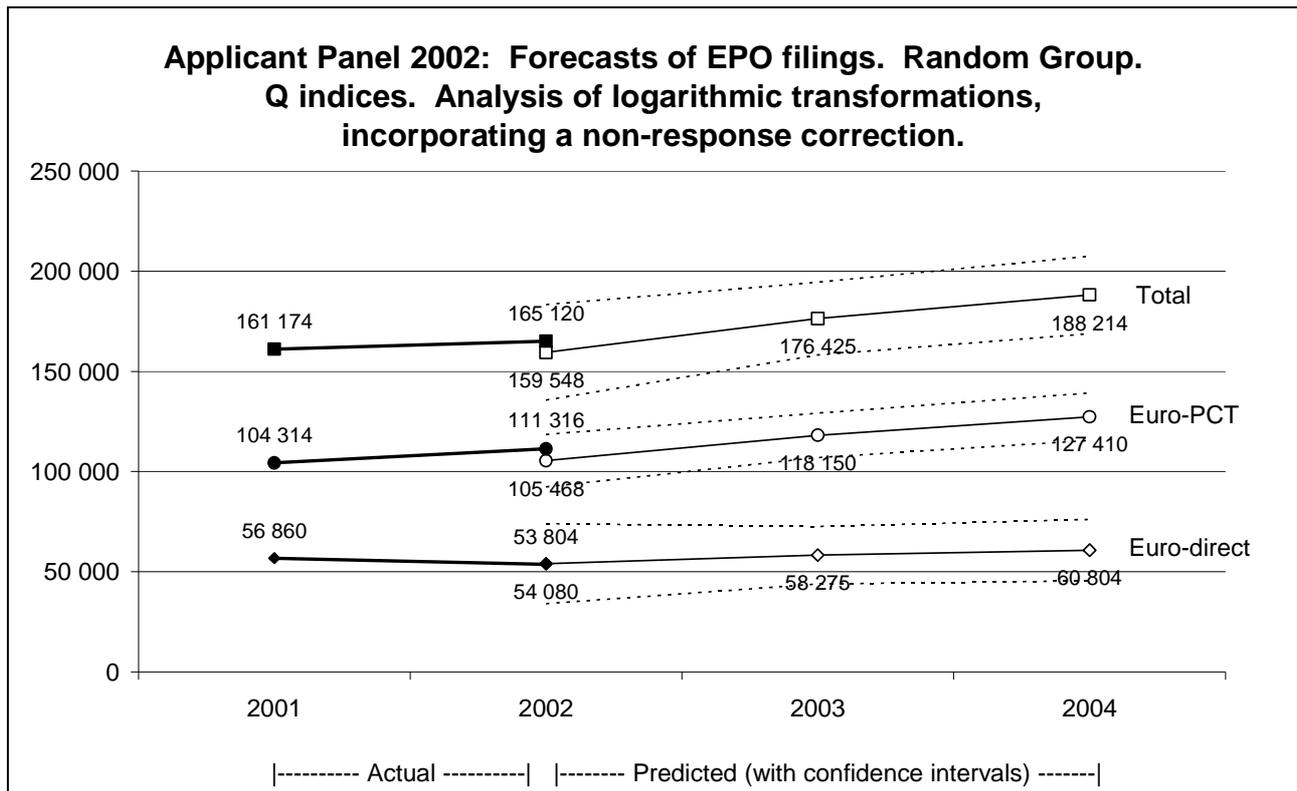
The Random Group results are issued from log-transformed data, and seem to confirm that of the Biggest Group, though applicants of the Biggest Group seem somewhat less optimistic. The index for the Random Group is a weighted growth index.

$$Q = \exp \frac{\sum_{i=1}^n q_i \text{Log}(I_i)}{\sum_{i=1}^n q_i}$$

where $\text{Log}(I_i)$ is the natural logarithm of the individual index $I_i = x_i / A_i$.
 q_i is the probability of applicant i being selected for the sample.

The level and direction of the difference between the two groups suggested that there might be a bias in the Random Group due to the non-responders. The assumption is that from the randomly selected applicants, the pessimistic ones may tend not to answer the questionnaire, or that the optimistic applicants may be more willing to demonstrate their optimism.

Figure 12 - Applicant survey -Random group forecast after correction



Compared to the first analysis, the correction for the non-response leads to lower forecast, and to a lower estimate for the reference year. The confidence intervals overlap to a large extent and cover the forecasts issued from the Biggest Group.

3.4 Consolidation process

The various results presented above are discussed in January by group of EPO experts on planning during a Round Table on forecasts. The following table summarises the results as they were presented in January 2003.

During this meeting, qualitative judgments on the methods and their results are made and the development of external factors are taken into account. For example, new rules in the granting procedure or legal amendments at the EPO or elsewhere in the international patent process are discussed, and their possible impact on the number of filings are integrated if they seem relevant.

A planning scenario is established on the basis of the forecasts and of this discussion, and is then submitted with other key parameters to the EPO management as the set of basic assumptions for the planning, the budget and the financial plan.

Table 1: Forecast results for the total number of applications for the period 2003-2008

Method	2000	2001	2002	2003	2004	2005	2006	2007	2008
Actual	145 237	161 174							
Estimation			165 120						
Extrapolations									
Long term (1980)			164 000	170 000	175 900	181 900	187 800	193 800	199 700
Mid term (1991)			164 000	173 700	183 300	193 000	202 600	212 300	222 000
1996-2002 (d°1)			169 000	182 700	196 300	210 000	223 700	237 400	251 100
1992-2002 (d°2)			172 300	191 300	211 700	233 800	257 300	282 400	309 000
AR - 1			172 600	176 000	188 500	201 500	214 900	228 900	243 300
Combined ED + EPCT			172 500	189 400	207 300	226 300	246 400	267 600	289 800
Transfer									
Global 0,1%			164 600	169 500	174 000	178 100	181 900	185 500	188 900
Global 1,5%			162 800	170 600	177 800	184 500	190 700	196 600	202 100
Blocwise			169 700	179 200	190 500	202 200	216 200	231 000	246 800
Panel			159 300	176 200	188 000				

4. Activities to improve the forecasting methodology

Realising the importance of the forecast as a basis to prepare it's budget, the EPO has developed a policy to improve the forecasting methodology. In the frame work of the Trilateral Cooperation with the JPO and the USPTO, the EPO takes part in a cooperative programme on forecasting, by means of regular exchanges of work and discussions between the respective staff concerned with forecasting. The EPO also launched a research programme on forecasting methodology.

In 2003, the EPO has decide on a new strategy to better serve its customers. The Examining area of the EPO have been re-organised in technical areas. The Office expected to be able to plan its activities as far as possible at the level of these technical areas.

4.1 Trilateral activities

In 1992, the three major patent offices decided to share their efforts in improving their ability to forecast the number of patent filings they will receive. Each office developed its own modelling concept and regularly progress reports were exchanged and discussed. More recently a working group was set up (Trilateral Statistical Working Group or TSWG), to further strengthen this cooperation.

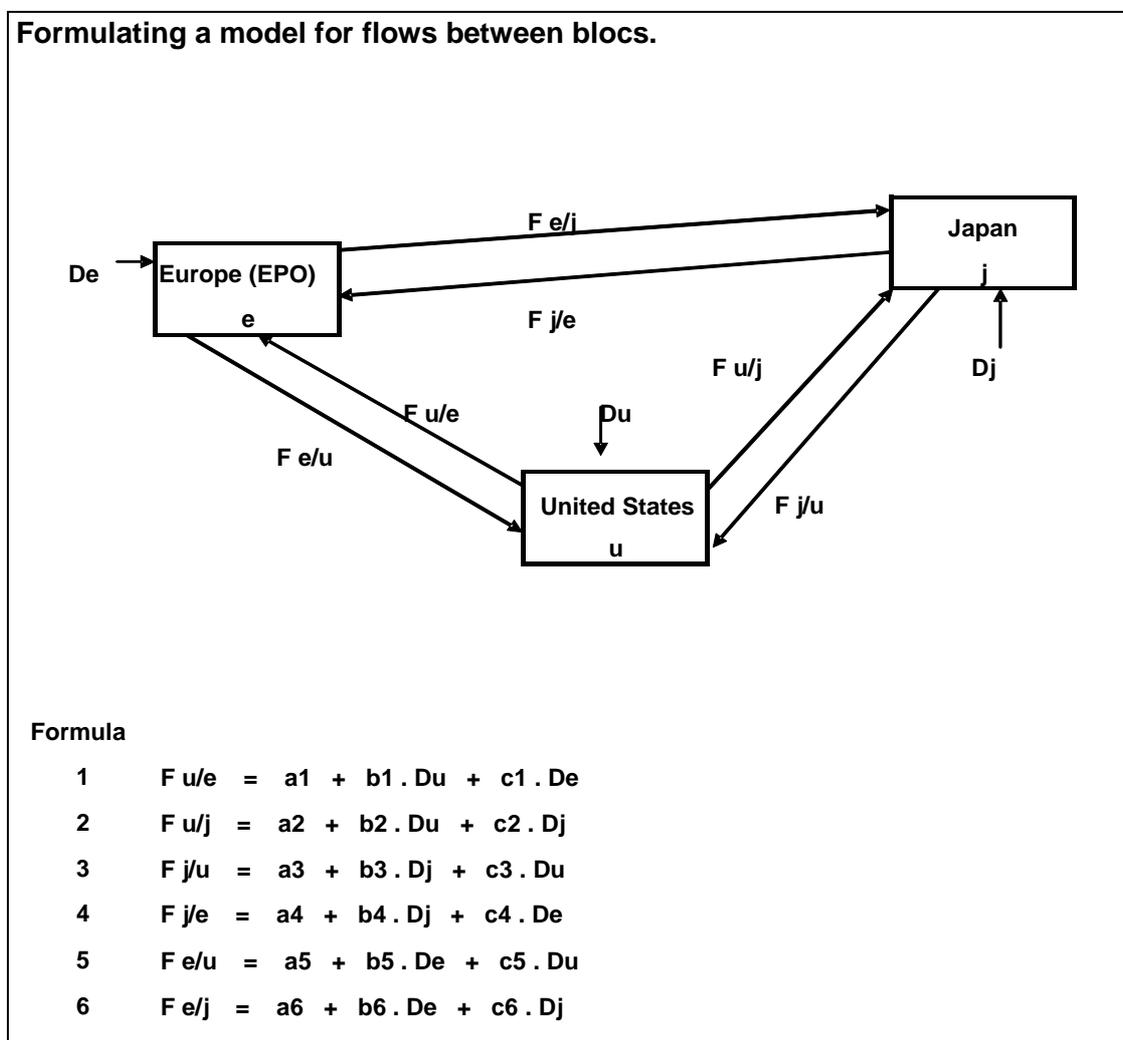
Some econometrics models have been considered in depth, and the Model A (Figure 2) has been analysed in some depth, in particular to establish the nature of the correlation between external factors such as GDP or R&D expenditure and the number of patent filings. Special consideration was given to define the time delays between R&D expenditure and patent filings [6].

Interesting results came from these studies to help modelling first patent filings (Model A). Unfortunately, model B, which is highly relevant to the EPO, has not been studied in such depth. It is hoped to develop a so-called *Global Model*, assuming that patent filings in the

different locations are interrelated by an internationalised patent protection mechanism that depends on factors such as the attractiveness of a market and the development over time of process of globalisation.

A set of equations was pre-analysed and some simplified versions were tested [7]. Figure 13 shows a simple description of such model. The number of applications in a bloc is described as a function of the number of filings in the bloc of origin and the number of filings in the bloc of destination. As a key element to make substantial progress, this approach requires some data on patents subject to filing in several regions. Patent families statistics could be used to study more in details this model - these data exist and are now subject to further work to overcome a major limitation of timeliness of the reported data [8].

Figure 13 - Global forecasting model - Trilateral flows



Forecasting is one only of the several activities of the TSWG, but it remains a critical part of the cooperation of the offices by exchanging ideas, results and data. All three offices are carrying out surveys of applicant filing intentions and discussions on survey

methodology have led to some agreement on harmonisation of questionnaires and other areas.

4.2 Research Programme

In 2001, the EPO decided to get support from external researchers, to help study alternative forecasting methods or to improve the methods already in use, by means of a Research Programme on improvement of forecasting [9]. The allocated budget allocated was used to select experienced researchers in the fields of patent statistics and forecasting with different areas of research:

1. Survey methods;
2. Patent filings at the firm level;
3. Patent filings at the Industry and National level;
4. Patent Transfer models;
5. Time series models.

The objective is not to obtain alternative forecasts straight away but to receive advice with a view to implement new or enhanced methods and recommendations on software to be used. Projects were selected to cover aspects of all five themes.

Initial reports have been received for the projects. The results available so far shows some interesting provisional findings:

- there may be no gain in accuracy of forecasts to be expected from disaggregating the technical areas defined by the IPC sections,
- disaggregating by bloc of origin (Europe, Japan, USA, rest of the world) may improve the accuracy of the predictions for the total,
- dynamic linear model of monthly filings data provides for accurate forecasting, at least over a limited time frame,
- exponential smoothing models could be easily implemented,
- ARMAX and state space models can be used to forecast filings from lagged R&D expenditure.

Further developments are expected during the near future. The EPO will then decide on which suggestions should be retained and how to proceed with their integration in the regular forecasting exercises.

4.3 Forecasts by technical areas

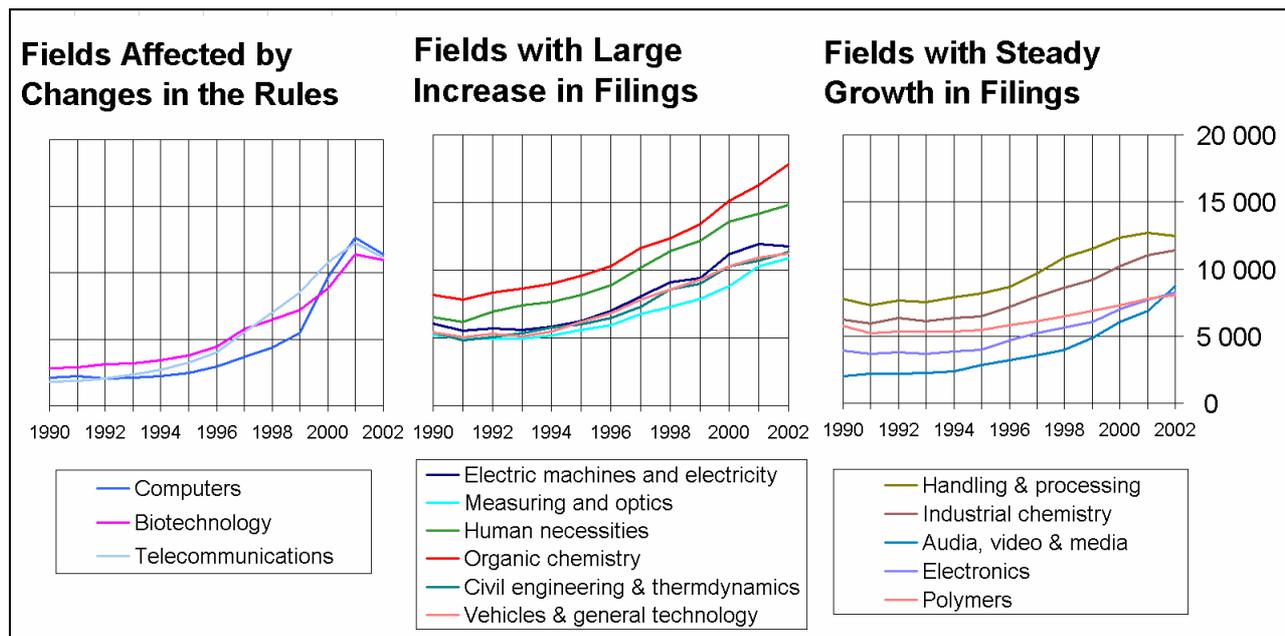
Previously the EPO organisational structure reflected the two main steps of the granting procedure. A branch of the Office was carrying out the search while a second branch performed the substantial examination. With big growth of the workload, and consequent increases in the duration of the granting procedure and backlogs, the EPO decided in

2002 to reconsider the organisation of the examining areas. All the directorates in Munich, The Hague and Berlin have now been regrouped into 14 *Joint Clusters* (JC) in related technical fields. The Office expects this reorganisation to boost efficiency significantly through synergy gains. One of the major objectives is now to complete the granting procedure for as many applications as possible within three years.

A key concept in the re-organisation is to give more autonomy to the Joint Clusters, in particular with respect to resource planning. Each JC is foreseen to become a unit whose size should allow the appropriate monitoring of its own activities. As one component of the new strategy, the planning will now be done at the JC level. This requires that forecasts of the numbers of applications should be made for each of the JCs.

It is clear that patenting behaviour varies between JCs, in numbers and in the choices made by the applicants. In some technical areas, applicants tend to give preference to the PCT route, in other fields, the majority of applications originate from Europe, and the choices are different. Some areas tend to seek faster grant procedures. Figure 15 shows the difference in the development among the JCs. In some cases, the trend remained stable over the last decade, while other sectors were severely affected by recent downturn in the corresponding economies, or by changes to the procedural rules.

Figure 14 - P Filings per cluster



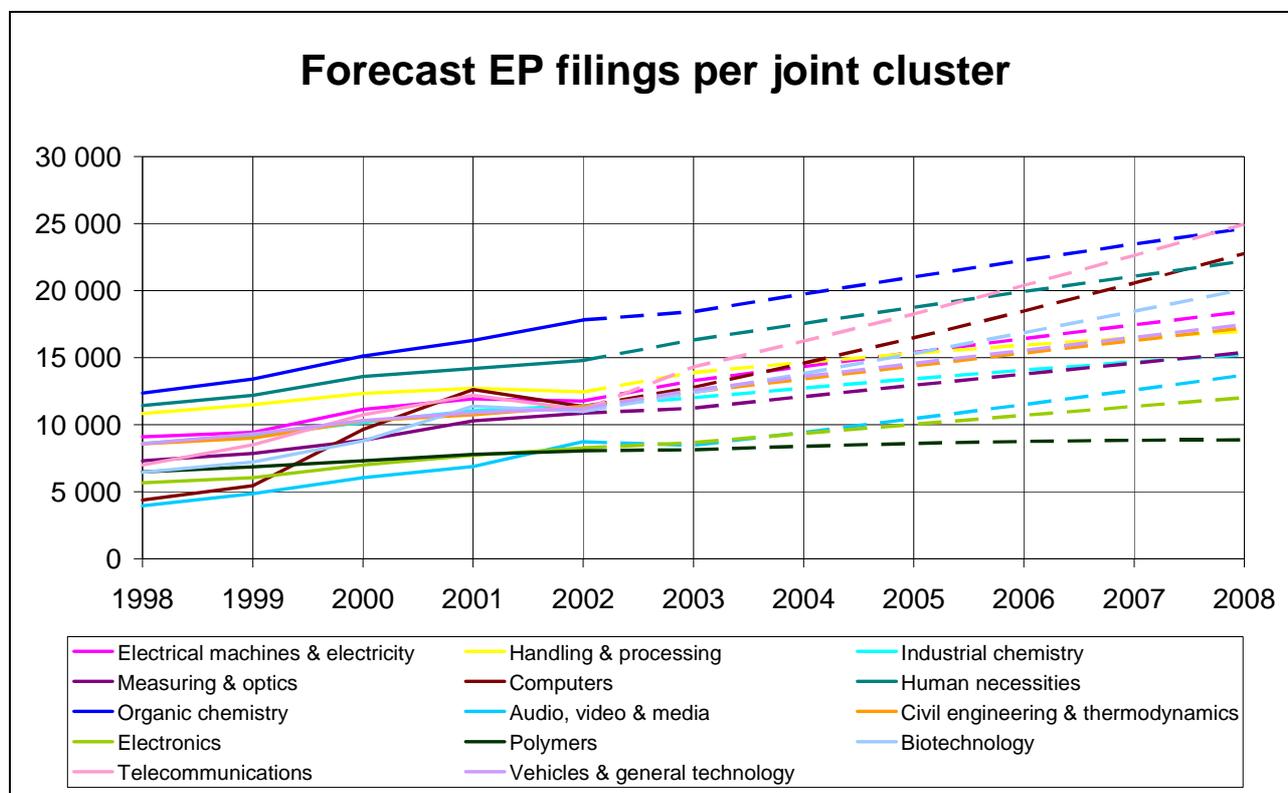
The consequence for Controlling Office is a need to provide statistical information according to this structure and to propose forecasts of the number of filings in each JC. Besides the immediate consequence of preparing the 2004-2008 plan per JC, Controlling faced some technical difficulties associated with the new requirements. Previously the forecast of total filings was so far the final step of the forecasting process, it now becomes one step among several.

A temporary solution was developed to cope with the new requirement for the 2003 MTBP. Total filings forecasts were split into 14 sub-forecasts. Simple trend analyses were applied separately to each of the 14 data series, to produce 14 forecasts. But once added up, the

resulting total was obviously not compliant with the initial forecast for the total number of applications. The difference was proportionally re-distributed to each group, to obtain a corrected series of forecasts. A second method consisted of trend analysis of the shares of each cluster in the total filings. This methods take into account, to some extent, the interdependency of the series and also presents an advantage in that the extrapolations comply with the total when they are summed up (Annex A). The final step consisted of taking an average of the two series of results as a proposed forecast per clusters. Resulting forecasts are shown in Figure 16.

This temporary solution satisfies neither the planning officers nor ourselves. The difference in pattern and the difference in patenting behaviour of the applicants for applications in different JCs may justify the attempt to forecast per cluster. But most likely some of the series are interrelated and simultaneous forecasts would be preferable to account in a better way for the structure of the underlying process.

Figure 15: Forecast per cluster



As from January 2004, the intention is for Controlling to propose a *top down* forecast of the total number of applications, and to compare this with the *bottom -up* approach where total filings forecast will be the sum of the 14 forecasted filing numbers produced for each JC.

The Controlling Office is in a phase of reflection on how to adjust forecasting to the new context at the EPO. The extrapolation techniques can be applied 14 times, but there are obvious limitations and some studies on inter-dependencies are already foreseen. Alternatively, some *super-clusters* could be generated for forecasting purposes, by grouping those JC for which data series show high correlations. As an illustration of the difficulty that this causes, the transfer model requires first filing statistics at a number of patent offices. Expanding the method to be applied to each JC would require such data to

be provided by these patent offices for each individual cluster. This is under investigation with some offices in Europe. The assignment of an EP application to a cluster is done by the EPO, on the basis of the pre-classification according to the International Patent classification [10] when the application is received. Such pre-classification may be changed later on during the examination procedure. Patent offices may follow different rules to assigned an application to an IPC Class, or to any other grouping code. There will be clearly some difficulties to harmonise cluster first filings data from several offices.

Therefore it is most likely that, in the near future, the transfer model as it exists currently will be used only to forecast the total number of applications at the EPO.

The applicant survey might be adjusted to allow for calculation of growth indices could be for each cluster. An experiment was already conducted on the 2002 survey data [5]. Each respondent in the Random Group was allocated to a unique JC on the basis of the IPC code of the application by which he had been selected. It was necessary to define several Super-clusters in order to have a sufficient number of observations per cluster for analysis. Forecast were made for the numbers of applications to be filed in these super-clusters, and after amalgamation the results found for Total filings were similar to, but slightly greater than, the forecasts shown in Figure 12.

The supranational status of the EPO has already restricted the use of econometric models to predict filings from R&D data. This would be even more complex if one wants to apply such models per JC, considering the lack of clear concordance between the patent classification (IP) used for the allocation of patent applications to a technical area and the economical classification (NACE or ISIC) used to allocated R&D to a technical area.

Nevertheless, the encouraging preliminary results of the Research Programme makes the Office confident that in due course it will be able to apply relevant methodology to estimate numbers of applications to be filed at a certain level of sectoral breakdown.

5. Conclusion

As a supranational patent office, the EPO depends on the provision of patent statistics from other patent offices from both inside and outside Europe. This is particularly true when preparing the forecasts for numbers of applications to be filed for European patents. During the course of it's short history, the EPO and within the EPO, the Controlling Office of the EPO has developed methods of forecasting such as simple extrapolations, a transfer model and applicant surveys. Obvious limitations and weaknesses appear when one analyses the ways the EPO proceeds when forecasting. For example, the 95% confidence limits on forecast have not been presented for the trend analysis, though they can be established and subsequent years' data generally fall within such limits. The problem is that such 95% confidence limits tend to be rather wide. It should be born in mind that the forecasting exercise at the EPO aims at the selection of a planning scenario. Once this scenario is agreed by the management, it will serve as a reference for monitoring the filing activity. Therefore, the prime function of regular forecasting is to *top up* the planning scenarios.

After several years of under forecasting, the filings for 2002 were to a certain extent over forecasted. Recent developments in the patent application filings have therefore shown

the importance of accurate forecasts, and the limitations of the current techniques used at the EPO. Methodology should allow for identifying significant trend breaks to come or to identify those determinants for changing the applicants behaviour.

The EPO hopes to profit soon from the results of the research programme to adjust its methods and to incorporate new ones. It is also expecting from next year onward to be able to propose reliable forecasts per industrial sector, either at the EPO JC level, or for aggregations of clusters.

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Annex A. Joint Cluster (JC) forecasting. Why do the trends of proportions of filings in each JC add to 1.

Let m = Number of JCs, n = Number of time points that are studied for the trend analysis, x_{ij} = Number of filings in JC j , at time t_{ij} , $z_i = \sum_{j=1}^m x_{ij}$ = Total number of filings at time t_{ij} , $w_{ij} = \frac{x_{ij}}{z_i}$ = Proportion of filings in JC j at time t_{ij} .

Then

$$(0.1) \quad \sum_{j=1}^m w_{ij} = 1$$

Let $\bar{w}_i = \frac{\sum_{j=1}^m w_{ij}}{m} = \frac{1}{m}$ = Average proportion in JC j at time t_{ij} .

Then

$$(0.2) \quad \sum_{j=1}^m \bar{w}_i = m \cdot \frac{1}{m} = 1$$

Trend model: $w_{ij} = a_j + b_j t_{ij} + e_{ij}$, e_{ij} is iid $N(0, \sigma^2)$

Let $\hat{\cdot}$ mean the estimate of a parameter minimisation of least squares. Straight line regression theory gives

$$\hat{b}_j = \frac{\sum_{i=1}^n (w_{ij} - \bar{w}_j)(t_{ij} - \bar{t}_j)}{\sum_{i=1}^n (t_{ij} - \bar{t}_j)^2}$$

$$\hat{a}_j = (\bar{w}_j - \hat{b}_j \bar{t}_j)$$

because

$$(0.3) \quad (w_{ij} - \bar{w}_j) = \hat{b}_j (t_{ij} - \bar{t}_j)$$

where $\bar{w}_j = \frac{\sum_{i=1}^n w_{ij}}{n}$, and $\bar{t}_j = \frac{\sum_{i=1}^n t_{ij}}{n} = \bar{t}$.

It will now be proved that $\sum_{j=1}^m \hat{w}_{ij} = 1, \forall i$, where $\hat{w}_{ij} = \hat{a}_j + \hat{b}_j t_{ij}$.

1.

$$\sum_{j=1}^m \bar{w}_j = \sum_{j=1}^m \frac{1}{n} \sum_{i=1}^n w_{ij} = \frac{1}{n} \sum_{i=1}^n \sum_{j=1}^m w_{ij} = \frac{1}{n} \sum_{i=1}^n 1$$

which, by equation 0.1, = 1.

2. If

$$\sum_{i=1}^r \sum_{j=1}^m \hat{w}_{ij} = r$$

where $r \leq n$, then by similarity

$$\sum_{i=1}^{r-1} \sum_{j=1}^m \hat{w}_{ij} = (r-1)$$

3. Prove that $\sum_{i=1}^n \sum_{j=1}^m \hat{w}_{ij} = n$

From equation 0.3 above,

$$\sum_{i=1}^n \sum_{j=1}^m (\hat{w}_{ij} - \bar{w}_j) = \sum_{i=1}^n \sum_{j=1}^m \hat{b}_j (t_{ij} - \bar{t}_j)$$

Therefore

$$\sum_{i=1}^n \sum_{j=1}^m \hat{w}_{ij} = \sum_{i=1}^n \sum_{j=1}^m \bar{w}_j - \sum_{i=1}^n \sum_{j=1}^m \hat{b}_j \bar{t}_j + \sum_{i=1}^n \sum_{j=1}^m \hat{b}_j t_{ij}$$

(by equation 0.2) =

$$(0.4) \quad n - \sum_{i=1}^n \sum_{j=1}^m \hat{b}_j \bar{t}_j + \sum_{i=1}^n \sum_{j=1}^m \hat{b}_j t_{ij} = n - \sum_{j=1}^m \hat{b}_j \sum_{i=1}^n \bar{t}_j + \sum_{i=1}^n \hat{b}_j \sum_{i=1}^n t_{ij} = n$$

because $\sum_{i=1}^n \bar{t}_j = n_j \bar{t} = \sum_{i=1}^n t_{ij}$

4. Equation 0.3 shows that the result in Part 2. above holds when $r = n$. The process in Part 2. can be cycled $(n-1)$ times to centre on any particular value of i that is of interest. Let k be this special value of i .

$$\sum_{i=k}^k \sum_{j=1}^m \hat{w}_{ij} = \sum_{j=1}^m \hat{w}_{kj} = 1$$

This centering process can be done $\forall k, 1 \leq k \leq n$. This completes the proof.



European Patent Office

Forecasting the number of European patent applications at the EPO

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Forecasting the number of European patent applications at the EPO



European Patent Office

EPO filing forecast

- Planning & Budgeting
- Patenting options in Europe
- Standard EPO methods
- Improving methodology
- New context

Forecasting the number of European patent applications at the EPO



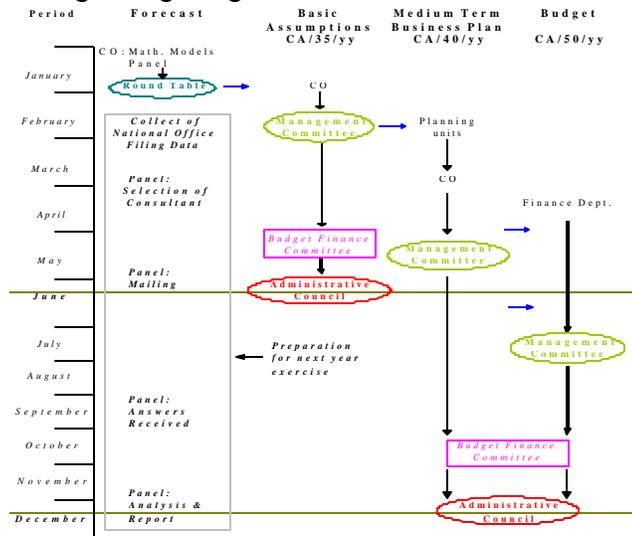
Planning & Budgeting

- Financial autonomy of the EPO (resource planning
- First step in the planning process
- 5 years plan: 1st year = budget
years 2-5 = financial plan
- Reviewed each year
- Final approval by AC

Forecasting the number of European patent applications at the EPO



Planning Budgeting time frame



Forecasting the number of European patent applications at the EPO



Patenting options in Europe

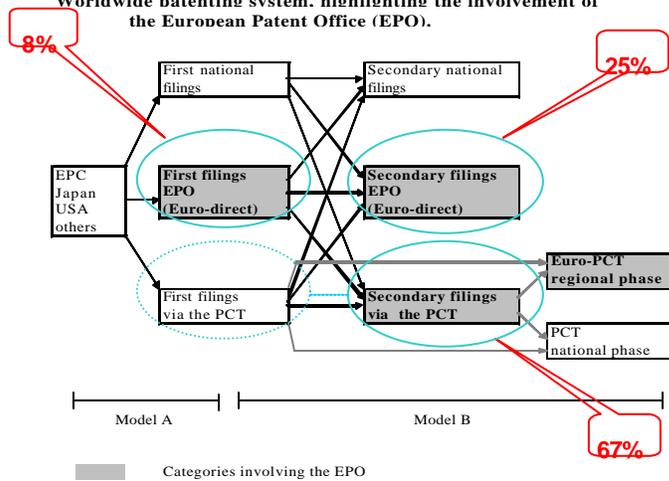
- Paris Convention \ First filings + Subsequent filings
- 3 ways to obtain patent protection in Europe
 - national route
 - regional (European) route
 - national or European combined with the PCT
- EPO = supranational Office \ attracts subsequent filings

Forecasting the number of European patent applications at the EPO



Patenting options in Europe

Worldwide patenting system, highlighting the involvement of the European Patent Office (EPO).



Forecasting the number of European patent applications at the EPO



European Patent Office

Forecasting methods at the EPO

- Trend analysis: linear regression over time
- Transfer model: "most EP filings claim priority"
- Panel: 2000 applicants surveyed

Forecasting the number of European patent applications at the EPO



European Patent Office

Trend analysis

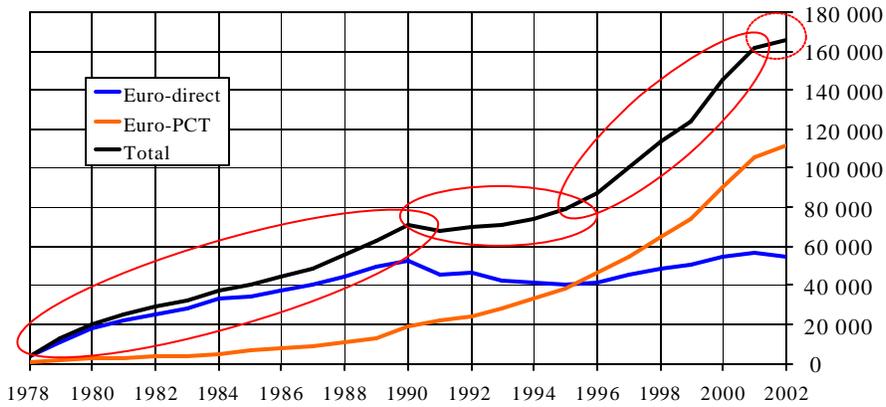
- 3 phases in EP filings development:
 - centralisation effect \ steady growth
 - move to PCT \ decline in the direct route, exponential growth of PCT
 - globalisation \ exponential increase
- End of the .com bubble
Office(s) mastering their workload \ Start of a 4th phase ?

Forecasting the number of European patent applications at the EPO



European Patent Office

European Patent Application Filings

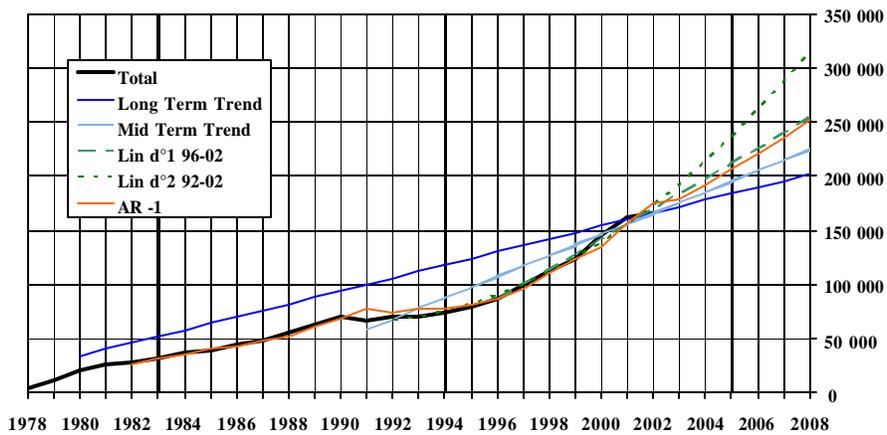


Forecasting the number of European patent applications at the EPO



European Patent Office

European Patent Application Filings Direct extrapolations

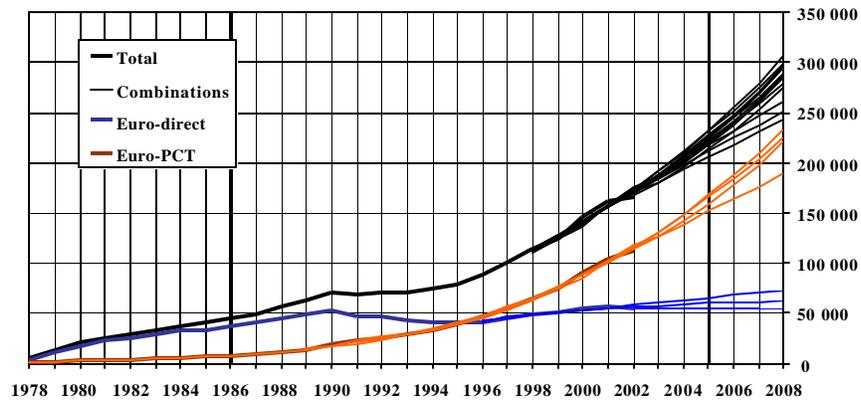


Forecasting the number of European patent applications at the EPO



European Patent Office

European Patent Application Filings Combinations of independent extrapolations



Forecasting the number of European patent applications at the EPO



European Patent Office

EPO transfer model

- 80% of the worldwide first filings are applied for in Europe, Japan or the USA;
- 89% of the EP applications are subsequent filings (2001);
- 90% of EP filings are originating from Europe, Japan or the USA (2002);
- shares of other countries increased from 3% to 10% since 1978;

Forecasting the number of European patent applications at the EPO



European Patent Office

EPO transfer model

4 steps process:

- 1 - to extrapolate the number of first filings in Europe, Japan and the USA;
- 2 - to extrapolate the transfer ratios of first filings into European patent application the year after per bloc of origin;
- 3 - to extrapolate the proportions of first filings directly applied at the EPO per bloc of origin;
- 4 - to adjust for the rest of the world.

Forecasting the number of European patent applications at the EPO



European Patent Office

EPO transfer model by bloc

Step 1

$$\begin{aligned} \text{FF.Europe}_{y-1} \times & \text{TR.Europe}_{y-1} = \text{SF.Europe}_y \\ \text{FF.USA}_{y-1} \times & \text{TR.USA}_{y-1} = \text{SF.USA}_y \\ \text{FF.Japan}_{y-1} \times & \text{TR.Japan}_{y-1} = \text{SF.Japan}_y \end{aligned}$$

$$? \quad \text{SF.3B}_y$$

Step 3

$$\begin{aligned} \text{SF.Europe}_y / (1 - \% \text{EPFF.Europe}_y) &= \text{TF.Europe}_y \\ \text{SF.USA}_y / (1 - \% \text{EPFF.USA}_y) &= \text{TF.USA}_y \\ \text{SF.Japan}_y / (1 - \% \text{EPFF.Japan}_y) &= \text{TF.Japan}_y \end{aligned}$$

$$? \quad \text{TF.3B}_y / \text{Wgt.3B}_y = \text{TF}_y$$

Step 4

FF.Ba_y *First filings by residents of bloc a in year y*
TR.Ba_y *Transfer Rate to EPO of FF of bloc a in year y*
SF.Ba_y *Subsequent filings at the EPO from bloc a in year y*
%EPFF.Ba_y *Proportion first filings in filings at the EPO from bloc a in year y*
TF.Ba_y *Total filings at the EPO from bloc a in year y*
Wgt.3B_y *Share of 3B (Europe, USA and Japan) in total filings at the EPO in year y*
TF_y *Total filings at the EPO in year y*

Forecasting the number of European patent applications at the EPO



European Patent Office

Origin = EPC

Year	First filings EPC area			Trend	Euro subs. applications (EPC priority)			Total Euro Filings from EPC				
	Dom N	EPOFF	Total		Actual	rate	trend	Predicted	Actual	% FF	Trend	Forecast
1997	983562	3782	1021444		40004	39.2%	39%		45929	11.5%		
1998	101098	5261	106359		44714	42.0%	40%		51824	11.4%		
1999	106085	5918	112003		47709	42.6%	42%		56396	12.1%		
2000	112464	6802	119266		52230	43.8%	44%	53313	64368	13.0%		
2001	116832	8204	125036		52263	44.3%	46%	56214	69592	13.8%		
2002	113677	9176	122853		55881	49.0%	48%	58881	69943	13.9%	68392	
2003			123654					61456		14.5%	71879	
2004			124138					63983		15.1%	75559	
2005			124534					66482		15.7%	78855	
2006			124671					68962		16.3%	82374	
2007			125163					71423		16.9%	85933	
2008			125421					73887		17.5%	89531	

Origin = USA

Year	First filings USA			Trend	Euro subs. applications (USA priority)			Total Euro Filings from USA				
	Dom N	EPOFF	Total		Actual	rate	trend	Predicted	Actual	% FF	Trend	Forecast
1997	106892	560	107452		32631	30.4%	30.0%		32725	1.9%	2.4%	
1998	119214	607	119821		37052	30.9%	31.1%		36869	2.5%	2.6%	
1999	132767	909	133676		41320	30.9%	27.8%		40441	2.7%	2.8%	
2000	146581	1089	147670		49683	33.6%	27.8%		48145	2.6%	3.0%	
2001	161786	1231	163017		55702	35.7%	27.8%		53702	2.4%	3.2%	
2002	172667	1236	173903		61604	35.7%	27.8%	61604	55903	2.2%	2.2%	63006
2003	177847	1244	179092		65389			65389	55903	2.2%	2.2%	68862
2004			188046		70703			70703		2.2%	2.2%	72280
2005			197449		76384	38.7%	38.7%	76384		2.2%	2.2%	78077
2006			211270		84028	39.8%	39.8%	84028		2.1%	2.1%	85864
2007			226059		92368	40.9%	40.9%	92368		2.1%	2.1%	94365
2008			241883		101463	41.9%	41.9%	101463		2.1%	2.1%	103634

Origin = Japan

Year	First filings Japan			Trend	Euro subs. applications (Japan priority)			Total Euro Filings from Japan				
	Dom N	EPOFF	Total		Actual	rate	trend	Predicted	Actual	% FF	Trend	Forecast
1997	339043	240	339283		15983	4.1%	4.2%	14473	14794	2.7%	2.5%	
1998	349211	255	349466		15132	4.3%	4.5%	16057	16161	2.7%	2.5%	
1999	357379	236	357615		16077	4.5%	4.9%	17612				
2000	357531	238	357769		165810	5.4%	5.2%	19157				
2001	384204	256	384460		170527	6.0%	5.6%	20691				
2002	383609	244	383853		174661	6.3%	5.9%	22226		1.0%	1.0%	22440
2003	372101	217	372318		178346			23762		0.8%	0.8%	23956
2004			381673		181673	6.6%	6.6%	23300		0.7%	0.7%	25470
2005			384708		184708	7.0%	7.0%	26840		0.5%	0.5%	26982
2006			387500		187500	7.3%	7.3%	28384		0.4%	0.4%	28494
2007			390086		190086	7.7%	7.7%	29932		0.2%	0.2%	30005
2008			392496		192496	8.0%	8.0%	31483		0.1%	0.1%	31513

Consolidation : Combined result

Year	Tri-Bloc	EP filings	EP share	Tri-Bloc	Trend	Total Euro
1997	93448	100390	93.1%		92.9%	
1998	104862	113338	92.5%		92.6%	
1999	114154	123866	92.2%		92.3%	
2000	133556	145237	92.0%		92.0%	
2001	147881	161143	91.8%		91.7%	
2002	153837	148718	164000	90.7%	91.3%	168423
2003	162697			91.0%	91.0%	178748
2004	173109			90.4%	90.4%	190856
2005	183907			90.4%	90.4%	203498
2006	196734			90.1%	90.1%	218443
2007	210503			89.7%	89.7%	234340
2008	224680			89.4%	89.4%	251254

Forecasting the number of European patent applications at the EPO



European Patent Office

EPO Applicant survey

- Introduced in 1996 to receive input from users
- Objective = intention of filings in year y, y+1 and y+2
- Mail questionnaires (Aug-Sep)
- Analysis Nov-Dec
- 2 groups
 - panel of the top 450 applicants = 16% of filings
 - random group of 2 000 applicants = 20% of filings (overlapping)
- Response rate: 35%

Forecasting the number of European patent applications at the EPO



EPO Applicant survey

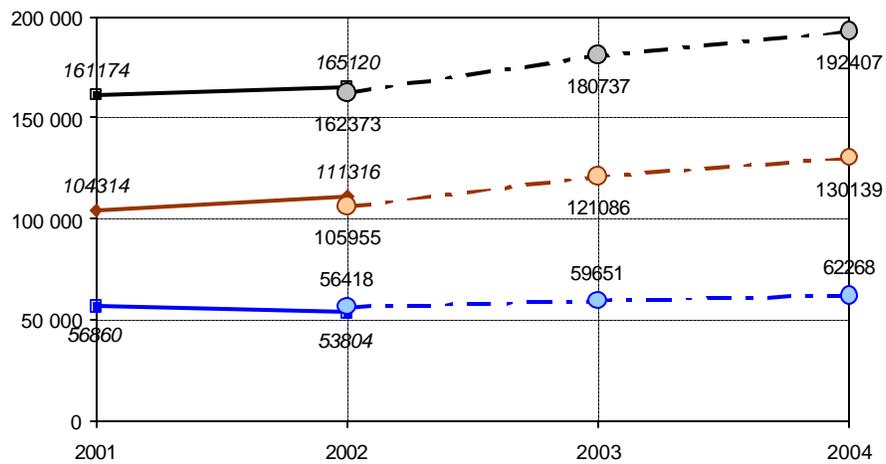
→ Biggest Group (Composite Index (per bloc and type of filing)

$$CI = \frac{\sum_{i=1}^n x_i}{\sum_{i=1}^n A_i}$$

Where n is the number of applicants in the sample,
 and summation is taken over the sample members $i = 1, \dots, n$.
 x_i is the intended number of filings reported by the i th sampled applicant in 2002.
 A_i is the known number of applications made by the i th sampled applicant in 2001.



Forecast issued from the Biggest Group





EPO Applicant survey

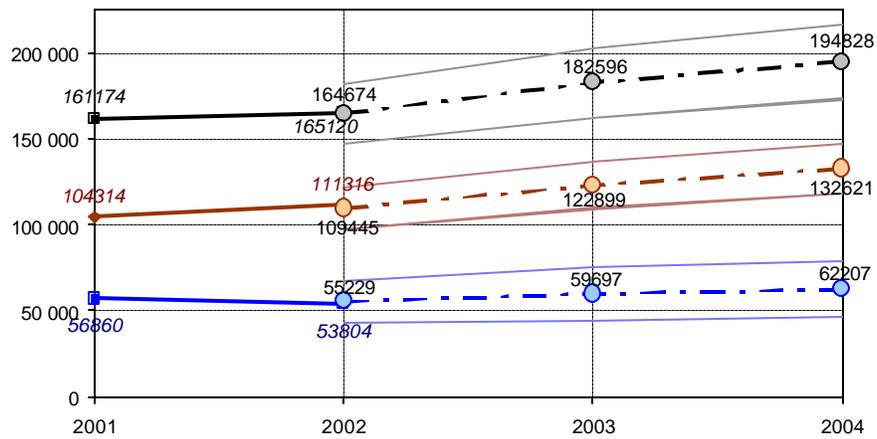
→ Random Group (Q index on Log transformed data (per bloc and type of filing)

$$Q = \exp \frac{\sum_{i=1}^n q_i \text{Log}(I_i)}{\sum_{i=1}^n q_i}$$

where Log(I) is the natural logarithm of the individual index $I_i = x_i / A_i$, q_i is the probability of applicant i being selected for the sample.



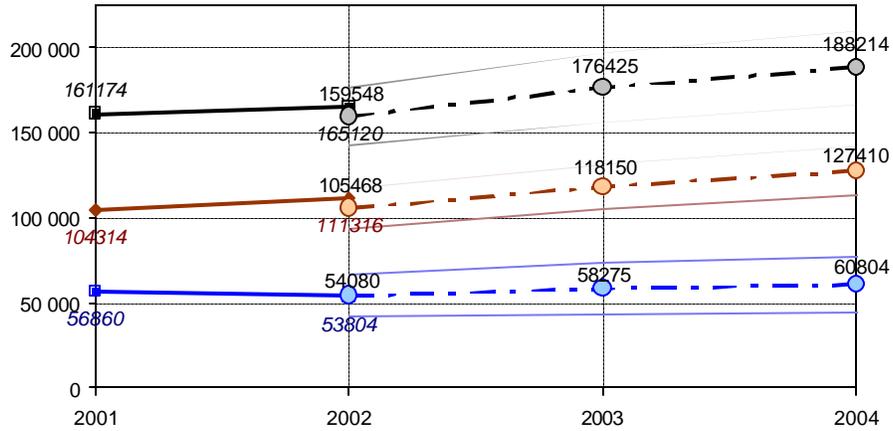
Forecast issued from the Random Group





European Patent Office

Forecast issued from the Random Group with a non-response correction



Forecasting the number of European patent applications at the EPO



European Patent Office

Use of the forecast on EP filings

- Consolidation during a Round Table on forecasting and planning

Preference given to the bloc-wise transfer model
and to the Random Group with correction

- One planning scenario presented to EPO management,
with other key parameters

- Approval by AC

↳ Detail plan (MTBP)

↳ Budget

Forecasting the number of European patent applications at the EPO



Improvement of Forecasting Methodology

- Trilateral cooperation = Exchange of methods and results
Econometrics models
Harmonisation of survey
- Research Programme = External methodological support
- Forecast per technical areas = New orientation



Trilateral Forecasting Activities

- Exchange of techniques and results
Econometric models for first filings
Use of partner data for transfer model type techniques
- Development of a global model
Multivariate modelling of trilateral flows of filings
- Harmonisation of applicant surveys



European Patent Office

EPO Research Programme

- Methodology for patent filing forecast
- 5 themes and 4 projects retained
 - Time series analysis
 - Time series methods
 - International patenting patterns
 - Sector base forecasting - microeconomic
- 3 years programme (2002-2004)
- EPO to implement recommendations

Forecasting the number of European patent applications at the EPO



European Patent Office

EPO Research Programme

Preliminary results

- Dynamic linear model of monthly filing data may provides accurate short distance forecasts;
- Aggregation of forecasts by bloc of origin may give more accurate forecasts
- Aggregation of forecasts per technical areas does not necessary lead to more accurate forecasts;
- ARMAX and state space models to be tested to forecast filings from lagged R&D;
- Final reports expected end of 2004

Forecasting the number of European patent applications at the EPO



Forecast per technical areas

- Full deployment of *BEST* working method
- New objective: EPO to grant patent in 3 years (on average)
- Re-organisation of the EPO examining departments

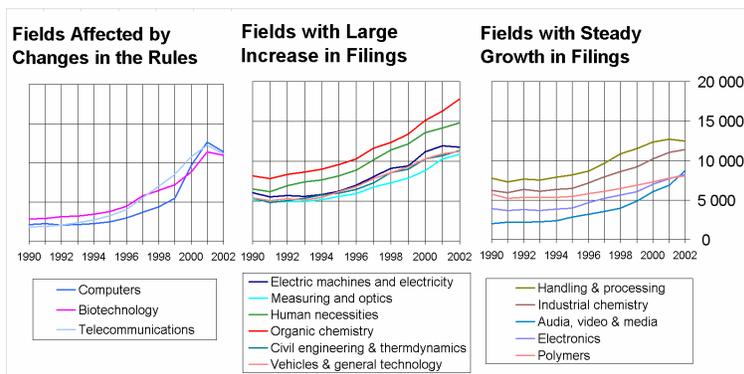
2 DGs \ 14 Joint Clusters (JC)

- More autonomy of the JC \ Planning per JC \ Forecast per JC to monitor resources



Forecast per technical areas

- Different trend in filings
- Different patenting patterns





Forecast per technical areas

- Trend analyses replicated per JC
 - Data available ✓
 - Timeliness ✗
- Transfer models
 - First filings by bloc and JC
 - Definition of JC on basis of the IPC ?
- Survey
 - To augment the sample size ✓
 - To review questionnaire ✓



Conclusions

- Methods used
 - Trend analyses
 - Transfer model
 - Applicant survey
- Research programme
 - Methodology support
 - Recommendations to be implemented
- New challenge
 - Forecast for 14 Joint Clusters



European Patent Office

Forecasting the number of European patent applications at the EPO

Thank you

Forecasting the number of European patent applications at the EPO