

a reaction from industry. This has been helpful to the industry in getting new services.

The TIRC has supplied expertise available within the industry to vendors when requested for specific projects. It hopes to be able to do so in the future.

In addition to its patent activities, the TIRC has been involved in other projects mainly of interest to its On-line Subcommittee and Hazardous Chemicals Subcommittee. These Subcommittees, like the Chemical Abstracts Subcommittee, operate in fields broader than the patent field. They have made and are making contributions which will be useful to patent retrieval also.

The Committee is pursuing the purpose for which it was established, namely to analyze services offered by suppliers of technical information and to suggest improvements, to encourage research and development in the area of information retrieval, and to act as a forum for interchange of information retrieval with similar groups in this country and abroad. It has reported to the Board of Directors on the needs of the chemical industry in technical information retrieval and has emphasized the problems involved in trying to introduce new information services to industry. In his report to the MCA Board of Directors on October 8, 1974, Dr. R. H. Blaker said:

"Generally, technical information facilities in most companies are so decentralized that there is rarely one individual or a group who can speak for the entire corporation. Our Committee has conducted a survey and determined, among other things, that the average company represented on our Committee spends on the general order of 0.10 percent of sales on salaries and services represented in corporate information-retrieval facilities, libraries, special information services, etc. This probably means that in aggregate the chemical industry spends in excess of \$50 million on corporate infor-

mation-retrieval facilities. Our questionnaire also shows that the people involved in this work have usually administratively reported to various divisions or administrative site managers or service managers scattered throughout the corporation, and there is rarely any small group or individual who can speak for the corporation as a whole. This leads, we believe, to a situation where a large information retrieval service which requires back-up use of computers and trained analysts is usually too expensive a project to be seriously considered by the corporate representative contacted by the vendor of such a service. Usually, it appears, there is no mechanism within most companies for librarians, heads of information services in research or in legal departments or whatever, to get together and decide what is best for the corporation—or no mechanism to figure out how to share the cost of a large service, once purchased, through the various groups which might be interested within the corporation. The net result is that the vendor finds it difficult to sell enough copies of this product in order to make money, and, consequently, if this situation maintains, vendors will not in the future seriously consider developing significant information services for sale.

"There may be no easy solution to this problem, but I believe the matter seriously merits your consideration. It certainly follows that if vendors of significant information services are unable to make sufficient money to stay in business by selling subscriptions to their services to a reasonable number of chemical companies, the chemical industry will end up the loser. It will be deprived of improvements of information retrieval techniques which could in this way be acquired at reasonable prices but which would be prohibitively expensive for each of the companies to develop individually, or, for that matter, for MCA as a trade association to undertake the development."

## Patent Intelligence and Technology—Gleaning Pseudoproprietary Information from Publicly Available Data<sup>†</sup>

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A new approach for gleaning useful correlative and statistical information from the patent literature is described. Common computer techniques are used to determine the level of U.S. patent activity by the 125 companies receiving the greatest number of U.S. patents in 1976. Analyses are reported on patent ownership, profiles of patent activity, patents granted vs. research budgets, pseudoproprietary information, and other useful intelligence.

Over the years many papers have been presented on ways for searching patents. The search systems reported comprise a variety of modifications on the traditional arrangements, such as subject matter indexes, classification files, concept coordination databases, and assignee listings. For the most part, authors have related these to the needs of research scientists and patent attorneys. In this paper, our intent is to focus attention on the intelligence aspects of patents. Emphasis will

be on the possibility of analyzing, as well as forecasting the technological activities of major corporations. The results of these analyses will be of particular value to marketing managers and research strategists.

With the publication of The IFI Assignee Index to U.S. Patents in 1975, we became aware of the possibility of using this type of data to develop information not normally extracted from patent literature. The IFI Assignee Index to U.S. Patents contains references to all patents, reissued patents, and defensive publications that issue during a calendar year. The index is arranged alphabetically by assignee name. The patents under each assignee are arranged by U.S. Patent Office

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Classification code and within each class by patent number. Patent titles are included for all patents. We noted that little if any attention had been given to (1) identifying the organizations (industrial firms, government agencies, or individuals) that receive the greatest number of patents, (2) plotting the geographical location of these organizations, or (3) determining the frequency of patent issues within subject categories for these organizations. Therefore, in 1976, we initiated a study to obtain facts relating to each of these areas. We felt that this information should be of interest to patent literature specialists, and particularly to business managers. As part of this study we wanted to determine the relationship between research dollars spent and patents granted. We also wished to analyze a company's patent activity by subject matter as a means of determining the future research direction of the corporation.

This paper reports on the results of these studies and gives the answers we found to these objectives.

### METHOD

U.S. patents issued in 1976 constituted the primary information source for this study. However, some information from earlier years was employed, where comparisons or relationships with other time periods were desired. This information was extracted from the "IFI Data Base of U.S. Patents-1950 Through 1976" maintained on magnetic tape by IFI/Plenum Data Co. at Arlington Va. This file contains:

- Patent Titles
- U.S. Patent Office Classifications
- Assignee Names
- Inventor Names
- IFI Keyword Indexing

For purposes of this study, the magnetic tape file was processed by conventional computer techniques to provide summaries of the number of U.S. patents issued in 1976 by various subcategories.

The tabulations thus provided were correlated and classified to provide the results described in the following sections.

### DISCUSSION

**Who Owns Patents?** During 1976, nearly 71 000 U.S. patents were granted, consisting of utility and reissue patents and defensive publications. The actual totals are: utility patents, 70 249; reissue patents, 424; defensive publications, 205. We found that 57 391 of these documents were assigned to "corporate assignees" (includes government agencies, universities, colleges, foundations, as well as industrial firms). The remaining 13 487 were either unassigned or were assigned to individuals.

Approximately 22 000 corporations own the 57 391 assigned patents. This averages 2.6 patents per corporation. As might be expected, a relatively small number of corporations own a major portion of all assigned patents. We selected as a special part of our study the 125 companies receiving 65 or more patents in 1976. These 125 companies hold 24 210 patents. This amounts to 42% of all the assigned patents and averages 194 patents per company. The remaining 33 181 patents, or 58% of the assigned patents, are distributed among nearly 22 000 companies at an average of 1.5 patents per assignee.

Of the top 125 companies selected for closer study, we found that 90 companies, or 72%, were United States based and that 35 companies, the remaining 23%, were foreign based. This foreign segment comprised eight countries as follows: Japan (14 companies), West Germany (9 companies), France (3 companies), Great Britain (3 companies), Switzerland (3 companies), and the Netherlands, Panama, and Sweden (1 company each).

Table I. Top Twenty U.S. Patent Assignees in 1976

Ranking	Company	No. of patents assigned	Country of incorporation
1	General Electric	812	U.S.
2	U.S. Navy	636	U.S.
3	Bayer	560	W. Germany
4	Xerox	551	U.S.
5	Ciba-Geigy	508	Switzerland
6	IBM	504	U.S.
7	Siemens	491	W. Germany
8	Philips	472	Netherlands
9	Westinghouse	468	U.S.
10	Bell Telephone Labs.	465	U.S.
11	E. I. du Pont	461	U.S.
12	RCA	427	U.S.
13	U.S. Army	416	U.S.
14	Hitachi	402	Japan
15	General Motors	401	U.S.
16	Hoechst	366	W. Germany
17	Caterpillar Tract.	356	U.S.
18	ICI	352	G. Britain
19	BASF	327	W. Germany
20	Dow Chemical	300	U.S.

Table II. Top Assignees by Areas of Major Interests

Area of interest	Ranking	Company	No. of patents assigned
Mechanical	15	General Motors	401
	17	Caterpillar Tract.	356
	44	United Technologies	197
Chemical	3	Bayer	560
	5	Ciba-Geigy	508
	11	E. I. du Pont	461
Electrical	1	General Electric	812
	9	Westinghouse	468
	10	Bell Telephone	465
Mech./chem.	33	Universal Oil Products	222
	36	Eastman Kodak	211
	36	3M	211
Mech./elect.	4	Xerox	551
	6	IBM	509
	7	Siemens	491

**The Top 125 Patent Companies.** We examined in detail the assignment distribution of the top 125 companies. Table I lists the top 20 such companies by frequency of assigned patents. The leading organization is General Electric with 812 patents, followed by a U.S. Government agency (U.S. Navy) rather than another industrial firm as might have been expected. It is of further interest to note that within the top 20 assignees, there was a second U.S. Government agency and corporations representing six major countries located on three continents.

In order to selectively treat corporations having closely related interests, we categorized companies from among the top 125 into several broad subject areas. Based on these arbitrary subject categories, chosen to represent reasonable and logical classifications, we derived the distribution as summarized in Table II. The three highest assignees in each category are listed together with their rank number among the top 125 corporations.

Two patent development companies, representing individual inventors, also appear in the top 125 corporations. They are Lawrence Peska Associates (ranked number 30) and The Raymond Lee Organization (ranked number 36), with respectively 237 and 211 assigned patents. Most of their inventions relate to consumer devices, particularly in the area of games, toys, and sporting equipment.

**Patents Owned by Individuals.** There were 13 487 patents issued to private individuals in 1976. In Table III, we have displayed the top ten U.S. Patent Office classes represented

**Table III.** Patents Assigned to Individuals in Top Ten U.S. Patent Office Classes, 1976

U.S. Patent Office Class	Subject	No. of patents assigned
128	Surgery	422
273	Amusement Devices, Games	301
52	Static Structures	276
280	Land Vehicles	266
73	Measuring and Testing	252
260	Chemistry, Carbon Compounds	227
340	Communications, Electrical	187
123	Internal Combustion Engines	183
43	Fishing, Trapping, and Vermin Destroying	179
210	Liquid Purification or Separation	177

**Table IV.** Research Dollars Spent vs. Patents Issued

Company	1972 research budget, \$'s (millions) <sup>a</sup>	No. of patents issued (assigned)	Av cost per patent, \$'s (thou-sands) <sup>b</sup>
Caterpillar Tract.	107	356	150
Dow Chemical	100	300	165
E. I. du Pont	255	461	275
Westinghouse	445	468	475
Xerox	132	551	120

<sup>a</sup> From company's annual report. <sup>b</sup> Based on one-half of research budget.

in this collection. It is interesting to note that Class 128, Surgery, heads the list. It would appear that surgeons are heavily involved in researching their own tools.

**Research Dollars Spent vs. Patents Issued.** Another study objective was to relate the number of issued patents to the amount of money spent on research. We thought that by determining research dollars per patent obtained for major corporations, we might detect relationships between relative levels of research and patenting policies. For this analysis we compared the annual research budgets for calendar 1972 with the number of patents obtained in 1976 for five corporations selected to represent the mechanical, chemical, and electrical areas of patent art. We chose 1972 research budgets on the assumption that U.S. patents issue about four years after the research is done. We also assumed that one-half of an organization's research budget was spent on projects not expected to generate patentable inventions. Research budget figures were obtained from individual annual reports of the respective companies as filed in the Security Exchange Commission in Washington, D.C. The results of this comparison are summarized in Table IV. Review of the information presented in Table IV indicates that the cost of obtaining patents is extremely high. However, from the wide spread in the average cost per patent calculated, no simple conclusions would appear warranted from the study here reported. The approach employed is still intriguing, and perhaps a larger sample of companies and other assumptions for the parameters may still yield trends of value.

**Who's Active Where?** Another feature of our study was to sort the total collection of 24000 patents issued to the top 125 companies by U.S. Patent Office Class. In this way we were able to quickly determine the top companies in each subject area as well as the spectrum of interests shown by a profile of classes to each company.

Table V provides a summary of the top five areas of activity, for General Electric and the U.S. Navy. In each organization, a wide range of interests was indicated, but actually somewhat apart from the primary objectives one might assume. According to the "Standard Industrial Classification Guide", the

**Table V.** Major Activities of Top Two Assignees

U.S. Patent Office Class	Subject	No. of patents assigned
General Electric 812 Patents Assigned		
260	Chemistry, Carbon Compounds	110
317	Electricity	27
29	Metal Working	25
357	Active Solid State Devices	22
340	Communications, Electrical	20
U.S. Navy 636 Patents Assigned		
343	Communications, Radio Wave	62
340	Communications, Electrical	59
102	Ammunition and Explosive Devices	54
350	Optics, Systems and Elements	24
331	Oscillators	21

**Table VI.** Who's Active Where? (by U.S. Patent Office Class)

Company	No. of patents assigned
Class 68—Textiles, Fluid Treating Apparatus	
General Electric	10
Philips	3
Class 75—Metallurgy	
U.S. Steel	15
Ethyl Corporation	10
E. I. du Pont	7
Class 96—Photographic Chemistry, Processes and Materials	
Fuji Photo	112
Xerox	77
Agfa-Gevaert	48
Eastman Kodak	47
Polaroid	18

**Table VII.** Top Ten Companies in Chemicals<sup>a</sup>

Company <sup>b</sup>	No. of patents assigned
Bayer	365
Ciba-Geigy	341
BASF	181
Hoechst	181
E. I. du Pont	176
Upjohn	156
Hoffmann-La Roche	143
Dow Chemical	138
Sandoz	138
ICI	131

<sup>a</sup> Based on U.S. Patent Office Class 260, "Chemistry, Carbon Compounds". <sup>b</sup> For Class 260: U.S. companies = 470 patents (24%), non-U.S. companies = 1480 patents (76%).

General Electric Co. is classified as an electrical company. Thus, the top number of 110 patents in Class 260, "Chemistry, Carbon Compounds", could be considered somewhat surprising. Similar surprise might be noted for the Navy's class of first prominence being "Communications, Radio Wave" rather than Class 114, "Ships", for which the Navy received only 17 patents in 1976.

Some specific examples of the distribution by class are provided in Table VI. This is a convenient way to examine the level of patent activity and obtain a classification profile of the current efforts of the leading organizations acquiring patents. The class distribution sort provides a great amount of intelligence. A full printout of the 125 companies is most informative and could offer many leads of interest to research people, to marketing personnel, as well as to licensing administrators.

As another example of the use of a class distribution sort,

we thought it would be of interest to tabulate the ten leading companies receiving patents in the area of organic chemistry, specifically in Class 260, "Chemistry, Carbon Compounds". The results are summarized in Table VII. This analysis shows that seven of the ten leading companies in Class 260 are non-U.S. companies. This same technique can be applied to any other class or company that might be of interest.

**Patent Licensing Activities.** In another part of our study, we attempted to gather information about the licensing representatives in each of the 125 top companies. Our mission, we thought, would be a simple one. We merely wanted to know the proper individual to contact and where he might be found. This task, however, turned out not to be as simple as it sounded. While we did finally elicit information from 31 of the 125 companies, we were also educated in the process.

We found, for example, that the licensing contact varied from company to company. In one company, the contact may be a patent attorney, in another a research director, in another the marketing director, and in still another a member of the corporate management office. We found also that the licensing contact is frequently not located at corporate headquarters but instead at some distant field location. American Telephone & Telegraph and Western Electric are headquartered in New York City. Bell Laboratories is located in New Jersey. Their licensing manager for corporate patents, on the other hand, is located in Greensboro, N.C.

Attempts to obtain lists of those patents issued in 1976 that were available for licensing were also less productive than anticipated. In only a few cases were we able to obtain such listings. In other cases, we were informed that requests for licensing information would be handled on an individual patent basis. In still other replies we were led to believe that the patents and licensing area was rather sensitive and that no further general information would be made public.

**Trends Predicted from Patent Information.** As an important facet of our study, we wanted to determine if publicly available patent information might suggest changes in corporate interests and perhaps reveal proprietary-like information. We used two approaches to answer this question.

For the first approach, we compared U.S. patent class codes for patents issued in 1976 with those issued in 1975 for each of the 125 top companies. By listing those classes new in 1976 with their respective patents, we were able to identify potentially new technology. While the issuance of one or two patents in a new class may not represent a change of substance, a new class producing multiple patents may well signal a significant change in research activities. The results for six companies showing the greatest change in a particular class are as follows:

1. Caterpillar Tractor Co.—21 patents issued in Class 418, "Rotary Expansible Chamber Devices"
2. Joseph Lucas Industries-Great Britain—14 patents issued in Class 318, "Electricity, Motive Power Systems"
3. U.S. Energy Research & Development Agency—10 patents issued in Class 48, "Gas, Heating and Illuminating"
4. United Technologies Corp.—9 patents issued in Class 136, "Batteries, Thermoelectric and Photoelectric"
5. Sun Company, Inc.—8 patents issued in Class 264, "Plastic and Non-Metallic Article Shaping or Treating Processes"
6. PPG Industries, Inc.—8 patents issued in Class 126, "Stoves and Furnaces", that dealt with solar collectors

None of these companies had any patents issue in these classes during 1975. It is also interesting to note that Chevron Research Co., a petroleum company, received 14 patents in

**Table VIII.** Ciba-Geigy Assignee Map by U.S. Patent Office Class (1976 vs. 1971-1975 Average)

U.S. Patent Office Class	No. of patents assigned				
	Five-year average		1976		1976 % dev
	No.	%	No.	%	
8	16.5	4	27	5.3	+33
71	8	2	14	2.8	+40
260	288	70	341	67	-4
424	48	11.7	65	12.8	+9
428	2.5	0.6	12	2.4	+300
Other	48	11.7	49	9.7	-17
Total	411	100.0	508	100.0	+24

1976, in Classes 250, 324, and 340 dealing with "Radiant Energy", "Electricity, Measuring and Testing", and "Communications, Electrical", and no patents in 1975 in these areas. Of all 125 companies analyzed, only one company had no patents issue in a new class in 1976 as compared with 1975. These changes in patent activity should be of significant help in evaluating future trends for the companies concerned.

For the second approach, we compared the average number of patents issued during the previous five years in a company's major areas of interest with the number of patents issued in 1976. We were looking for any classes that might show significant changes and thus act as indicators of new trends. Ciba-Geigy, a prominent chemical company, ranking No. 5, with 508 patents assigned in 1976, was selected for this analysis.

We identified the five classes in which Ciba-Geigy received the most patents in 1976 and compared this with the average number of patents received in the same classes during the previous five years. As shown in Table VIII, the classes in which Ciba-Geigy received the greatest number of patents during 1976 were Classes 8, 71, 260, 424, and 428. By comparing the changes in the percentage of total issues for these classes, it is apparent that the greatest change occurred in Class 428. The percentage of patents issued in this class increased by 300% over the average for the previous five years. In looking at the patents issued to Ciba-Geigy in Class 428, we found that all relate to textile treating and finishing.

While all companies may not show such a dramatic change, we do believe that this study does show another route for piecing together the patent intelligence puzzle. At least in this particular case, we did identify an apparently new emphasis that competitors might well wish to follow.

**Predicting Corporate Mergers from Patent Information.** Another way to obtain unusual information from patents should be to review a company's profile and compare this information with other companies' profiles to locate candidates for possible acquisition. To verify this hypothesis, we looked at the major patent profiles for Ciba Co., Geigy Chemical Co., and Ciba-Geigy Co. We knew that Ciba and Geigy did merge in October 1970. If our hypothesis was correct, we should find a correlation of the patent activities between these companies.

Table IX shows the number of patents issued to each of the three companies according to subject matter classifications during the ten-year period 1967 through 1976. As shown in the table, Ciba's and Geigy's research efforts resulted in patents issuing in Classes 8, 71, 252, 260, 424, and 526 in common. While the tabulation shows only the ten classes having the highest frequency of issue for each company, a calculation on the total issues for each company shows that 94% of Ciba's patents were in classes common to Geigy's, and 98% of Geigy's patents were in classes common to Ciba's. Indeed, the patent histories for these two companies do suggest the merger that took place in 1970.

It is apparent that by applying similar techniques, detailed histories can be obtained concerning a company's research

Table IX. Ciba-Geigy Merger Reflected in Patent Issues

U.S. Patent Office Class	No. of patents assigned in ten-year period 1967-1976 to		
	Ciba	Geigy	Ciba-Geigy
8	41	38	19
23		3	
71	15	6	34
96	44		31
106	13	15	24
156			10
204	11		10
252	11	38	28
260	868	513	1094
423		7	
424	105	102	179
427	12		13
428		7	
526	9	8	

activities without ever formally contacting the organization. After the analysis is made, the acquisition or tender negotiations can begin with important background information obtained through this unusual approach to searching the patent literature. The same process could be used should one want to buy or sell selected areas of technology and want to know

who the best prospects might be.

### SUMMARY

We believe we have demonstrated that by utilizing common computer techniques on a database of publicly available information, unique and sometimes pseudoproprietary results can be obtained. Specifically, we believe that we have presented ways for analyzing the patent literature which give unusual and valuable results. Of statistical interest, we have identified that for 1976, over 40% of assigned patents were issued to only 125 companies. We have determined that foreign assignees play an important role in U.S. patents. Almost one-quarter of the top 125 companies were found to be foreign based and seven of the top 10 chemical companies were identified as European. With respect to further intelligence information, we noted that the cost in research dollars for obtaining patents is extremely high. By analyzing patent activity over a period of time we were able to show changes in research emphasis, and using Ciba-Geigy as a model we presented evidence that mergers and similar business developments might be predicted.

The prerequisites for this type of analysis are a database covering a significant collection of information and a desire to look for the unusual.

## INPADOC: A Computerized Patent Documentation System<sup>†</sup>

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The International Patent Documentation Center, founded by the Republic of Austria by agreement with the World Intellectual Property Organization (WIPO) in Geneva, has built up a database covering patents from 45 countries. The various services available are described.

Over the past years the importance of patent literature to industrial research and development has changed fundamentally. Before the 1970s, patent documents reflected the state of the art with a three- to four-year delay due to the slow examination in the patent offices. In recent years, however, several offices have decided to publish unexamined applications within 18 months, which has made patent literature a timely type of technical information. With the introduction of unexamined patent documents the number of documents published increased dramatically.

Keeping track of these patent publications involves huge expenditures. There are about 300 000 publications a year, or some 1200 per workday, alone in the countries that publish unexamined applications (Belgium, France, Germany, Japan, the Netherlands, Portugal, South Africa, and the Scandinavian countries; Great Britain in the near future). Processing this mass of information is hardly conceivable today without electronic data processing. In order to achieve a favorable cost-performance ratio in solving this problem, it is best to store in a computer merely the bibliographic data—that is, application data, publication data, priority data, classification, applicant, inventor, and a significant title—with a short version and the complete text of the patent document recorded on

microfilm or the complete document kept in numerical order according to patent numbers.

It was the aim of the International Patent Documentation Center to solve the first part of this problem, gathering and storing in a central database the bibliographic data of patent documents on a worldwide basis. This center was founded on the basis of an agreement concluded on May 2, 1972, between the Republic of Austria and the World Intellectual Property Organization in Geneva.

Why was this step taken? The patent offices in different countries were bound solely to their national assignments. The Paris Convention had established a basis for claiming foreign priority. Nevertheless, search and examination were done only on a national basis. Intellectual work and clerical effort were thus duplicated. Therefore the idea of the Patent Cooperation Treaty, PCT, was born. This treaty requires equally equipped search files in all patent offices working as search authorities. A check of the search files for completeness and correctness has to be effected, and duplicate documents emerging from priority claiming applications had to be eliminated from the search files.

A central database was required for solving this problem. Therefore, the agreement mentioned before was concluded. It provides for worldwide concentration of patent documents in a planned central database which is to play a major role under the Patent Cooperation Treaty, PCT, of 1970. This agreement is one step in the forthcoming international co-

<sup>†</sup> Presented in the symposium, "Trends in Handling Patent Information", before the Division of Chemical Information, 174th National Meeting of the American Chemical Society, Chicago, Ill., Aug. 28, 1977.