Research Impact on Genetic Engineering Research - Patent Citation Analysis

Szu-chia Lo*, Mu-Hsuan Huang**

* *losu@mail.ncku.edu.tw,*
University Library, National Cheng-Kung University, Ta-hsueh Rd. 701 Tainan,Taiwan (R.O.C)

** *mhhuang@ntu.edu.tw,*
Department of Library and Information Science, National Taiwan University, No, 1, Sec. 4, Roosevelt rd., Taipei, Taiwan (R.O.C.))

Introduction

With the success of the experiment of recombinant DNA technique by Herb Boyer and Stan Cohen in 1973 and the discovery of the method of cell fusing by Cesar Milstein and Georges Kohler, genetic engineering becomes one of the prominent research topics (McCamant, 2002; Rifkin, 1997). The possible commercial development of genetic engineering research encourages the researchers from both public and private sectors seek the protection for the new "inventions." Patenting becomes a noticeable step in the process and the issued patents become a valuable resource of the technology documents (Walker, 1995). Research productivity shows the progress of the genetic engineering research and citation analysis illustrates the prior art inspires the progress of research. It could be also seen as an indicator for the quality of works.

This study uses bibliometric methods to investigate the research impact on genetic engineering research through USPTO patents. Based on the 13,055 genetic engineering patents (source patents) that issued from 1991 to 2002, this study found 18,490 cited patents for analysis. The aim of this study is to reveal the influential entities, including countries, assignees, inventors and technologies that have impact on genetic engineering research by the cited patent count.

Research Method

Counting times cited of the cited patent is the basis of this study. The counting analysis is done by years, countries, assignees, inventors and International Patent Classification (IPC) Groups. The core countries, assignees, inventors and technologies are identified based on the counting results. Patent age of citation is also calculated to enclose the time span of the influential patents.

The data source used in this study was USPTO Patent database[5] and the source patents were selected based on the patents' main International Patent Classification numbers. The group numbers used for source patents include "Mutation or genetic engineering" (C12N 15/00), "Preparation of peptides or proteins" (C12P 21/00, C07H 21/00, C07K 14/00) and "Measuring or testing processes involving nucleic acids" (C12Q 1/68). The U.S. Patent Classification was used during the patent search to include more samples. The classes relate to the genetic engineering, such as subclasses 435/440, 435.69.1, were also added to the search strategies. Cited patents that are examined in this study are the examiner-referenced patents listed on the front page of the 13,055 source patents. 108,115 cited patents are found and 63,954 of them are U.S. Patent and Trademark Office issued patents. After the consolidation of the 63,954 cited patents, 18,490 patents are identified and those patents will be examined further in this study.

[5] www.uspto.gov

Results

18,490 patents were cited by 13,055 source patents and each of them was cited 3.46 times in average. Most of the 18,490 patents were cited less than 10 times. 9,468 (51.21%) patents were cited only once, 3,275 (17.71%) patents were cited twice and 1,824 (9.86%) patents were cited three times. There are only a few patents were highly cited. The earliest cited patent was issued in 1858 and the latest one was granted in 2003 that was listed as a referenced citation by the examiner before the patent was issued. 12,437 cited patents were issued during the period of 1990 to 1999 and were cited 42,665 times. The average of the cited patent age is 7.6. Although the cited patent age is from 0 to 140, most of the patents were cited when they are 2 to 8 years old. A few cited patents, 1,993 (3.11%) were still cited by other patents 20 years after they are issued.

Analysis by Cited Countries

50 countries are identified from 18,490 cited patents based on the assignees country. United States is the most influential country from the number of patents cited, 13,980 cited patents and were cited 52,247 times. The average times cited were 3.74. Followed by Japan, there are 1,112 cited patents, cited 2,232 times and the average times cited are 1.99. Great Britain and Netherlands are also cited heavily among 50 cited countries. The times cited of the first 5 cited

countries take 90% of the total times cited. Table 1 shows the top 10 cited countries.

Table 1. The Top 10 Influential Countries in Genetic Engineering Research

Rank	Cited Countries	Times Cited	%
1	United States	52,247	81.69%
2	Japan	2,276	3.56%
3	Great Britain	1,628	2.55%
4	Netherlands	1,489	2.33%
5	German	1,425	2.23%
6	Canada	997	1.56%
7	France	879	1.37%
8	Sweden	303	0.47%
9	Denmark	298	0.47%
10	Finland	287	0.45%

Analysis by Cited Assignees

3,088 cited assignees are identified. 2,941 among the cited assignees are institutions and 147 cited assignees are individuals. 1,893 cited assignees are U.S. based organizations, 322 are Japan based, 124 are Great Britain based, 117 are German based and 116 are Canada based. Majority of cited assignees, 2,393 (77.49%) were cited less than 10 times. Only a few assignees, 130 (4.21%) were cited more than 100 times. Cetus, University of California, Genentech, Affymax and Hoffman are the most cited assignees. Table 2 shows the top 10 cited assignees.

Table 2. The Top 10 Influential Assignees in Genetic Engineering Research

Rank	Cited Assignees	Times Cited	%
1	Cetus	2,230	3.49%
2	U. Of California	1,597	2.50%
3	Genentech	1,238	1.94%
4	Affymax	1,143	1.79%
5	Hoffmann	845	1.32%
6	Dept. of Health (U.S.)	799	1.25%
7	Chiron	797	1.25%
8	Harvard U.	779	1.22%
9	Genetics Institute	685	1.07%
10	Leland Stanford U.	625	0.98%

Analysis by Cited Inventors

26,160 cited inventors were identified from the 18,490 cited patents. Most of the cited inventors, 22,635 (86.53%) were cited with limit times. Among 26,160 cited inventors, there are 375 inventors had more than 10 cited patents and 157 inventors were cited more than 100 times. The inventors cited most are Mullis, Saiki, Erlich, Horn, Fordor, Scharf, Arnheim, Gelfand, Stemmer and Stryer. Each of the inventors mentioned above was cited over 500 times. Table 3 shows the top 10 cited inventors.

Table 3. The Top 10 Influential Inventors in Genetic Engineering Research

Rank	Cited Inventors	Times Cited	%
1	Mullis, Kary B.	1,649	2.58%
2	Saiki, Randall K.	1,226	1.92%
3	Erlich, Henry A.	1,153	1.80%
4	Horn, Glenn T.	988	1.54%
5	Fodor, Stephen P. A.	784	1.23%
6	Scharf, Stephen J.	700	1.09%
7	Arnheim, Norman	696	1.09%
8	Gelfand, David H.	591	0.92%
9	Stemmer, W.P.C.	566	0.89%
10	Stryer, Lubert	536	0.84%

Analysis by Cited Technologies

The cited patents spread in 181 groups and the processes of 85% of the cited patents are allocated in 10 core processes. Patents deal with "Mutation or genetic engineering" (C12N 15/00), "Preparation of peptides or proteins" (C12P 21/00, C07H 21/00, C07K 14/00) and "Measuring or testing processes involving nucleic acids" (C12Q 1/68) were the highly cited procedures. Besides the in-field, the measuring processes involving nucleic acids and preparation of proteins are influenced by out-fields technologies, such as G01N (the analysing processes to determining the chemical or physical properties), C07H (the preparation of nucleic acids) and C07K (the preparation of peptides.) The procedures relate to G01N were cited in measuring process with nucleic acids. The processes in the groups C07H and C07K hold impact on the preparation of proteins.

Conclusion

The results present in this short article reveal the preliminary findings of this study. The findings show that U.S. is the most influential country among the 50 cited countries. The cited assignees located in California, U.S., include Cetus, University of California and Genentech hold high impact on the genetic engineering research among 3,088 cited assignees. The inventors from the research groups related Cetus, include Mullis, Saiki, Erlich … etc., also inspired the research of genetic engineering. Not only are the in-fields technologies are highly cited, but out-fields technologies also introduced into the works of genetic engineering research.

References

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