Effective strategies for marketing biomedical inventions: Lessons learnt from NIH licence leads

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Abstract We analysed the origins of 281 licence agreements completed by NIH between 2001 and 2004. The origin of these licences was distributed among three sources that were classified as Inventor Contact (38 per cent), Marketing (34 per cent) and Public Information (28 per cent). Detailed analyses showed that while inventors played a more prominent role in securing leads for biological material licences, marketing efforts by the technology transfer personnel played a larger role in identifying commercial patent licensees. An inventor citation index analysis from 1992 to 2004 demonstrated that inventors who were personally involved in obtaining licence leads, and inventors whose technologies were licensed through NIH marketing efforts had similar citation indices. Taken together, these results suggest that inventor contact and technology marketing efforts are equally important in generating licence leads. Based on these data, we propose effective strategies that can be used by academic and governmental institutions for marketing their inventions to the private sector.

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INTRODUCTION

The mission of the National Institutes of Health (NIH) is to pursue fundamental knowledge about the nature and behaviour of living systems and the application of that knowledge to extend healthy life and reduce the burdens of illness and disability. This mission is accomplished through a combination of basic research, training the next generation of scientists and wide dissemination of medical information. With an intramural annual budget of approximately US$2.7bn (Fiscal Year (FY) 2004) and a staff of over 6000 scientists, numerous discoveries are made each year in the NIH intramural laboratories. To benefit society, these discoveries have to be translated into useful biomedical products. We rely on our industry partners to complete most post-discovery efforts including product development, clinical testing and finally marketing and distribution. The transfer of these important early-stage discoveries from research laboratories to our industry partners has thus become a critical goal for the NIH.

In the past 17 years (FY 1988 to FY 2004), the NIH Office of Technology Transfer (OTT) has entered into more than 2500 licences and earned nearly US$500m in royalty revenues.[1] More than 200 biomedical products on the market can trace their origins back to NIH inventions and about 20 of these products belong to the category of life-saving drugs and vaccines.[2] Taken together, the NIH licensing programme represents one of the largest technology transfer establishments in the US biomedical field, and therefore the conclusions drawn from this study may be relevant and applicable to biomedical licensing programmes in most research institutions.

One critical question the authors hope to answer in this paper is precisely the question others and those in the technology transfer field have been asking for many years, namely what are the different ways by which our potential licensees find out about the technologies they ultimately license, and are there any preferred mechanisms of communicating useful information to industry? There have been a few preliminary studies on this subject[3,4] but the authors here decided to perform an in-depth study in order to confirm or refute many commonly accepted views in this area. This study differs from previous studies in that data was analysed that were directly reported by potential licensees in their licence application. This allowed the capture, in real time, of the motivations of our potential customers. Also analysed was the relationship between the source of leads in different customer segments, and the decision-making behaviour of that particular segment. The vast majority of the technologies originating at the NIH are biomedical in nature, so the results presented here may not reflect licensing practices in other areas. It is possible that in the engineering and physical sciences, the methods used to communicate findings and to exchange information, expertise and technologies may be quite different.

By analysing the licence application that was submitted before licence negotiations began, the real-time data about the customer behaviour patterns was captured. It is hoped that this study will encourage others in the field to carry out similar quantitative market research in the field of technology transfer. The authors believe that such studies would not only help transfer nascent technologies more efficiently from development to commercialisation, but they would also answer a number of fundamental questions. (1) What are the best strategies to market technology? (2) Do these strategies depend on the nature of the technology being marketed, in other words, can principles of product segmentation be effectively applied to

technology marketing? (3) What are the logical ways to segment the technology transfer market, and how can it benefit both the buyers and the sellers of technology? (4) How important is branding in technology transfer, and are there ways to measure brand equity in these complex one-of-a-kind transactions?

METHODOLOGY

The data presented here were collected from the licence application form that was submitted by the licensees during the fiscal years 2001 to 2004 (http://ott.od.nih.gov/licapp.html). The relevant section of the application form required the applicant to identify the source from which they learnt about the technology they sought to license. Approximately 46 per cent of the 610 licensees provided the requested information on the licence application, which allowed the analyses of 281 licences. A proprietary relational database software, TechTracS, developed jointly by NIH and Knowledge Sharing Systems (Raleigh, North Carolina) was used to collect and analyse the data. Because the main interest was in the *origins* of licence agreements at NIH, data from applications that did not lead to licence agreements were included. All statistical analyses were done using the SPSS statistics software (SPSS Inc., Chicago, Illinois).

These data were then organised into different categories based on the source of information that led to the licence agreement, type of licence, exclusivity and type of business that licensed the invention. For simplicity, the origin of licence agreements were organised into three major categories: (1) Inventor contact, (2) Marketing and (3) Public information. Inventor contact simply refers to licence leads that originated because of personal contact with the scientists or their collaborators. The Marketing category consisted of seven sub-categories that included marketing by OTT's technology transfer staff, OTT website, prior licensees, Advertising, Cooperative Research and Development Agreement (CRADA) collaborators, e-mail listserv members and a miscellaneous category. The Public Information category comprised of licence leads where the relevant information came from sources that were publicly available. This last category contained: (a) inventor publications including PubMed searches, (b) patent searches and (c) other public information sources including general web searches and online cell repositories.

Business firms were divided into two categories: (1) Large Businesses and (2) Small Businesses, as defined by the United States Small Business Administration.[5] The types of licence agreements included in this study were: (a) Biological Material Licence (BML), (b) Commercial Evaluation Licence, (c) Commercial Patent Licence and (d) Internal Use Licence. BMLs allow a company to make, use and/or sell commercially useful biological materials which are not in the public domain and for which patent protection cannot or will not be obtained. This type of licence is typically non-exclusive. Commercial Evaluation Licences grant a company the non-exclusive right to make and use the technology for evaluating its commercial potential. The licence is for a limited number of months and does not grant the right to sell or otherwise distribute the invention. Companies are required to obtain a commercial patent licence for further use and/or development of the invention. Internal Use Licences grant the non-exclusive right to make and use the invention for the purpose of internal use by the licensee. These licences do not grant the right to sell or otherwise distribute the invention, but allow the licensee to use the invention as a tool in their commercial development activities.[6]

In order to have a numerical approximation of each scientist's professional reputation, an averaged

citation index score was calculated (described below) for each scientist whose inventions were licensed. This averaged citation index score was used as an approximate measure of the scientist's eminence or brand equity. By querying the Science Citation Index Expanded database, a list of all scientific publications and reviews published by the inventor over the last 12 years and the number of times each paper had been cited was compiled. This result was summed and the total divided by 12 to get the averaged citation index score per year. A period of 12 years was chosen because it was felt that this period would be sufficiently long to account for any year-to-year fluctuations in the publication record, giving a better measure of the inventor's reputation in the field. In addition, many inventions were actually patented several years before they were licensed. The averaged citation index score accounted for this time lag and allowed the analysis of correlations between the reputation of a particular scientist and the number of inventions licensed from that scientist, irrespective of when the patenting took place.

RESULTS AND ANALYSIS

After analysing the 281 licence applications filed during the four fiscal years 2001 to 2004, inventor contact constituted approximately 38 per cent of the leads, followed by marketing 34 per cent and public information 28 per cent (Fig. 1). It was found that inventor contact and marketing were statistically indistinguishable, but public information was distinguishable from the other two categories (Table 1 and Fig. 1). The trends were similar in each of the four years (Table 1), and therefore for simplicity the data from all four years was combined. Although this data point to a higher number of licence leads resulting from marketing efforts (34 per cent) when compared with a previous study[7] (19 per cent), it is believed that the larger size of the office, with approximately 25 licensing professionals and staff dedicated solely to marketing, might be a significant factor. The authors are of the opinion that in order to sustain a specialised marketing programme, one needs a critical number of professionals that are solely devoted to marketing efforts. Therefore, the larger size of the office allows the investment of more efforts in marketing. The fact that multiple marketing channels are used, may have also contributed to the higher effectiveness of this marketing programme.

Personal contact with the Principal Investigator (88 per cent) was the largest subdivision in the inventor contact category, while collaborators made up the remaining 12 per cent. Breakdown of the marketing category showed that technology transfer employees (33 per cent) played a prominent role in marketing NIH inventions followed by the OTT website (22 per cent) (Fig. 2). When analysing licensing leads that were acquired because of access to public information, it was found that inventor publication (58 per cent) was the most important factor that led to licence inquiries. Specific patent searches by potential licensees generated 24 per cent of the potential leads within that category (Fig. 3).

The relative role of marketing and inventors as sources of leads among different types of licenses was then explored. Because the decision thresholds for different types of licences such as patent licences or biological material licences are different, it was expected to see differences in the way different types of licences originate. For simplicity, commercial evaluation licences were included into the category of commercial licences and internal use licences were included in the biological material licences category. When these two main categories, namely commercial licences (158) and biological

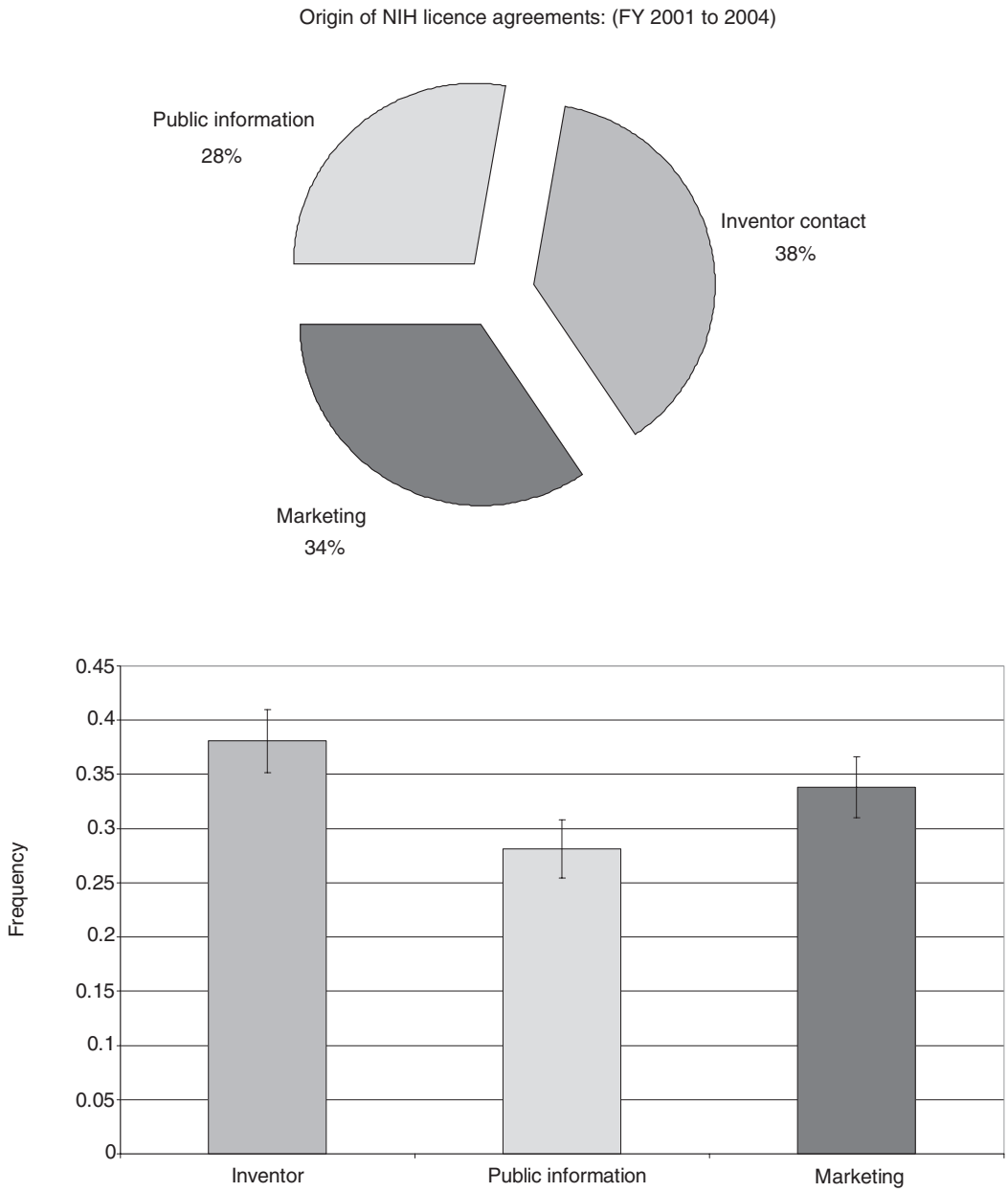

Figure 1: Inventor contact and marketing play important roles in generating leads for licence agreements followed by public information. The accompanying bar graph indicates the standard error of mean for each category

material licences (123) that were executed during the same four year time-period (2001–2004) were compared, it was found that marketing efforts played a greater role (40 per cent) in generating leads for commercial patent licences while the inventor played a greater role (45 per cent) in generating leads for BMLs (Fig. 4). A Pearson χ^2 test confirmed that the results were significant ($p = 0.038$).

We had assumed that companies who licensed technologies based on an inventor's research results would place a high value on the inventor's reputation, ie

Table 1: The origin of 281 licence applications filed between Fiscal years 2001 and 2004. Three major categories: inventor, marketing and public information were included in this analysis

Lead category	2001	2002	2003	2004	Total	Total (%)	SEM
Inventor	22	26	43	16	107	38	0.029
Marketing	24	18	43	10	95	34	0.026
Public Information	16	21	29	13	79	28	0.028
Total	62	65	115	39	281		

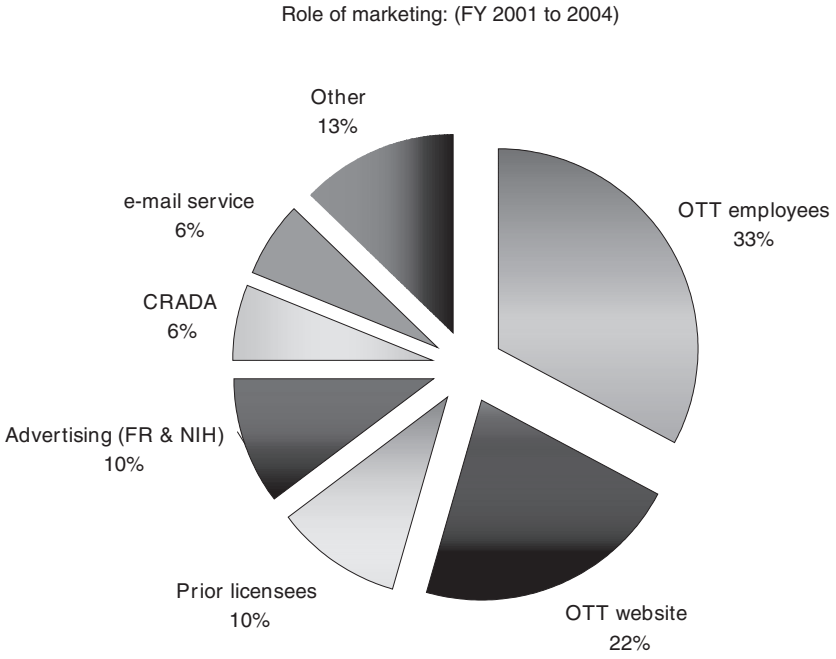

Figure 2: Direct marketing by OTT employees and the OTT website make up 55 per cent of all marketing leads.

a company would be more likely to license an invention from those inventors who had a greater number of highly cited scientific publications. Analysis of the citation index for each of the inventors from 1992 to 2004 showed that there was no statistically significant difference between inventors who directly exchanged scientific information with companies, and inventors who had their technology licensed through the marketing efforts of the OTT's technology transfer personnel. This analysis (two-tailed *t*-test, $p = 0.132$) showed that inventors who were personally involved in generating licence leads and inventors who had their

Table 2: Here the licence leads are segmented according to large versus small businesses using the same categories as in Table 1.

Lead category	Large business	Small business
Inventor	39 (41%)	68 (37%)
Marketing	25 (26%)	70 (37%)
Public Information	31 (33%)	48 (26%)
Total	95	186

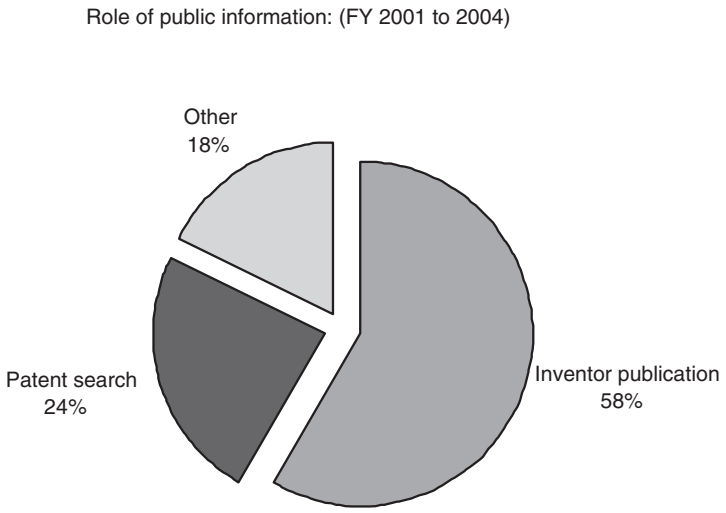

Figure 3: Some 58 per cent of the licencing leads in the public information category come from inventor publications

technologies licensed through OTT marketing efforts had very similar citation indices (Fig. 5).

Also analysed was the importance of knowledge of and contact with the inventor as a source of licence leads for large business versus smaller business firms. Detailed statistical analyses showed only a weak correlation (both Pearson χ^2 ($p = 0.153$) test and Logistic regression) between the type of business and mode of getting licensing information. One reason for these results may be the presence of multiple interactions between the type of business and the different modes of information transfer (marketing, inventor and public information) which could probably give rise to a weak correlation

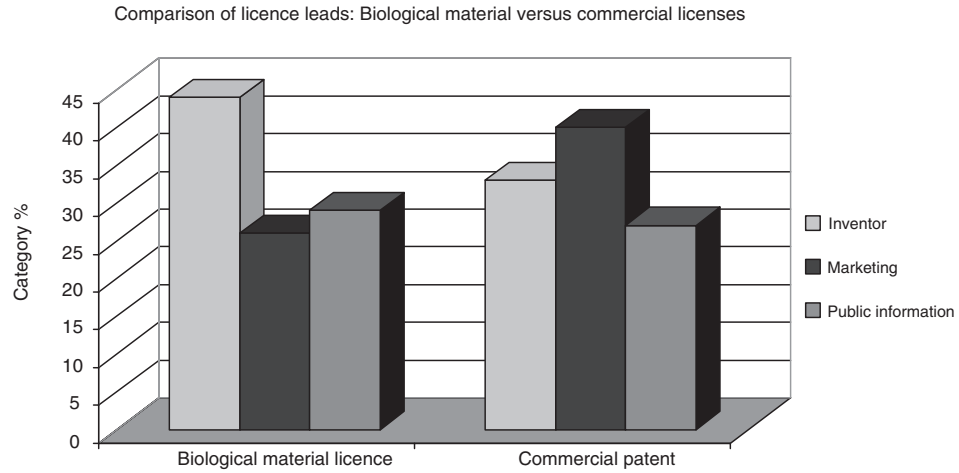

Figure 4: The inventor plays a much greater role in generating leads for Biological Material Licences (45 per cent) when compared with Commercial Patent Licences (33 per cent). Conversely, marketing plays a much larger role when generating leads for Commercial Patent Licences (40 per cent) when compared with Biological Material Licences (26 per cent)

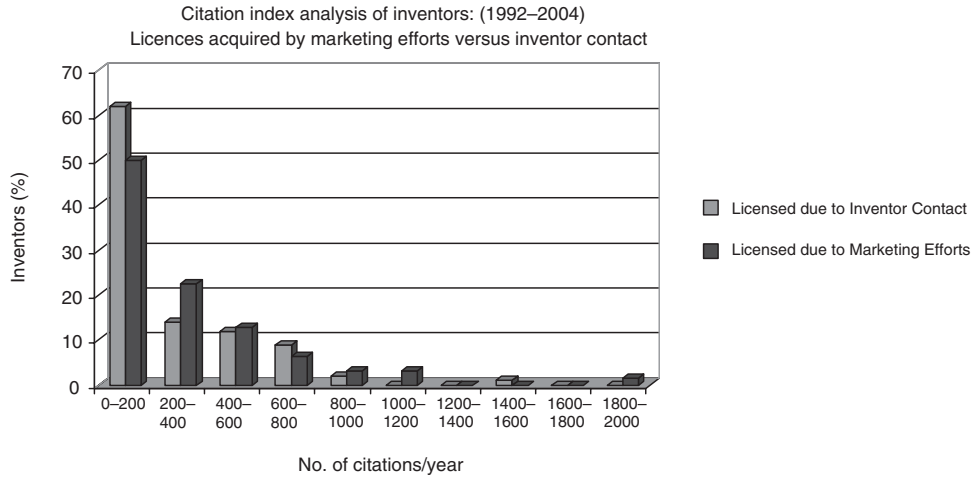

Figure 5: Analysis of inventor citation index showed that the inventors who were personally instrumental in generating leads for their technologies did not have a significantly higher citation index when compared with scientists whose technologies were licensed through marketing efforts

within any single category. However, the authors think that these results highlight important facets regarding the roles of the inventor and marketing when dealing with small and large businesses, and therefore have included data as a representative model of how technology transfer could conceivably take place in this setting. It was found that the inventor (41 per cent) played a greater role in generating licence leads for large business firms when compared with marketing (26 per cent) (Fig. 6 and Table 2). In the case of small business firms, it was found that marketing (37 per cent) played a greater role in generating leads that led to licence agreements (Fig. 6). A possible explanation for this result could be that small business

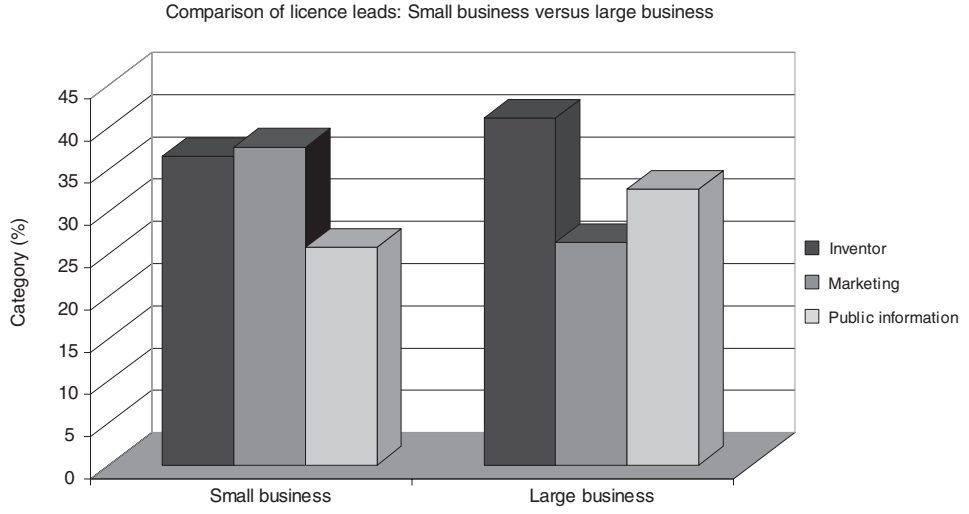

Figure 6: Technology marketing efforts by NIH OTT have greater impact on the licensing activities of small businesses (37 per cent) in comparison to large business firms (26 per cent)

firms have insufficient resources to actively search for nascent technologies and therefore could be more receptive to marketing communications. Larger businesses may be able to deploy more resources to technology scouting and therefore may rely more on other sources of information, such as publications, inventor presentations and personal contact between scientists and inventors.

DISCUSSION

These results point out the importance of segmenting the customer base when marketing technologies. The ideas of market segmentation and the use of preferred media of communication are well documented in other industries[8] and can also be applied in the technology transfer arena. As seen in Figure 4, the inventor's role is distinctly different when biological material licences and commercial patent licences are compared. Inventors play a much greater role in generating leads for biological material licences, while marketing plays a greater role in commercial patent licences. Generally, biological materials are licensed because of purely scientific considerations and in most cases, the decision-making process for licensing a biological material lies with the scientist in a particular pharmaceutical or biotechnology company. Scientists working in this company are more aware of the inventors' work and the importance of their discoveries and, therefore, the effect of the inventors in securing leads for a biological material licence is greater. Conversely, a commercial patent licence takes longer, is more involved and is usually a business decision. In this case, there is a high probability that the influence of scientists is limited, and active marketing efforts might play a greater role. Thus, the marketing strategies used should be dictated by the kind of intellectual property or technology being promoted. When promoting BMLs, the inventors' role should be acknowledged and they should be allowed to play a more active role in the marketing programme either explicitly or implicitly by using references to their work. Although licensing personnel do not market products, this kind of segmentation based on the 'product profile' can help maximise the marketing effects of a technology transfer office.

The authors also looked at the other classical way to segment the market in terms of customer profile. Generally, one expects small and large businesses to behave differently in terms of their risk tolerance, product development and decision-making strategies. When the relative roles of marketing and inventor contact between two different market segments that included small versus large businesses were examined, it was discovered that marketing had a larger role to play in generating leads among small businesses when compared with large businesses. Therefore, directly marketing technologies to small business firms in a targeted fashion is likely to pay greater dividends in comparison with larger pharmaceutical or biotechnology firms (Fig. 6 and Table 2). Thus, these concepts of segmentation can be used to fine-tune and customise marketing messages depending on the type of customer being targeted, the type of technology being marketed and the ultimate application of the technology.

It is worth remembering that inventor contact remains the most important factor in generating licensing leads. In this study, 38 per cent of all licensed inventions originated from inventor contact, and considering the fact that inventor publication within the Public Information category accounted for an additional 16 per cent (0.58 $\times$ 28 per cent) of *total* licence leads, it is believed that the role of the inventor is crucial in technology marketing. The authors suggest that a

technology transfer office should invest considerable effort in contacting the scientist when formulating any targeted marketing strategy. Scientists are more knowledgeable about their specific areas of interest than licensing specialists and are therefore more likely to offer relevant insights about the nature of the technology. Inventors can serve as allies in marketing efforts in a number of ways: (1) providing specific information about the technology applications, (2) suggesting potential company names and contacts, (3) helping to design a compelling marketing message, (4) brainstorming about future developments in the area and (5) promoting the technology to potential licensees through meetings or conferences they attend.

In order to analyse the role of the inventor in generating licensing leads, the authors wanted to explore if there was any causal relationship between inventors' reputations and number of licence leads that resulted from knowledge of the inventors' activities. A generally recognised measure of scientists' reputations is the citation index. This index not only measures how often scientists publish in their field, but also how often they are quoted by their peers. This analysis suggests that scientific reputation might play a much smaller role than previously imagined in generating licensee interest for their inventions. Scientists who had their inventions licensed through marketing efforts had comparable average citation index scores with scientists who personally marketed their inventions. This suggests that the brand value of the NIH as an institution overrides the individual reputation of the scientists. It is believed here that these results emphasise the importance of branding when marketing scientific inventions but further research must be performed to validate this statement.

In addition, the role of marketing, which contributed to 34 per cent of all licence leads, should not be underestimated. The present research reiterates the importance of multiple channels in marketing technologies. Direct marketing by technology transfer professionals (33 per cent) combined with the OTT website (22 per cent) generated 55 per cent of all leads in marketing. Prior licensees and advertising in the Federal Register together constituted 20 per cent of all leads in the marketing category. These data suggest that it pays to advertise one's technology transfer office, the technologies available and the office website itself, especially if one has a well-established network of customers. This is consistent with previous studies that show that technology transfer between industry and public institutions depends on well-established networks between the customer and the technology transfer office.[9] With the advent of the internet and multiple search engines, the most common focus of all searchers looking for technologies is the institution's technology transfer website. The number of such searches is likely to grow with time. Therefore, investing in a user friendly, well-indexed website with a sophisticated internal search engine is likely to pay rewards over time. This in turn could lead to a higher number of licence agreements.

Websites can also be used as an electronic transaction medium that could handle some of the initial exchanges between the technology transfer office and the potential licensee, such as the transmittal of a Confidential Disclosure Agreement (CDA) to the customer. It is worth remembering, however, that while the advent of the internet has reduced the barrier to entry for many products, there is little evidence that a technology transfer office with little experience in knowledge transfer with the business sector can compensate for this disadvantage by designing an innovative website.[10]

CONCLUSION

Personal contacts by the principal investigator and technology transfer professionals, targeted marketing and a dynamic website are three of the most effective ways to market technology. Different marketing activities act synergistically and are more powerful when used together. Hence, it is critical to employ multiple marketing activities and fine-tune the overall technology-marketing programme, based on client feedback, market/product segmentation and organisational constraints. In the process, it is important to communicate the brand of the institution from where the technologies originate.

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