

Intellectual Property in the AAAS Scientific Community:

A descriptive analysis of the results of a pilot survey
on the effects of patenting on science.

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Executive Summary

Historically, academic scientists chose to disseminate basic research findings and inventions through free and open channels such as informal sharing, journal publications or conference presentations. These basic discoveries had little immediate commercial value for the author to appropriate privately, but could prove highly useful for other researchers to build upon. The reward structure of academic science reinforced this practice, awarding prestige and tenure on the basis of discoveries published in journals and provided openly to the scientific community. The patenting of intellectual property generated by research, while pursued by academics in some fields, was primarily reserved for discoveries made in the commercial sector, which could be developed into marketable products and bring monetary rewards to their inventors.

The past two decades have seen an increase in patenting, most notably in the life sciences, by both industry and academic scientists in the U.S. Much concern has been raised that this increase in patenting would create an “anti-commons” effect¹ where basic, non-commercial academic research would be hindered by the imposition of long negotiations and expensive licenses to acquire necessary research inputs from either industry or academia.

In early 2005, the Science & Intellectual Property in the Public Interest (SIPPI) project at the American Association for the Advancement of Science (AAAS) conducted a survey to help determine the effects patenting has had on research conducted by academia, industry, non-profit organizations and government in a range of scientific fields. The survey was conducted using a random, stratified sample of 4,017 drawn from AAAS membership. A total of 1,111 AAAS members responded to the survey, providing a response rate of 28%. Of these respondents, 76% reported that they were actively conducting or managing research or specializing in intellectual property.

This survey allowed us to gain some insight into the way scientists approach their own intellectual property, including their motivations for protecting IP. From the results of this survey, it appears that there may be some appreciable differences in the methods by which scientists in different fields and sectors protect and disseminate their IP.

Acquiring Patented Technologies

Overall, 24% of respondents conducting or managing research or specializing in intellectual property reported acquiring a patented technology for use in their research since January 2001. Within almost every scientific field, respondents from industry reported acquiring technology at a higher rate than respondents from academia. The majority of these (79%) reported that the technology originated in their own field. Additionally, 11% of respondents from a field outside the biosciences identified their technology acquisition as originating in a bioscience field.

For those attempting to acquire intellectual property, the greatest overall proportion of respondents reported acquiring their last patented technology through the use of a material transfer agreement (MTA). The use of MTAs was concentrated among bioscience respondents and academic bioscience respondents in particular. For industry bioscience, non-exclusive licensing was the most common method used in the acquisition

¹ Heller and Eisenberg, 1998.

of technologies. In both industry and academia, exclusive licensing was one of the least used methods for technology transfer.

In terms of the time spent in acquiring technologies, non-exclusive licenses accomplished transfers of technology most quickly, with 39% of these transactions completed in less than one month. These were followed by informal transactions (31%) and MTAs (27%). The greatest proportion of technologies that took over 6 months to acquire involved exclusive licensing.

A total of 40% of respondents who had acquired patented technologies since 2001 reported difficulties in obtaining that technology. Bioscience respondents working in industry reported the most problems, with 76% of those reporting that their research had been affected by these difficulties. By contrast, only 35% of university-based bioscience respondents reported difficulties that affected their research.

Of the 40% of respondents who reported their work had been affected, 58% said their work was delayed, 50% reported they had to change the research, and 28% reported abandoning their research project. The most common reason respondents reported having to change or abandon their research project was that the acquisition of the necessary technologies involved overly complex licensing negotiations.

Protecting Intellectual Property

Overall, 46% of respondents reported that they had made a discovery or created a technology they considered eligible for some form of intellectual property protection since 2001. Within every scientific field, a higher proportion of respondents from industry reported creating IP than respondents from academia. The scientific fields with the highest proportions of respondents creating IP were math and computer science (77%) and engineering (69%).

Of the methods used to protect IP, patents were used by 55% of those who reported creating IP. Copyright was the second-most common method for protecting IP (21%). Patenting was highest among industry respondents in the fields of chemistry (94%) and biosciences (85%). Among academic respondents, those in the field of engineering reported the highest rate of patenting (68%). Academic respondents in the fields of chemistry (59%) and biosciences (56%) reported relatively high patenting as well.

Of the 55% of respondents who reported using a patent to protect IP, 41% described their most important patented technology created since 2001 as a research tool – a technology that is used to conduct research and is not the subject of the research itself. Among university scientists this proportion was even higher, with 50% characterizing their patented technology as a research tool.

Overall, 25% of the respondents who disseminated their technology used a research exemption that allowed the patent holder to continue to conduct research on or with the licensed technology. Overall, 32% of respondents who used licensing in the dissemination of their technology included a research exemption.

Although the survey found that the greatest proportion of respondents who created IP did in fact patent it, 66% of respondents that created IP, protected it with a patent, and attempted to disseminate it, representing both academia and industry, reported

publishing as the primary means used to disseminate or share their intellectual property. Sharing informally was the second most frequently reported means of dissemination. An overall total of 85% of respondents that created IP, protected it with a patent, and attempted to disseminate it said they disseminated their intellectual property through either publication, sharing informally, or both methods.²

For those who had not disseminated their patented technologies, the most frequently reported reason was that they were developing or commercializing it themselves (65%). The top reason among academic respondents why they did not disseminate the technologies they had patented was that they planned to conduct future research with them (40%).

While the survey found that patents were the most common means used by respondents to protect IP, especially in the fields of chemistry and biosciences, the licensing of these patented technologies is not the primary means by which respondents within academia acquire or disseminate technology. And while it may be difficult to demonstrate from this unweighted³ sample, it appears that academia has been less affected than industry by more restrictive and formal licensing practices in the acquisition of necessary patented technologies for research. In fact, difficulties reported by industry respondents in attempting to access patented technologies outnumbered those of academic respondents by a ratio of more than 2:1. This may be due to the fact that industry respondents reported creating and holding more intellectual property than academic respondents, as well as the fact that industry relies more on licensing, which entails more and longer negotiations than other more traditional and informal forms of technology transfer still used within academia.

² A 2003 study by Walsh, Cohen and Arora found that despite numerous patents on upstream technologies, academic researchers experienced little problem in accessing knowledge. In a more recent study Walsh, Cho, and Cohen (2005) found that the major reason that academic researchers themselves denied requests to intellectual property was that they were protecting their ability to publish.

³ See Survey Design section of this paper for an explanation.

Background

The past two decades have seen an increase in patenting by academic and public sector scientists in the U.S., most notably in the life sciences. This has had the effect of blurring traditional distinctions between mechanisms for disseminating basic research findings and applied inventions. Traditionally, academic scientists chose to disseminate the former through free and open channels such as journal publication or conference presentations. These basic discoveries had little immediate commercial value for the author to privately appropriate, but could prove highly useful for other researchers to build upon. The reward structure of academic science reinforced this practice, awarding prestige and tenure on the basis of discoveries published in journals and provided openly to the scientific community. Patenting, while pursued by academics in some fields, was primarily reserved for discoveries made in the commercial sector, which could be developed into marketable products and bring monetary rewards to their inventors.

Two developments in the latter part of the 20th century affected this model. First, the U.S. Congress passed the 1980 Bayh-Dole Act, which made it easier for university scientists to file for patents on federally funded inventions, leading to the establishment of designated offices and administrative procedures at many universities to facilitate this process. Secondly, the U.S. Patent Office, along with various courts, issued a series of decisions permitting the patenting of biological components and organisms. These types of inventions were frequently made in the more basic stages of research pursued by academic scientists, but could serve as the basis for lucrative pharmaceutical products or products in other fields, as well as a foundation for future exploratory work. In addition, computer software and business methods also came under patent protections.

These circumstances have led to concerns among some scientists, legal scholars and economists that the shift in mechanisms for protecting or disseminating basic academic research could impair the ability of researchers, collectively, to advance the work of basic science. Issues have been demonstrated by such controversial cases as the BRCA I and II patents, the Oncomouse, the Human Genome Project, accessibility of diagnostic tests, and research tools for basic research that have been patented.

As a result, concerns have been raised about the potential anti-commons effects of the fragmented ownership of intellectual property and the effects of overwhelming transaction costs for obtaining numerous patented research inputs.⁴ While there have been several additional empirical studies on this matter,⁵ they mostly focused on specific scientific technologies, fields or sectors, or had relatively small sample sizes, leaving many questions to be explored. Therefore, the Science and Intellectual Property in the Public Interest (SIPPI) project at the American Association for the Advancement of Science (AAAS) conducted a survey in early 2005 of its membership in order to study the effects of patenting and exclusive licensing by scientists in general. The remainder of this paper will discuss the implementation and results of the 2005 AAAS-SIPPI survey.

⁴ Heller and Eisenberg, 1998.

⁵ Cohen and Walsh, 2002; Murray and Stern, 2005; Sampat, 2004; and Shapiro, 2001.

Survey Design⁶

This survey asked 4,017 scientists to provide details about their experiences acquiring patented technology for use in research, as well as their experiences using different methods to protect intellectual property they had created. The random, stratified and unweighted sample was drawn from a list of U.S. and international members of the American Association for the Advancement of Science (AAAS), a general scientific society with approximately 120,000 members in a variety of scientific disciplines. Only members with valid email addresses (a total population of 88,117 individuals) were sampled.⁷

AAAS collects a variety of information on its members, which allowed the stratification of the sample by five traits: region, age, scientific discipline, job function, and sector. Certain groups were oversampled relative to their representation in AAAS, to facilitate comparison between regions, age groups, scientific disciplines, job functions, and sectors. The oversampled groups were those with relatively fewer AAAS members in them. Those groups overrepresented in the sample include those identified by the AAAS membership data as: (1) members in the disciplines of engineering, mathematics and computer science, physics and astronomy, and social and behavioral science (who were overrepresented relative to biological and medical scientists), (2) members residing outside of the United States, (3) members who are 22-44 years of age, or 65+ years of age (as compared with members aged 45-65, and members who did not provide their age), and (4) members whose job function is applied research (as compared with those doing basic research and those who did not give their job function).

The sampling method should be considered when interpreting proportions given for the survey sample as a whole.⁸ For example, higher proportions of certain underrepresented groups (e.g. biomedical scientists) were more likely to have acquired a patented technology for use in their research. This means that our sample is likely to have a lower proportion reporting having acquired a patented technology than the AAAS membership as a whole.

With a focus on experiences since 2001, the survey instrument consisted of 37 questions and was divided into two general sections. The first section asked a series of questions concerning the acquisition of the last patented technology, material or method by the respondent, how that technology was transferred (shared informally, licensed, etc.), the amount of time the acquisition took, and whether or not the respondent experienced any difficulties in acquiring protected technologies since 2001. The second part of the survey asked a series of questions concerning the last technological innovation or discovery for which the respondent attempted to secure intellectual property protection, whether or not that technology was disseminated, and if so, the method used.

⁶ A detailed report was prepared by the statisticians who assisted in drawing our sample. This document will be made available upon request (Mushtaq and Scheuren, 2005).

⁷ The original sampling frame, drawn from the membership database in October of 2004, included 88,522 individuals. Two groups were discarded from the sampling frame: Region "Other" (350 members) and Age Group "21 and under" (55 members).

⁸ Because of the under- and over-representation described, the data collected would need to be weighted for our analysis to be representative of the underlying population of the 88,117 AAAS members included in the sampling frame. However, this analysis treats the unweighted results. We chose to analyze the unweighted data because of complications in the sampling process that make estimation of confidence intervals difficult. These statistics are therefore descriptive of the sample only.

Survey Administration

The Washington State University (WSU) Social and Economic Science Research Center was contracted to administer a web-based survey and tabulate results. Selected AAAS members received an email invitation from WSU inviting them to participate in the survey. The email included a message from AAAS CEO Alan Leshner, along with a link to the online questionnaire, and a unique identification code for each participant. Those who did not completed the survey right away were sent two reminder emails after the initial contact, spaced two weeks apart.

Results⁹

A total of 1,111 AAAS members responded to the survey, for an overall response rate of 28%.¹⁰ A majority of these respondents, 76% (n=843)¹¹, reported that they were actively conducting or managing research, or specializing in intellectual property. The following analysis is based on these 843 respondents.

Acquiring Patented Technology

Overall, 24% (n=200) of respondents had acquired a patented technology for use in their research since January 2001. Within almost every scientific field, respondents from industry reported acquiring patented technology at a higher rate than respondents from academia. Respondents working in bioscience fields (defined as biological science, biochemistry, medical science, life sciences) had the highest proportion reporting an acquisition of patented technology, with 34% (n=103) reporting an acquisition, as opposed to 24% of respondents overall. Bioscience respondents working in industry (53%, n=28), as well as those working in academia (30%, n=49), reported IP acquisition at higher rates than respondents working in any other field.

Detailing Circumstances of Respondent's Last Patent Acquisition

Respondents who reported acquiring a patented technology were asked to provide details regarding the last technology they acquired and the field(s) in which the last patented technology they acquired originated.¹² Of the 196 respondents who answered

⁹ Please note that each percentage in this section will use the denominator that reflects the number of people that answered the question that provides the count in the numerator. In other words, non-respondents will not be counted in the denominator.

¹⁰ Additional discussion of the response rate is available in Mushtaq and Scheuren, 2005.

¹¹ Throughout this paper, "n=X" will represent the numerator in the mentioned proportion.

¹² Respondents were provided a matrix of potential combinations of scientific fields and economic sectors from which they acquired the technology. They were asked to place check marks in the matrix to describe the field and sector from which they acquired the technology (e.g. source field: chemistry, source sector: academe). However, respondents were able to check multiple boxes in the matrix. Many respondents described their technology as originating in several different scientific fields, and more than one economic sector, which causes the percentages from this question to add to more than 100%. 15% (n=30) of those who acquired a patented technology identified it in more than one field, and 22% (n=42) identified it in more than one sector. The most source fields identified by a single respondent were six. It is not clear whether these respondents misunderstood the question (i.e. thought we wanted them to check appropriate boxes for *all* of the patented technologies they had acquired over the previous four years), or whether the technologies acquired by

this question, the majority (79%, n=155) reported that the technology originated in their own field, as defined in Table 1. Additionally, 11% (n=21) of respondents from a field outside the biosciences identified their technologies as originating in a bioscience field.

Similarly, 196 respondents identified the sector from which they acquired the patented technology. Most acquired the technology from either industry (59%, n=115) or academia (51%, n=99), with 10% (n=19) acquiring the technology from government, and 8% (n=15) from a non-profit source. The primary source sectors of technologies varied according to scientific field. Technologies identified with biomedical or biological science were acquired from academic sources in 59% (n=66) of cases, and from industry sources in 51% (n=57) of cases. Technologies identified with engineering, on the other hand, were acquired from industry in 79% (n=23) of cases and from academic sources in 41% (n=12) of cases. Technologies identified with math and computer science came from academia in 45% (n=13) of cases and industry in 83% (n=24).

Methods/Terms Involved in Acquiring Technologies

The greatest overall proportion of respondents reported acquiring their last patented technology through the use of a material transfer agreement (MTA) (35%, n=67). The use of MTAs was concentrated among bioscience respondents (n=45), and academic bioscience respondents in particular (65% of the academic bioscientists used MTAs, n=32).

Table 1: Respondents Reporting Acquisition of Patented Technology, by Scientific Field of Respondent and Scientific Field of Technology

Scientific field	Acquired within own field	Acquired from bioscience field	Total # in scientific field
Biosciences	90 (90%)	N/A	100
Chemistry, Earth sciences, Physics & Astronomy	25 (61%)	11 (27%)	41
Engineering, Math, Computer Sciences	31 (86%)	7 (19%)	36
Social/Behavioral sciences	9 (60%)	2 (13%)	15
Non-Scientific Field	0 (0%)	1 (100%)	1
Other	0 (0%)	0 (0%)	3
Total	155 (79%)	21 (11%)	196

Non-exclusive licenses were most frequently used in the acquisition of patented technology by industry bioscience respondents. While 57% (n=16) used non-exclusive licensing, only 32% (n=9) used an MTA. Among university bioscience respondents who acquired a patented technology, only 8% (n=4) used a non-exclusive license to effect the transfer.

Among respondents who acquired patented technologies, 29% (n=57) used a non-exclusive license. Non-exclusive licenses were especially highly used by respondents in social and behavioral sciences (67%, n=10) and respondents in math & computer science (60%, n=6).

those respondents indeed originated in several scientific fields and economic sectors. In the following analysis, percentages of technologies acquired from a particular field or sector were calculated from the total technologies for which that field or sector was checked (although others may have been checked too).

Exclusive licenses were involved in only 20% (n=40) of all technology acquisitions, and were used in a greater proportion of acquisitions by industry respondents (32%, n=21) than acquisitions by academic respondents (16%, n=15). For bioscience respondents, exclusive licenses were used in 19% (n=20) of technology acquisitions, with 29% (n=8) of industry bioscientists and 18% (n=9) of academic bioscientists reporting acquisitions involving exclusive licenses. Confidentiality agreements were used in 20% (n=39) of acquisitions overall.

Overall, 30% (n=60) of respondents who acquired a patented technology reported that a research exemption¹³ by the patent holder was one of the conditions of the transaction. Transfers involving biological or medical technologies were most likely to include research exemptions, with 40% (n=31) and 36% (n=16) of these transfers including the licensing terms, respectively. Technologies originating in academia were more likely to involve a research exemption than technologies originating in other sectors, with 40% (n=41) of technologies acquired from academia and only 23% (n=27) of technologies acquired from industry carrying a research exemption.

Time Taken to Negotiate Acquisition of Technology

We asked about how long the process took for their last acquisition of patented technology and the form of that transaction (e.g. an informal transfer, material transfer agreement, licensing). The acquisition of technology happened most quickly in transactions that employed non-exclusive licenses; 39% (n=22) of transactions involving a non-exclusive license were completed in less than one month.

The greatest proportion of transactions taking over 6 months to negotiate involved an exclusive license (33%, n=13). The fields of physics and astronomy (27%, n=3) and medical science (26%, n=11) had the highest proportion of transactions taking over 6 months.

Table 2: Length of Time to Technology Acquisition, by Transfer Method

	Less than one month	1-2 months	2-6 months	More than 6 months	Don't know
Informal	8 (31%)	1 (4%)	6 (23%)	2 (8%)	9 (35%)
Exclusive License	8 (21%)	7 (18%)	9 (23%)	13 (33%)	2 (5%)
Non-exclusive License	22 (39%)	7 (12%)	11 (19%)	8 (14%)	9 (16%)
Material Transfer Agreement	17 (27%)	16 (25%)	15 (23%)	12 (19%)	4 (6%)
Sponsored Research Agreement	2 (8%)	7 (25%)	7 (25%)	5 (19%)	4 (60%)
Confidentiality Agreement	6 (16%)	8 (21%)	10 (26%)	7 (18%)	7 (18%)
Other	2 (40%)	0 (0%)	0 (0%)	0 (0%)	3 (60%)
Don't know	2 (20%)	0 (0%)	1 (10%)	0 (0%)	7 (70%)
Total	55 (30%)	34 (18%)	40 (22%)	27 (15%)	28 (15%)

¹³ Generally speaking, a research exemption allows the patent holder to continue to conduct research on or with the patented technology after it has been licensed to others.

Acquisitions of technologies from industry finished more quickly than those from academia, possibly because more acquisitions from industry were executed using non-exclusive licenses and upfront fees. While 35% (n=37) of acquisitions from industry were negotiated in under 1 month, only 25% (n=23) of acquisitions from academia finished in under 1 month, as MTAs and informal agreements were used more frequently.

Difficulties Affecting Research

We asked respondents if their research had been affected by difficulties obtaining patented technology since January 2001. Out of the 179 respondents to this question, 40% (n=72) reported that their research was affected by difficulties in obtaining that technology. Bioscience respondents working in industry reported problems at the highest rate: 76% (n=19). In the case of university-based bioscience researchers, 35% (n=16) who acquired patented technologies reported difficulties affecting their research.¹⁴

Those who reported that difficulty obtaining patented technology had affected their research were asked to specify the way in which their work was affected. Overall, 58% (n=42) responded that their research had been delayed, 50% (n=36) had to change the research, and 28% (n=20) had to abandon the research. The most common reason which respondents provided for having to change or abandon their research was that acquiring the patented technology involved overly-complex licensing negotiations (58%, n=26). High individual royalties was the next most frequent answer, provided by 49% (n=22) of respondents. That necessary patents were not licensable was an answer provided by 40% (n=18) of respondents, while breakdowns in licensing negotiations was provided as a reason by 36% (n=16). Six or fewer respondents attributed their need to change or abandon research to the following reasons: an inability to determine the IP status or the technology, notification of an infringement claim, or the fact that royalties were required for multiple patents.

¹⁴ In recent research reported in *Science*, 414 biomedical researchers from the university, government, and non-profit sectors are questioned about their experiences with intellectual property. Walsh et. al. (2005) reports that "Of the 32 respondents who were aware of relevant IP, four reported changing their research approach and five delayed completion of an experiment by more than 1 month. (p. 2002)" This suggests (but is not identical to) a rate of 28% of biomedical scientists that use patented technologies reporting difficulties due to the patents. In our sample, of the 75 bioscience respondents from the academic and GNHC (Government, Non-profit Organization, Healthcare Organization, or Self-Employed/Consulting Firm) sectors, 33% (n=25) report difficulties. These percentages are remarkably similar.

Walsh et. al.'s study yields different findings, however, concerning the number of scientists that have acquired patented technology, reporting "32 out of 381 respondents (8%) believed they conducted research in the prior 2 years using information or knowledge covered by someone else's patent. (p. 2002)" In our study, we find 31% of bioscience respondents from the academic and GNHC sectors reporting the use of patented technology in their research. This difference may be due to subtle differences in definitions. While Walsh et al. ask whether the scientists *believe* they have used technology that was "covered by someone else's patent (p. 2002)", we ask specifically if patented technology had been acquired. Walsh et al. also report that only "5% (18 out of 379)" of their respondents "regularly check for patents on knowledge inputs related to their research. (p. 2002)" This suggests that there are potentially substantial differences between the two populations sampled for the two studies.

Table 3: Respondents Reporting Difficulties Obtaining Patented Technology Which Affected Their Research, by Scientific Field and Employment Sector

Field of respondent	Sector of respondent ¹⁵	Total	# who acquired (acq) patented technologies (pt) for use in research, since 2001				Of those who acquired pt, # reporting that difficulties affected research (pt w/ diff)			
			acq pt	no pt	nr ¹⁶	% acq pt	diff	no diff	nr	% pt w/ diff
Bioscience	GNHC	81	26	54	1	33%	9	13	4	41%
	Industry/ Business	53	28	25		53%	19	6	3	76%
	University/ College	164	49	115		30%	16	30	3	35%
	Other	11	0	10	1	0%				
Chemistry	GNHC	14	0	14		0%				
	Industry/ Business	25	11	13	1	46%	4	6	1	40%
	University/ College	47	8	39		17%	1	5	2	17%
	Other	5	0	5		0%				
Earth sciences	GNHC	15	0	14	1	0%				
	Industry/ Business	3	1	2		33%	0	1		0%
	University/ College	18	1	17		6%	0	1		0%
	Other	4	0	4		0%				
Physics and astronomy	GNHC	26	4	22		15%	2	2		50%
	Industry/ Business	12	3	9		25%	0	3		0%
	University/ College	73	13	60		18%	4	6	3	40%
	Other	16	1	15		6%	0	1		0%
Engineering	GNHC	19	2	17		11%	0	2		0%
	Industry/ Business	46	17	29		37%	6	9	2	40%
	University/ College	36	7	28	1	20%	1	5	1	17%
	Other	6	0	6		0%				
Math and computer sciences	GNHC	4	2	2		50%	0	2		0%
	Industry/ Business	11	2	9		18%	1	1		50%
	University/ College	21	5	16		24%	2	3		40%
	Other	5	1	3	1	25%	1	0		100%
Social/ Behavioral sciences	GNHC	23	2	21		9%	1	1		50%
	Industry/ Business	6	3	3		50%	1	2		33%
	University/ College	64	10	54		16%	4	6		40%
	Other	6	0	6		0%				
Non-scientific field	GNHC	0	0	0						
	Industry/ Business	4	0	4		0%				
	University/ College	2	1	1		50%	0	0	1	
	Other	3	0	3		0%				
Other	GNHC	4	1	3		25%	0	1		0%
	Industry/ Business	2	1	1		50%	0	1		0%
	University/ College	8	1	7		13%	0	0	1	
	Other	6	0	5	1	0%				
Total		843	200	636	7	24%	72	107	21	40%

¹⁵ GNHC = Government, Non-profit Organization, Healthcare Organization, or Self-Employed/Consulting Firm. Please note that the values for this variable are counts derived from the sector of employment as reported on the AAAS membership form, not as reported on the survey.

¹⁶ nr = non-response.

Creating Intellectual Property

Overall, 46% of respondents reported that, since 2001, they had created a technology or made a discovery that they believed was eligible for intellectual property protections (n=372).¹⁷ Within every scientific field, a higher proportion of respondents from industry reported creating IP than respondents from academia. The scientific fields with the highest proportions of respondents creating IP were math and computer science (77%, n=30), and engineering (69%, n=70). Within math and computer science, 90% (n=9) of respondents from industry, and 67% (n=14) of respondents from academia created IP. Within engineering 80% (n=35) of industry respondents created IP, while 59% (n=19) of respondents from academia did. In most other fields, the proportion of industry respondents who created IP was close to double the proportion of academic respondents who created IP.

Of the methods used to protect IP, patents were used by the greatest proportion of respondents who created IP (55%, n=204).¹⁸ Patenting was highest among industry respondents who had created IP in the fields of chemistry (94%, n=16) and biosciences (85%, n=29) respectively. Among academic respondents who created IP, those in the field of engineering reported the highest rate of patent use, at 68% (n=13). Academic respondents in the fields of chemistry and biosciences reported relatively high patent use as well, with patents reported by 59% (n=10) in chemistry who created IP and 56% (n=32) in biosciences who created IP.

Copyright was the second-most common method for protecting IP (21% of all respondents who created IP copyrighted their work, n=77). Across all scientific fields except engineering, the proportion of respondents from academia that used copyright was higher than the proportion from industry. Additionally, 36% (n=134) of all respondents who created IP protected it by withholding data, delaying publication, not publishing at all, or a combination of those approaches. In 55% (n=74) of such cases, the respondents had also protected the IP using a patent.

Details of Most Important Patent

Respondents who used patents to protect IP they had created since 2001 were asked to provide details regarding their most important patent. Of the 204 respondents that reported using a patent to protect IP, 194 supplied this information. Of these, 41% (n=79) described their most important patent as a technology whose value is wholly or partially as a research tool.¹⁹ Among university scientists this proportion was higher, with 50% (n=33) characterizing their patented technology as a research tool.

Motivations for patenting differed somewhat between sectors, although “protecting technology from imitation” ranked as the most important reason for all three (industry, academia, and the combined GNHC sector). For university respondents who applied for a patent, “acquiring private R&D funding,” was the second most important reason for their doing so. For industry and the GNHC sector, however, this reason ranked 10th, and 6th in importance, respectively. Acquiring public R&D funding was ranked 8th by

¹⁷ Only 808 of the 843 respondents answered this question; 372 is 46% of 808.

¹⁸ Only 370 out of 372 potential respondents answered this question; 204 is 55% of 370.

¹⁹ A technology used to conduct research and is not the subject of the research itself.

university patent applicants, 8th by patent applicants in the GNHC sector, and 12th by industry applicants.

Overall, 62% (n=117) of respondents who had created IP and attempted to protect it with a patent reported that they had also disseminated the technology in some way.²⁰ When we look at issued patents, we find that 67% (n=52) were disseminated, and 58% (n=61) of patents under examination or appeal were disseminated. A greater proportion of respondents (66%, n=77) reported using publication to disseminate their technology than any other method.²¹ Sharing informally was the second most frequent method, reported by 54% (n=63) of respondents. A total of 85% (n=99) of respondents said they disseminated their technologies through either publication, sharing informally, or both methods. For academic respondents, 88% (n=45) and for industry respondents, 76% (n=26) said they disseminated their technologies through either publication, sharing informally, or both.

The proportion of both industry and university inventors who disseminated their technology within their own sector was higher than the proportion that disseminated it to other sectors. While 81% (n=38) of university inventors disseminated their technologies to academia, only 57% (n=27) disseminated their technologies to industry. Likewise, 91% (n=29) of industry inventors disseminated their technologies to industry, while only 63% (n=20) disseminated their technologies to academia.

Overall, 25% (n=29) of respondents who disseminated a technology included a research exemption for themselves. Overall, 32% (n=15) of respondents who used some form of licensing in the dissemination of their technology included a research exemption.

Among industry respondents who had not disseminated their patented technology, the most frequently reported reason was that they were developing or commercializing it themselves (65%, n=33). The top reason among academic respondents who had not disseminated the patented technology they had created was that they planned future research with it (40%, n=6). Only three academic respondents (20%) did not disseminate their technology because they were developing or commercializing it themselves.

²⁰ Only 189 of the 194 potential respondents answered this question; 117 is 62% of 189.

²¹ The method of dissemination question was answered by 116 of 117 potential respondents.

Table 4: Respondents Reporting Creation of Intellectual Property (IP), and Method by which They Protected IP, by Scientific Field and Employment Sector of Respondent

Field	Sector	#	Created IP since Jan 1, 2001				Patent # (%)	Copy-right # (%)	Other ²² # (%)
			yes IP	no IP	nr	% IP			
Bioscience	GNHC	81	33	42	6	44%	14 (42%)	2 (7%)	10 (30%)
	Industry/ Business	53	34	16	3	68%	29 (85%)	3 (9%)	18 (52%)
	University/ College	164	57	102	5	36%	32 (56%)	14 (25%)	17 (30%)
	Other	11	2	8	1	20%	0 (0%)	1 (50%)	2 (100%)
	Total	309	126	168	15	43%	75 (60%)	20 (16%)	47 (37%)
Chemistry	GNHC	14	9	4	1	69%	4 (44%)	0 (0%)	5 (56%)
	Industry/ Business	25	17	6	2	74%	16 (94%)	0 (0%)	10 (59%)
	University/ College	47	17	28	2	38%	10 (59%)	4 (24%)	5 (29%)
	Other	5	1	4		20%	0 (0%)	0 (0%)	1 (100%)
	Total	91	44	42	5	51%	30 (68%)	4 (9%)	21 (49%)
Earth sciences	GNHC	15	2	13		13%	1 (50%)	0 (0%)	2 (100%)
	Industry/ Business	3	1	2		33%	1 (100%)	0 (0%)	0 (0%)
	University/ College	18	6	12		33%	0 (0%)	2 (40%)	3 (50%)
	Other	4	1	3		25%	0 (0%)	0 (0%)	1 (100%)
	Total	40	10	30		25%	2 (20%)	2 (25%)	6 (60%)
Physics and Astronomy	GNHC	26	7	19		27%	4 (57%)	2 (40%)	2 (29%)
	Industry/ Business	12	10	2		83%	7 (70%)	1 (10%)	0 (0%)
	University/ College	73	24	45	4	35%	10 (42%)	7 (30%)	11 (46%)
	Other	16	3	13		19%	2 (67%)	0 (0%)	0 (0%)
	Total	127	44	79	4	36%	23 (52%)	10 (24%)	13 (30%)
Engineering	GNHC	19	13	6		68%	4 (31%)	1 (8%)	3 (23%)
	Industry/ Business	46	35	9	2	80%	30 (86%)	5 (15%)	11 (31%)
	University/ College	36	19	13	4	59%	13 (68%)	1 (7%)	8 (42%)
	Other	6	3	3		50%	3 (100%)	0 (0%)	0 (0%)
	Total	107	70	31	6	69%	50 (71%)	7 (11%)	22 (31%)
Math and computer sciences	GNHC	4	4	0		100%	3 (60%)	1 (20%)	2 (40%)
	Industry/ Business	11	9	1	1	90%	4 (44%)	2 (22%)	5 (55%)
	University/ College	21	14	7		67%	5 (36%)	5 (36%)	5 (36%)
	Other	5	3	1	1	75%	2 (67%)	0 (0%)	2 (67%)
	Total	41	30	9	2	77%	14 (45%)	8 (26%)	14 (38%)
Social/ Behavioral sciences	GNHC	23	6	17		26%	0 (0%)	2 (33%)	2 (33%)
	Industry/ Business	6	4	2		67%	0 (0%)	2 (50%)	3 (75%)
	University/ College	64	22	42		34%	2 (9%)	16 (73%)	4 (18%)
	Other	6	2	4		33%	0 (0%)	0 (0%)	0 (0%)
	Total	99	34	65		34%	1 (6%)	20 (59%)	9 (26%)
Non-scientific field	Industry/ Business	4	4	0		100%	3 (75%)	1 (25%)	0 (0%)
	University/ College	2	0	1	1	0%	0 (0%)	0 (0%)	0 (0%)
	Other	3	2	1		67%	2 (100%)	1 (50%)	0 (0%)
	Total	9	6	2	1	75%	5 (83%)	2 (33%)	0 (0%)
Other	GNHC	4	1	2		50%	0 (0%)	1 (100%)	0 (0%)
	Industry/ Business	2	2	0		100%	2 (100%)	1 (50%)	1 (50%)
	University/ College	8	3	4	1	43%	1 (33%)	1 (33%)	1 (33%)
	Other	6	1	4	1	20%	0 (0%)	1 (100%)	0 (0%)
	Total	20	8	10	2	44%	3 (43%)	4 (57%)	2 (29%)
Total		843	372	436	35	46%	204 (55%)	77 (21%)	134 (36%)

²² Protected IP by withholding data, delaying publication, or not publishing.

Conclusions

This survey allows us to gain some insight into the way scientists approach their own intellectual property, including their motivations for protecting IP. Since this analysis does not deal with a weighted sample, we can draw only limited conclusions about the salience of intellectual property for AAAS members, or scientists in general. However, the results do suggest differences in the way that different sub-populations of scientists deal with intellectual property.

While the survey found that patents were the most common means used by respondents to protect IP, especially in the fields of chemistry and biosciences, the licensing of these patented technologies is not the primary means by which respondents within academia acquire or disseminate technology. As a result, it appears that academia may have been less affected than industry by more restrictive and formal licensing practices in the acquisition of necessary patented technologies for research. In fact, difficulties reported by industry respondents in attempting to access patented technologies outnumbered those of academic respondents by a ratio of more than 2:1. This may be due to the fact that industry respondents reported creating and holding more intellectual property than academic respondents, as well as the fact that industry relies more on licensing, which entails more and longer negotiations than other more traditional and informal forms of technology transfer still used within academia.²³

²³ A 2003 study by Walsh, Cohen and Arora also found that despite numerous patents on upstream technologies, academic researchers reported experiencing few problems in accessing knowledge.

References

- Cohen, Wesley M. and John P. Walsh. 2002. "Public Research, Patents and Implications for Industrial R&D in the Drug, Biotechnology, Semiconductor and Computer Industries" in C.W. Wessner, ed. *Capitalizing on New Needs and New Opportunities: Government-Industry Partnerships in Biotechnology and Information Technologies*. Washington, DC: National Academy of Sciences Press, pp. 223-243.
- Heller, Michael A. and Rebecca S. Eisenberg. 1998. "Can Patents Deter Innovation? The Anticommons in Biomedical Research." *Science*, Vol. 280, Issue 5364, pp. 698-701.
- Murray, Fiona and Scott Stern. 2005. "Do Formal Intellectual Property Rights Hinder the Free Flow of Scientific Knowledge? An Empirical Test of the Anti-Commons Hypothesis." National Bureau of Economic Research (NBER) Working Paper No. W11465 (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=755701, 10/6/2005).
- Mushtaq, Ali and Fritz Scheuren. 2005. "Intellectual Property Pilot Survey: Sample Design and Estimation." AAAS internal document, available upon request.
- Sampat, Bhaven. 2004. "Genomic Patenting by Academic Researchers: Bad for Science?" (http://mgt.gatech.edu/news_room/news/2004/reer/files/sampat.pdf, 9/28/2005).
- Shapiro, Carl. 2001. "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting." (<http://haas.berkeley.edu/~shapiro/thicket.pdf>, 9/28/2005).
- Walsh, John P.; Cho, Charlene; and Wesley M. Cohen. 2005. "View from the Bench: Patents and Material Transfers." *Science*, Vol. 309, Issue 5743, pp. 2002-2003.
- Walsh, John P.; Cohen, Wesley M.; and Ashish Arora. 2003. "Working through the Patent Problem." *Science*, Vol. 299, Issue 5609, p. 1021.

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