

**“HOW DOES INTELLECTUAL PROPERTY SUPPORT
THE CREATIVE PROCESS OF INVENTION?”**

THE LEMELSON-MIT PROGRAM
School of Engineering
Massachusetts Institute of Technology

**The Lemelson-MIT Program
Intellectual Property Workshop**

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FOREWARD

This draft document comprises Findings and a Summary of the discussion from a workshop held at Massachusetts Institute of Technology in September 2003, as part of a larger study on invention and inventiveness. The study will culminate in an “Invention Assembly” in Washington D.C. in April 2004. The study is supported by the Lemelson-MIT Program and by the National Science Foundation. The Assembly will be hosted by the National Academy of Engineering.

**The Lemelson-MIT Program
Intellectual Property Workshop**

CONTENTS

Findings	4
Introduction	7
Incentives and rewards for invention	8
Contrasting different forms of intellectual property	12
The impact of the patent system on invention	16
Concerns for the workings of the patent system	22
Improving the patent system to better support invention	26
Recommendations for further study	29
Notes	31
Appendix A: Questions for discussion	32
Appendix B: Participant biographies	33

**The Lemelson-MIT Program
Intellectual Property Workshop**

FINDINGS

The Patent System Provides Support and Incentives for Invention

1. Society as a whole is the customer of the patent system. Evidence suggests that high levels of invention are important to our economic welfare and that the patent system supports invention.
2. Inventors are motivated by a diverse set of factors, including financial gain, altruism, the intrinsic pleasure of inventing, and professional recognition.
3. Patents serve as an effective incentive for inventors to disclose their know-how to society in return for limited monopolies to exploit their own inventions. This bargain encourages investment in new technologies, prompts corporations to create new products, and gives entrepreneurs the impetus to get new business underway.
4. Invention is cumulative; many inventions create the opportunity to build on their ideas.

Observations of the Impact of the Patent System on Invention

5. In the past 20 years, patent rights have been extended and strengthened through a number of legislative acts and judicial decisions. There are new university patent holders through the Bayh-Dole Act. There is new patentable subject matter in the area of software through *Diamond v. Diehr* and *AT&T v. Excel Communications*, genetically modified organisms through *Diamond v. Chakrabarty*, and business methods through *State Street Bank v. Signature Financial Group*.
6. Patenting is moving upstream into the realm of fundamental science and products of nature, i.e. patents on manipulating genes.
7. GDP, numbers of patents, and R&D spending tend to be correlated across countries. However, no simple causal relationship has been demonstrated between the number of patents and overall increases of innovative activity or national economic performance.
8. Current trends suggest that within the next few years, foreign entities will be receiving the majority of U.S. patents issued annually for the first time.
9. Most of the recent growth in the magnitude of patent filings has come from one industrial sector: electronics, computing and communications. Much of this movement is defensive, to trade portfolios among big players.
10. Software patents have grown enormously in the past 20 years. Software inventions can also be protected by trade secrets and the source code can be protected by copyright.
11. Over the period of 1975-1998, 46 percent of U.S. patents were assigned to U.S. located corporations, 32 percent to foreign-located corporations, 16 percent to individuals, two percent to universities and three percent to government and nonprofits.

**The Lemelson-MIT Program
Intellectual Property Workshop**

12. Patents vary widely in importance and value. Less than 10 percent have commercial importance and less than one percent are of seminal importance. The most valuable patents tend to be the ones that are most highly cited, or referenced, in papers and other patent applications. In the period of 1975-1998, corporations were granted 85 percent of the highly referenced patents, individuals were granted 9 percent, universities 4 percent, and government and nonprofits two percent. In fact, the one half of one percent of patents granted between 1963 and 1999 that are cited more than five standard deviations above the average for patents granted that year are disproportionately assigned to US corporations (about 70% as opposed to 46% for all patents).
13. Trade secrets and patents are often complementary and can often dovetail together. Trade secrecy can be used in the early research and development stages, before patents are sought. Trade secrets protect sub-patentable innovations. Sometimes it is possible to protect the know-how associated with patents as trade secrets, but this strategy can be risky as it may run afoul of patent disclosure requirements.
14. Trade secrets involving early stage research can often discourage the formation of open, creative research environments at universities and in industry.
15. The latency of time between the filing of an application and the issuance of a patent is 24 months on average. The time increases to up to 36 months for biotech and business method patents. The approval rate for applications to be eventually realized as patents is 75 percent. Higher yields have been suggested when considering re-filings via continuation or the division of patent applications into numerous claims.

Concerns for the Workings of the Patent System

16. The U.S. patent system is under great strain; it is not only seeing an increased rate of patent applications but the inventions are getting far more complex.
17. While low-quality patents are a small minority of overall patents issued, they place a large cost on the patent system, in terms of money, resources, uncertainty, increased legislation and a slowing down of innovation. Public discussion of examples of low quality patents undermines the reputation of the system.
18. Success in performing accurate searches for prior art is decreasing due to the increased complexity of patents as well as the uncoordinated “piecework-style” of examination of patent applications in the U.S. patent office. Manpower limitations in the PTO have also influenced the quality of patents granted.
19. Experimental use of patented technologies is under question due to the *Madey v. Duke University* court ruling denying a research exemption on the grounds that the work was done at a university. This may have a chilling effect on innovation everywhere, particularly at universities and startup companies.

**The Lemelson-MIT Program
Intellectual Property Workshop**

20. There are social costs to patenting as well as benefits. Pooling of patents among different companies can create monopolies. In network industries such as telecom and computing, patents can strengthen already entrenched monopolies and lengthen the duration of monopolies. Patents can create the opportunities for pure rent seeking without taking creative risks, thus impeding the overall level of innovation.
21. There is a huge mythology among the general public around the patent system. Most people feel it is working well and it gives the little guy a shot at making it big. Such impressions make it difficult to make major changes in the system.
22. Independent inventors and large corporations tend to be concerned about different sets of issues, and sometimes have opposing viewpoints. Any major changes to the patent system will require building a consensus among these two groups.
23. There is a growing tendency to reward all creativity with protection of IP. Hence what were once islands of protection in an ocean of public domain are now large continents of protection, with only lakes of free access. There is reason to be concerned that there is a growing imbalance of information that is freely available for inventive use compared to information whose use is restricted.
24. The “public domain”, “the scientific commons”, and the “Mertonian ethos” are being threatened by the decline of the public role of the great corporate central research laboratories and by the push at universities to patent their research. What used to be public research is now becoming proprietary.
25. Cooperation between different international patent systems is being driven by the need to reduce the costs of duplicate filings in different countries. But broader harmonization of patent rules among industrialized countries is being held up by compatibility issues.
26. The creative process of invention is too often separated from the fruits of the patent system by many complicated processes, corporate structures, and slow and expensive legal processes that inhibit innovation. Changes to reduce this interference should be made to provide further incentive for innovation.

How the Patent System Could be Improved to Support Invention

27. To increase patent quality and reduce costs, it would be helpful if the government would provide better facilities and databases for searches at little or no cost to the inventors.
28. Today’s prior art search tools are inadequate for current needs. Advances in information technology make much better search tools feasible. This would be an appropriate area for research and funding by the NSF.
29. A post grant review or opposition appears to be a useful way to strengthen the quality of patents by resolving questions of validity. Such a process also allows competitors and others to supply and argue the relevance of prior art at the USPTO.

The Lemelson-MIT Program Intellectual Property Workshop

30. The patent system would be strengthened by a presumption of validity after a post-grant review, by changing the standard of non-obviousness to a higher level, by changing the clear and convincing evidence standard for approving invalidity under section 103, and by moving more of the validity determination from the courts to an administrative judicial process in the PTO.

Introduction

Invention as a human activity is much older than the notion of intellectual property. People had been inventing new tools, techniques and technologies for thousands of years before legal constructs granted individuals and organizations limited ownership rights for the ideas they produced. Systems of patenting were conceived to motivate and reward people not only for undertaking invention but also for disclosing their ideas to society in order to promote general progress. From the first patent law, in 15th century Venice, to the landmark English patent statute in the 17th century, to the establishment of the United States system of patent protection in the 1790s, to today's international patent structures, such legal conceptions have changed dramatically over time. In addition, patents have evolved along with the larger web of intellectual property that includes forms such as trade secrets and copyrights.

But like any set of laws and practices, these forms of protection sometimes get misinterpreted and misapplied, and they sometimes yield inconsistencies, loopholes, and unintended consequences. Since these rules and laws exist to support and stimulate the human activities that gave rise to them in the first place, we ask these overarching questions: How well does our current system of intellectual property support the creative process of invention? What are the ways it can be improved?

To answer those and related questions (see [Appendix A](#) for the list of initial questions), the Lemelson-MIT Program, in September 2003, convened a distinguished group of experts in the area of intellectual property. Our participants included professors of law, engineering and management, as well as patent attorneys, intellectual property researchers, a university patent office director, a former director of the U.S. Patent & Trademark Office, as well as inventors and entrepreneurs, with many of our participants taking on more than one of these roles over the course of their careers. The goals of this report are to summarize the discussion of the critical aspects of intellectual property and

The Lemelson-MIT Program Intellectual Property Workshop

to reach conclusions about how to change the system to better support and stimulate invention.

Incentives and rewards for invention

Insight into what causes people to invent and to disclose their ideas is critical to understanding the value of intellectual property.

David H. Staelin, professor of electrical engineering at MIT, says that patents themselves are not a primary motivator or incentive for inventors. “If patents do in fact lead to primary rewards, then they are coveted,” he says. “Patents tend to provide an indirect stimulus, if innovators are thinking about patents at all. I’m not sure that it really changes their agenda -- their day job -- very much.”

He says that the four biggest primary motivators for stimulating invention in individuals are as follows:

- Professional reputation, recognition, and advancement
- Altruism
- Financial gain
- Intellectual “currency” within companies

Rochelle Dreyfuss, professor of law at the New York University School of Law, agrees that reputational benefits that often result from having patents are critical. “Being in on a lot of patents with a lot of different people helps to signal the notion that you are a good person to collaborate with and it keeps you current in that marketplace,” she says.

Altruism is a significant motivation to the extent that the invention is perceived to have an important social benefit. Many medical inventions have been created primarily due to altruistic motivations. The “open software” movement may also be driven partly by altruism. Those that create software and provide open access to their source code or free usage rights tend to believe in the social good of what they are doing. “But even stuff that’s provided for free has motivation behind it,” says Dreyfuss. The Linux operating system is being given away, but Linus Torvalds, the original creator, has been hailed as a hero and the anti-Bill Gates in a wide range of media. “Linux does it by credit,” says Dreyfuss. “So, I think Linux is kind of an ad for programmers. It provides an avenue for them to get reputational benefits by showing them the work that they can do.”

The Lemelson-MIT Program Intellectual Property Workshop

Patents unquestionably protect entrepreneurs who are striving to commercialize new ideas. Dreyfuss says that patents “signal to venture capitalists that you are a firm that is worth investing in.” Of course, that doesn’t mean that the venture capitalist actually reads or understands the patents. But even the general public has a sense that “this product is better because it is patented.” Dreyfuss cites patent medicines. “They were patented so that people would think that they did not contain just narcotics or alcohol and that they really were making you better for some scientific reason.”

Staelin leads an MIT venture mentoring program that currently has about 50 startups in its portfolio. In about 95 percent of cases, the founders or the mentors are worried about protecting their intellectual property and thus seek patents. Having patents not only helps these startups raise money but it at least provides the perception that their innovations won’t be stolen when the company is ramping up its business. “I think that the measure of gold for most of these young people is not the royalties that would come, but the opportunity to start their company,” says Staelin.

In many some cases, these patents turn out to be irrelevant, Staelin says. In one startup that he ran, the product cycles changed so quickly that the patents rapidly became obsolete. “Nonetheless, our investors demanded patents,” he says. “We gave them patents. They were meaningless. We never enforced them. But it made [the investors] happy.”

However, when companies enter what Staelin calls their “mid-life crisis” phase, when they start to grow and mature and become profitable, that’s when their patents play a more substantial role. If the company doesn’t have the proper protection at that point, they can be sued by a rival startup or by a big company, and such a lawsuit would be damaging if it came at a critical moment, such as during a marketing campaign or an initial public offering.

In this respect, patents could be considered like insurance. Only about ten percent of patents or patent applications in the U.S. (and eight percent in Europe) are challenged by third parties at some point in their lifecycle, according to Stephen Merrill, executive director of the National Academies’ Board on Science, Technology and Economic Policy. And only about two percent of patents in the U.S. (about one percent in Europe)

The Lemelson-MIT Program Intellectual Property Workshop

become the subject of litigation.¹ But like insurance, the cost of not having patents can be extremely high, and businesses and their investors do not want to carry that risk.

The final motivation that Staelin cites is “intellectual currency.” Inside corporations or universities, credit on a patent application is sometimes traded to a researcher as a way to get them to work on a certain project, for instance. Those who are in charge of assigning credit on patent applications, therefore, have the power to use this form of reputational benefit as a way of paying or incentivizing members of their research staff. It is important, however, to ensure that people are being given credit only where credit is actually due—so that the process is fair and effective. In fact, the law already specifies “misjoinder” as a reason to invalidate a patent, notes Rochelle Dreyfuss.

Universities serve as especially instructive case studies for illustrating how intellectual property supports the process of research and invention. David Staelin says that patents generally promote disclosure of critical scholarly research, but in certain cases they can become impediments. For instance, a recent survey of university licensing offices shows that 27 percent will routinely delete from papers information that they deem patent-worthy, and 44 percent will ask for a delay in publication, with an average delay time of nearly four months.² So in this sense, patents are sometimes slowing disclosure of new ideas. Staelin adds that the impact of these roadblocks are difficult to assess. It may be that the trade-off is worthwhile because the economic incentive to patent and market the invention offsets any delay.

At large research universities, patents have become an especially important motivator for a variety of reasons. This has been true ever since the Bayh-Dole Act of 1980 enabled universities to own and profit from patents. “I don’t think the Bayh-Dole Act was created in order to provide university funding, but the fact of the matter is it can provide funding and so universities have gotten interested in it,” says Dreyfuss. That’s why technology transfer has become “the new football,” she adds. “Schools want football teams to make money for them. But football teams are money sinks at most schools. There are probably only five or six schools that are making lots of money off their football teams and probably an equal number of schools making money off their technology transfer offices.”

Lita Nelson, director of the MIT technology licensing office, says that universities

The Lemelson-MIT Program Intellectual Property Workshop

need to be realistic about building a successful patent licensing program, and they must align these efforts with the mission of the university. The number of patents that a university owns does correlate to the amount of research spending, she says, but it is also related to something more basic: the money budgeted to file patents. The cost of obtaining a single patent ranges from \$20,000 to \$30,000. “Most universities are limited by their patent budgets, which range from a few hundred thousand dollars per year to many millions a year. If 19 out of 20 professors don’t get their patent filed because they don't have a patent budget, then you can almost certainly see a decline in invention disclosures in the next year.” Nelsen says that MIT spends about \$7 million a year on patenting, of which about \$3 million is covered up front by corporate sponsors and \$4 million is spent on patents filed “on spec.” Operational costs add up to another \$2.5 million. When a patent is licensed, the inventor gets a third of the royalties, and most of the other two-thirds goes back into the university’s research and education coffers.

But pure profit motivations are a poor reason for setting up tech transfer offices at universities. “It takes an average of eight to ten years for an office to get in the black, and it may never return its investment,” Nelsen says. Steve Merrill concludes from his study that revenue from patent licensing tends to exceed the costs of filing patents and operating a tech transfer infrastructure only at universities that have significant academic medical centers.³

So why would a university president invest in a technology licensing office? Sometimes they develop unrealistic expectations, especially when it come to patents in the biotech and medical area. They see the money resulting from Stanford’s licensing of the Cohen-Boyer patent on recombinant DNA, or they see all the publicity received by Columbia’s Axel biotech patent, or Michigan State licensing of Sisplatin, an anticancer drug. Once in a while, a university is hit with a lucky strike out of the blue, as was the case with the University of Florida’s Gatorade patent. But spending millions on tech transfer offices based on these rare success stories, says Nelsen, is like basing your family budget on the fact that you saw your neighbor win the lottery.

Another popular motivation for setting up a patent licensing program is to foster wider economic development in the community or region, on the theory that patents lead to spin-off companies, which leads to investment and jobs. If you can get a governor to buy

The Lemelson-MIT Program Intellectual Property Workshop

this theory, then you can obtain state funding. “They’re trying to build a Kendall Square out of a vacant lot,” like MIT did, Nelsen says. That can happen, but it typically takes 20 years or longer. Other universities embrace tech transfer to attract more sponsored research from industry, like MIT has done. MIT has about 20 percent of its research sponsored by industry, as compared to a national average of eight percent, she says. The goal is to build the brand of the university and “to become a destination site for investors and companies to come around and say, ‘what you got?’,” says Nelsen.

All these rewards are possible. Patents can eventually lead to wider economic and social benefits and rewards. But there isn’t a straight line between patents and financial gain, or between increased patenting and increased motivation to invent. Other things need to happen for intellectual property to pay off. Patents typically have an indirect effect on the creative process of invention.

Contrasting different forms of intellectual property

All forms of intellectual property protection represent bargains between creators and society. They are a series of trade-offs in which the creator is granted limited protective rights in return for the benefits their creation provides to the rest of us. But each of the different forms of intellectual property possesses a different set of these trade-offs.

Sidney G. Winter, co-director of the R.H. Jones Center for Management Policy, Strategy, and Organization at the University of Pennsylvania’s Wharton School, says that these bargains must be viewed in the larger context of success in business. Companies, for instance, typically need to create new products or improve their current ones. When individuals or teams traverse the path toward those kind of goals, what sorts of roadblocks pop up along the way? How do the different forms of intellectual property that you may encounter affect what you can do?

To answer these questions, Winter looks at three different forms of intellectual property and contrasts their costs and benefits. Those three forms are copyrights, patents, and trade secrets. He asks a series of three questions about them: First, can you go there? (In other words, “can you acquire the knowledge that is represented by that particular piece of intellectual property?”). Second, can you stay there? (“Can you use that piece of intellectual property as part of your own solution to your problem without making a deal

**The Lemelson-MIT Program
Intellectual Property Workshop**

for it?”). Third, can you do it yourself? (Not use the intellectual property as such, but acquire an equivalent result). To compare the different forms, Winter constructs a matrix:

	<u>Copyrights</u>	<u>Patents</u>	<u>Trade secrets</u>
Can you go there?	YES – except for software’s hidden “source code”	YES – upon publication	NO
Can you stay there?	NO – except for “fair use” of short quotes	NO – not without licensing	NO
Can you work around it?	YES – express the ideas differently	NO – the basic ideas are protected	YES – come up with the ideas on your own (or acquire through a “leak”)

With copyrights, anyone can go there for the price of admission. Anyone can read or see or hear copyrighted works such as books or articles or movies or music. The exception is the source code for software – the lines of computer language – which aren’t disclosed beyond the confines of the company that distributes the executable version. “Software can actually be copyrighted without revealing it at all,” says Rochelle Dreyfuss. “And that’s its own little problem.” The so-called “open source” movement is an attempt to redress this problem by letting anyone see the underlying code so they can make use of the ideas within it.

With copyrights, though, you can’t stay there. The law clearly says that you cannot plagiarize a copyrighted work. Under the “fair use” provision, you can quote a small snippet or a few bars of a tune without making a deal for the rights, but you cannot appropriate more than that. You can, however, work around copyrights. “Copyright does not bar you from absorbing the content and using [its ideas] for your own purposes. So when you’re trying to make your way in the creative process through a space occupied by copyrighted intellectual property, this is not a very serious problem because you have easy access to the texts and you can absorb the knowledge [and express it in a new way.] That is the way a lot of academic research goes on.”

The Lemelson-MIT Program Intellectual Property Workshop

In this sense, patents provide a stronger form of protection. Upon publication (typically 18 months after filing), anyone can access patents. But you can't stay there or appropriate the ideas without negotiating for a license. "In contrast to the copyright case," Winter says, "you can infringe the patent without doing anything that the patent holder is actually doing. That's what creates the greater blockage effect of the patent. We have to steer clear not merely of what is already in the world, in the sense of actual practice, but of a whole bunch of things that aren't in the world but are within the scope of the patent. So the patent that's already held by somebody else prevents you from realizing the fruit of your own labors -- in cases where you haven't borrowed anything but have stood on the shoulders of the same giants as the other inventor stood on and [have] seen the same thing."

By comparison, trade secrets are much simpler. Typically, such secrets are bound by employment contracts. The recipe for Coca-Cola is a famous example of a trade secret. But if you have not signed a non-disclosure agreement with Coca-Cola, you aren't prevented from trying to duplicate the recipe and market it under a different brand. Unlike patents, trade secrets enable others to mimic what you've done, provided they don't violate a specific secrecy agreement. Companies often don't let outsiders visit their factories where they practice the ideas that are protected by trade secrets. "You might see exactly how they're doing something and go back to your place and do it exactly the way they do to do it as the solution to your problem," says Winter. In the 1970s, the Xerox Palo Alto Research Center made the mistake of giving research center tours to people such as Steve Jobs, who may have taken away conceptions of future personal computers. Since those were the days before software patents were recognized, Xerox could have benefited from strict enforcement of trade secrets.

Karl F. Jorda, director of the Germeshausen Center for the Law of Innovation and Entrepreneurship at Franklin Pierce Law School, says that the different forms of protection overlap in many ways and often dovetail together. "Intellectual property is now a single field of law -- a seamless web," he says. "If you don't explore the overlaps, you are committing malpractice."

The greatest synergies can be found between patents and trade secrets. As an example, Jorda cites the case of Pizza Hut, a division of the Pepsi Company. C&F Packing, a

The Lemelson-MIT Program Intellectual Property Workshop

supplier to Pizza Hut, invented a new process for pre-coating sausage toppings for pizzas. The supplier got two patents -- one on the machinery involved, and one on the process itself. On top of that, the company developed trade secrets on how to improve and modify the process. When Pizza Hut started making the toppings itself, C&F sued for patent infringement. In court, however, the patents were invalidated, because the applications were filed more than one year after commercial use. “End of story?,” says Jorda. “No. Under the misappropriation of trade secret count, the supplier was able to prove that certain employees leaked details of its secret methods to Pizza Hut. C&F was then awarded \$10.9 million in damages.⁴ “Patents are a very slender reed, because of at least three dozens of reasons concerning their enforceability,” Jorda says.

But trade secrets aren't just a back up plan. They often protect a set of “associated know-how” that can make patents more valuable. “Trade secrets can be licensed along with patents, under hybrid licenses,” Jorda says. “They can triple the value of the technology license. Some regard a patent as little more than an advertisement for the sale of the company know-how. You can integrate patents and trade secrets for optimal, synergistic protection of innovation.” That's because trade secrets often include the “best mode” of practicing the invention, which often gets developed after the associated patent is filed.

Under the Economic Espionage Act and other statutes, there are severe penalties for misappropriation of trade secrets. Jorda says there have been over 1,000 cases under that act prosecuted, although most of them involved appropriation by foreigners, “which is why we have the law,” he says. But the law also covers walking away with key research from U.S. universities.

Trade secrets and patents are “a happy marriage,” Jorda says. “Nowadays, more and more companies are going to rely on dual protection, because it's been sanctioned by the courts, it's possible, it's logical, and if you're not doing it you're missing opportunities.” You could enforce a trade secret for any amount of time. But as a practical matter, such secrets are often revealed much sooner, after non-disclosure agreements lapse, for instance. According to a recent study, Jorda says that trade secrets fall into the public domain on average in three years.⁵ Patents, meanwhile, protect ideas for 20 years after filing. So when it comes to that bargain between the creator and society, the trade secret

The Lemelson-MIT Program Intellectual Property Workshop

often doesn't deserve its reputation as the form of intellectual property that keeps ideas hidden indefinitely.

The impact of the patent system on invention

The patent system has been transformed over the past twenty-five years by an unusually large number of significant changes, says Steve Merrill of the National Academies. "Some of these changes are legislative," he says, "and even more of these changes are from the courts, applying the law to new circumstances." Collectively, the impact on invention has been dramatic. The largest of these changes can be summarized as follows:

- 1980: The Bayh-Dole Act creates a new category of patent holders, namely universities and non-profit research institutions
- 1980: Genetically modified organisms patentable through *Diamond v. Chakrabarty*⁶
- 1981: Software is patentable through *Diamond v. Diehr* and *AT&T v. Excel*⁷ (1999)
- 1982: The Court of Appeals for the Federal Circuit is established to consolidate appeals of federal patent cases, establishing uniform guidelines for patent enforcement, resulting in higher rates of patent validity
- 1988: Process patents granted by the USPTO
- 1991: *Polaroid v. Kodak*; \$1 billion in damages awarded for first time⁸
- 1994: TRIPS agreement for international intellectual property recognition
- 1998: Business methods are patentable through *State Street v. Signature Financial*⁹

These and other developments have contributed to a general expansion of rights and benefits for patent holders, says Merrill. He agrees that it's much easier and more common in IP law to expand rights rather than take them away. Intellectual property protections tend to be "a one-way ratchet," as it may be unconstitutional to take away a legitimately expected right without just compensation, says Rochelle Dreyfuss.

This expansion of rights may have contributed to the simultaneous surge in patents applied for and issued, adds Merrill. The U.S. issued between 60,000 and 70,000 patents per year from 1965 through 1983. Then there was a sharp spike upwards, leaping to about 170,000 per year by the late 1990s. During this time, we've also seen higher renewal rates and a more frequent asserting of patent rights. Since 1988, the number of patent

The Lemelson-MIT Program Intellectual Property Workshop

lawsuits filed in U.S. District Courts have doubled, and overall patent litigation rates have increased tenfold over the past two decades.¹⁰

Anthony Breitzman, vice president and chief technology officer at CHI Research Inc., says that the increased rate of patenting has naturally favored large multinational corporations who can best afford to file and assert large numbers of patents. Foreign corporations now receive nearly half of U.S. patents, up from about 40 percent in 1980. About 41 percent are now received by U.S. corporations. Individually owned patents have declined slightly over this period, to about nine percent. Only about two percent of patents are university owned, and one percent are owned by government.¹¹

Not surprisingly, patenting is highly correlated with R&D spending.^{11A} About 100 companies account for 70 percent of the R&D in the United States, and about 20 universities represent a very substantial portion of academic R&D, according to CHI. But we're also seeing increased patent productivity among big firms. "The number of patents yielded on dollars of R&D spent is increasing within large firms," Breitzman says. This concentration is spreading to large government and university laboratories too. About two-thirds of all patents now are being granted to about 1,500 organizations.

However, Breitzman also revealed a surprise. In terms of high-impact inventions, the field is "concentrated, but not as much as you might think," he says. "Against the odds, there's still a substantial amount of independent and small company invention. A lot of the individual inventors are in small companies and so small companies are actually pretty big in this pecking order." The next question, he says, is "where do small companies patent?" The data show real barriers to entry in aerospace, motor vehicles, oil and gas, computing, and plastics. More than 97 percent of the patents in each of those areas are being issued to large corporations. Small companies, meanwhile, are showing strength in biotechnology, pharmaceuticals and medical electronics. About 25 percent of patents in these industries are being issued to small companies and individuals. "There are areas where small companies are really competing," Breitzman concludes.¹²

Numbers, of course, only tell a part of the story. "The actual number of patents doesn't mean much," he says. Numbers of patents correlate with money spent on R&D. And on a macro level, you can even correlate patents with country by country GDP. But since only a small number of patents – an estimated one percent – turn out to be valuable or have a

The Lemelson-MIT Program Intellectual Property Workshop

high impact on the marketplace, the sheer numbers don't tell you much about where these high-impact patents are being generated. To find those kind of patents in its database, CHI Research looks for patents that are highly cited by writers of other patents. Universities and small companies tend to have a disproportionate share of highly cited patents.

Historically speaking, high-impact inventions have tended to come from individuals. "Historians look back at inventions and divide them into two different categories, what they call macro inventions and micro inventions," says Merton Flemings, director of the Lemelson-MIT Program. As defined in previous workshops, macro inventions are the pioneering creations that change the world in a significant way. Examples include the light bulb, the Xerox machine, the laser, the airplane. They're also inventions that lead to hundreds or thousands of follow-on inventions and improvements, which are the so-called micro inventions.

Bronwyn Hall, professor of economics at the University of California at Berkeley, says that "I think your historians are correct in that sense. Macro inventions such as the personal computer do tend to create new firms." Hall says that the trend is still alive. "These days, the real pioneering patents are disproportionately created outside big corporations, by individuals or universities," she says. As an example, Hall cites a study of the encryption software industry, where "all of the important players are small firms, start-ups, new entrants."¹³ Big firms have patented in that area -- IBM has patented a lot -- but they aren't big players in the industry. By far, the most highly cited patent in that class is held by MIT." She's referring to the patent from Professor Ronald L. Rivest that formed the basis of RSA Data Security. Another example, previously mentioned, is the Cohen-Boyer patent, developed at Stanford, which formed the basis of Genentech and the biotech industry. "So again, there are many cases in which patents protect dramatic innovation and help lead to new enterprise."

There are also many instances of high-impact corporate patents. Hewlett-Packard's inkjet patent was cited 450 times over a 12 year period, for example. "This is the patent that made inkjets ubiquitous," Breitzman says, "It's the reason you can go to Office Max and buy a printer for \$69 dollars." Inkjet printers had been around since 1970, but were messy and expensive, and the ink dried up too quickly. In 1979, a Hewlett Packard

The Lemelson-MIT Program Intellectual Property Workshop

engineer named John Vaught had the idea of doing away with inkjets that work by vibrating the cartridge. Inspired by watching a coffee percolator, Vaught got the idea of making it work by rapidly heating the ink and shooting it out a tiny nozzle. His counterpart at Canon in Japan had a similar idea around the same time. Based on their long standing partnership in laser printers, they agreed not to fight each other over their competitive ink jet patents and compete instead in the marketplace.

Robert Gundlach, who has retired as senior research fellow at Xerox Corporation, says that high-impact patents often have the most dramatic effect on the company that holds that patent, as the owner has the unique chance to build on its own innovation. “Every patent creates the opportunity to create more patents,” Gundlach says. “My 155 patents would not have happened had not Chet Carlson had his first one.” He’s referring to the pioneering patent created by Chester Carlson in the late 1930s, the patent which led to further research in xerography at the Battelle Institute, and which was later sold to the Haloid Corporation, which changed its name to Xerox. Invention, therefore, breeds more invention. “Output is input,” says Rochelle Dreyfuss.

Gundlach cites several examples of his own inventions which improved Xerox machines in numerous ways. After completing his graduate work in physics, Gundlach joined the corporation in 1952, before it was Xerox, and his basic understanding of the relationship between electrical voltage patterns and image patterns on paper helped him come up with a variety of inventions, including a “tone tray” for solid area development, multi-sheet copying, and inventions that led to the first desktop-sized copy machines and early color copiers. “I enjoyed opportunities to figure out how things worked and how to make them work better,” he says.

All along, Gundlach worked closely with Xerox patent attorneys to write the strongest possible claims. For many years, patents protected the Xerox monopoly on the copier industry, which generated the profits necessary to fund further invention. He says patents gave the corporation the right to exclude others from the market. “Xerox was patenting so much that they felt it was costing too much at one point,” he says. Meanwhile, the other big technology company in Rochester, N.Y., Kodak Corporation, was using trade secrets more often, says Gundlach, and Kodak would rather keep their inventions as trade secrets, because they didn’t want them to expire. Of course, doing so runs the risk then

The Lemelson-MIT Program Intellectual Property Workshop

that somebody else might get a patent on it, and then you wouldn't be able to use it. Something to that effect happened in Kodak's competition with the upstart Polaroid, which was able to assert its patents on instant photography, exclude Kodak from the market, and win nearly \$1 billion in damages in the famous 1991 decision.

Mark B. Myers, who retired from Xerox after a 37-year career, points out that in those days companies such as Kodak, Xerox and IBM had policies of lifetime employment. So the risk of your trade secrets and know-how leaving the company were low. "Today, that is not the case," Myers says, "so the risks are much higher."

Gundlach says that he wasn't motivated directly to pile up patents. At Xerox, inventors were granted a bonus of \$300 per patent. "I wasn't really driven to get more patents," he says. But he says that patents and the bonus did "provide incentive" to disclose his work then move on to creating new improvements. "When you're employed by a company, your first goal is to improve their marketable products," he says. "I wanted to help the company get better and better equipment, and I was one of many, many people who did it." The cost of R&D and of patenting is high, he says, but there are also risks to cutting back on these fundamental areas. In the early 1990s, many large research-oriented corporations dramatically slashed R&D, including Xerox under then CEO Paul Allaire. "When Paul Allaire said every division had to be profitable," Gundlach recalls, "it created a disincentive to invest in things that would improve the company at large in the long run."

That brings us back to one of our main questions: Does patenting and the patent system increase innovative activity? Bronwyn Hall says there is a different impact on different companies. About a quarter of U.S. patents are granted to Japanese companies, and they regularly hold seven of the top ten positions. But that's because Japanese companies such as Hitachi and Mitsubishi are especially huge and tend to file on every incremental improvement. It doesn't mean that such corporations are the most innovative. She notes that university-held patents tend to be disproportionately high impact, in part because universities don't have the money to file a patent on every single idea.

Overall, Hall says that you "cannot conclude that patents are uniformly good or bad, but have costs and benefits, a set of trade-offs." She expresses "the economics of the patent system" like this:

**The Lemelson-MIT Program
Intellectual Property Workshop**

<u>Effects on:</u>	<u>Benefits</u>	<u>Costs</u>
Innovation	-Creates an incentive for research and new product/process development -Encourages the disclosure of inventions	-Impedes the combination of new ideas & inventions -Raises transaction costs for follow-on innovation -Provides an opportunity for rent-seeking
Competition	-Facilitates the entry of new (small) firms with a limited asset base or difficulties obtaining financing	-Creates short-term monopolies, which may become long-term network industries -May be used to maintain a cartel

As expressed by Hall, the benefits are extremely good but the costs can be extremely high. “The patent is the granting of a limited monopoly,” she says “and that’s somewhat negative for competition. It tends to raise prices on that product, and so forth. In certain types of industries which reside on standards, such as computing, software, or telecommunications, the patent gives you such an advantage that it may make your monopoly relatively longer-term, because, basically, everybody adopts your standard, and gives you a better position in the network industry,” she says. “We can point to the rise of venture capital as a benefit, but the pooling of patents between large companies that trade portfolios as a hindrance to competition. Pooling can give rise to a cartel.”

Hall also believes that patenting is having an effect on the organization of industries. She cites the “vertical disintegration of knowledge-based industries.” Whereas industries in the past may have been dominated by large and centralized R&D labs, innovation is now coming from hundreds of smaller, independent firms and individuals.” Dreyfuss, however, says that such disintegration is happening regardless of patents. “The Internet and other information technology creates the ability to perform projects with an ad hoc groups, rather than within a firm,” Dreyfuss says. “The way that work is done is changing now for reasons that have nothing to do with the patent system. For example, there is much more interdisciplinary work that is being done. For your average medical invention, you need your chemist, you need your biochemist, you need your biotechnologist, you need your statistician. So there are a lot of different people whose

The Lemelson-MIT Program Intellectual Property Workshop

skills are all necessary to bring a product to market. In some industries, the globalization of the marketplace also makes a difference; sometimes you need different cultural input and that requires that groups work together.”

Many of our participants agreed with the statement that “where you stand depends on where you sit.” In other words, if you are benefiting from patents at the moment, you extol their virtues. If you are on the wrong end of an infringement suit, you curse their faults. Hall cited a quote by Robert Barr, the vice president for intellectual property at Cisco Corp., who agreed that there are many examples where the patent system works well to support innovation. “These benefits must be preserved,” Barr said. But he argued that the costs outweigh the benefits. “Namely,” Barr said, “the stockpiling of patents, the consequences of innocent infringement through independent development, the costs of proving non-infringement or invalidity through patent litigation and the exploitation of the patent system as a revenue generating tool.”¹⁴ As the Supreme Court has said: “A patent is not a hunting license, it is a reward for completing the task.”

This deep ambivalence may be inherent to the nature of the patent system. Hall cites a Canadian study that concluded that increased innovation leads to increased patenting, but increased patenting doesn’t necessarily lead to increased innovation.¹⁵ Generally,” says Hall, “patenting doesn’t increase innovative activity broadly, but it tends to redirect innovation.” A lot of the innovation tends to be channels to new areas. New drug discovery and biotechnology, for instance, seem to be currently benefitting both from increased patenting and increased innovation.

Concerns for the workings of the patent system

While our participants agree that there is no way to eliminate all of the above-cited “costs” of the patent system while retaining only the “benefits,” they also identified some major concerns that need to be addressed in order to maintain a reasonable balance between the costs and benefits.

Chief among those concerns is that the “experimental use” of patented subject matter – the so-called research exemption – is under fire. “I see a very dark cloud based on the recent decisions in cases that renounce the experimental use,” says Karl Jorda. He refers primarily to the *Madey v. Duke University* court ruling denying a research exemption for

The Lemelson-MIT Program Intellectual Property Workshop

pure inquiry into subject matter under patent protection.¹⁶ “That’s a huge problem,” Jorda says. There are two types of players in innovative activities, he notes. There are the people who hold the patents and there are the people who want to work in that space. If this case set a strong precedent, then those who want to conduct research in certain areas would be prohibited from doing so. The judge in the case, John Noonan, even went so far as to say, “If taken literally, the advancement of technology would stop.”

Rochelle Dreyfuss says that the *Madey vs. Duke* decision seems to have moved or perhaps eliminated the line between non-commercial research and commercial use. As defined by the ruling, “any conduct that is in keeping with the alleged infringer’s legitimate business, regardless of its commercial implications, is going to be considered infringing.” But how do you define a legitimate business purpose? “What is a university’s legitimate business purpose?” Dreyfuss asks. “Educating and enlightening students and faculty is part of Duke’s mission. That increases the status of the institution and lures lucrative research grants.” Those grants typically fund research on patented technologies. “So it leaves very little room for a university to be doing any work that is going to be utilized within that research exemption.”

The issue is trickier than it first seems, because universities do create commercial spin-off companies on a routine basis. “That distinction is a problem,” Dreyfuss says. “Do David Staelin’s people [in the MIT entrepreneurship program], the people who are entrepreneurs but not in their mid-life crisis yet, do they get the benefit of the experimental use defense? How about the MIT professor before he spins out [a new company] as an entrepreneur? Does he get it at that point, even though we know perfectly well he is going to spin out?”

David Staelin says that a primary objective of the patent system “is to encourage people to improve the prior art. If you can’t practice and test the prior art in a non-economic environment, in order to improve it, that runs absolutely counter to the purpose of the patent system.”

Q. Todd Dickinson, a partner with Howrey, Simon, Arnold & White and a former director of the U.S. Patent & Trademark Office, argues that these cases concerning the research exemption are rare and will continue to be. “As a practical matter, a commercial enterprise would be foolish to launch a lawsuit against a university conducting

The Lemelson-MIT Program Intellectual Property Workshop

experimental use,” Dickinson says. “With such lawsuits costing anywhere between \$1 million and \$10 million, it wouldn’t be worth the time and money to sue an academic user.” The question, though, is whether researchers feel they are being impeded and whether universities will effectively self-censor themselves in order to avoid risk. That is the chilling effect that many non-commercial institutions are worried about.

Dreyfuss argues that corporations that feel their intellectual property is threatened will indeed sue, no matter how non-threatening the alleged infringer might seem. Look at music industry suing kids over copyright infringement. Even if you don’t get sued, says Mark Myers, “a letter from a large company has a chilling effect. You take it very seriously, and it is worrisome, and it starts influencing you or your directions.”

An interesting sub-issue underneath the research exemption controversy can be found in this question: Can government-funded universities get sued for research work on patented inventions? “You can’t enforce patents against the government,” Staelin notes. “Most university research is government funded. Isn’t it within the power of the government when they grant the research contract to say that this research that you are being directed to do, as our agent, is government research?” This is an issue that remains to be resolved.

Looking at the big picture, our participants see a major threat to the “public domain” of research, a base of common resources that have been responsible for so many innovations in the past, from the space program to the semiconductor industry to the Internet to biotech. If research universities get treated the same as corporations, in the eyes of the law, will they respond by acting more and more like corporations? Public research is already becoming more and more proprietary. Will it become more so? What were once islands of protection in an ocean of public domain, says Sid Winters, are now large continents of protection, with only lakes of free access. There is reason to be concerned that there is a growing dearth of information that is freely available for inventive use.

Another huge concern over the health of the patent system is the current proliferation of low-quality patents. Our participants agree that this is one of the biggest problems plaguing the patent system specifically and the overall environment for innovation in general. “Patent offices around the world are just swamped,” says Bronwyn Hall. As a

The Lemelson-MIT Program Intellectual Property Workshop

result, examiners are letting a lot of patents that should be non-enforceable slip by into issuance.

In order to receive a patent, an invention needs to be useful, novel, and non-obvious. “The problem is the non-obvious standard,” Hall says. To what extent is that test being applied? This is another tricky issue, because it’s an area where prior art searches and disclosure doesn’t help. “That’s a real problem for really obvious things,” Hall says, because people don’t tend to write articles and papers about things that are obvious.

There are three systems in place for judging patent quality, says Steve Merrill. “One is litigation over validity,” he says. This, of course, is an extremely expensive way to determine whether a patent should be considered valid or not. “The second way is the re-examination process. And the third is the USPTO’s own quality review process, where they take a sample of about-to-issue patents, and they judge whether the decisions made by examiners were correct. These are all deficient in various ways. Most importantly, they’re deficient in that they touch a very, very small number of patents.”

The consequences of low-quality patents are numerous, according to our participants. Those consequences include the following:

- Low-quality patents clog the entire patent office process, leading to time delays for all patents.
- R&D areas are avoided because thickets of obvious technologies that are patented.
- New investment slows as a result.
- That slows the advance of cumulative technologies that require building on existing ideas.
- Uncertainty increases, due to chance that someone will appear trying to enforce rights to something that’s obvious.

“The increasing complexity of applications” and the jump in “the number of claims associated with each patent,” says Merrill, are contributing to the rise in low-quality patents, says Merrill. Faced with such complexity, examiners may be taking the easy way out more often, as it is much less work to approve a patent than to reject one. A conclusion of that National Academies study is that overall approval rates are in the range

The Lemelson-MIT Program Intellectual Property Workshop

of 75 to 80 percent, which is higher than the traditional claim of a 67 percent approval rate.¹⁷

To help weed out low-quality patents, should there be a more robust opposition system? The European patent system includes more provisions for third party challenging of patent applications, notes Merrill. Would that be beneficial to improving quality? Under the European system, about one-third of the opposition cases result in an overturning or blocking of the patent and another third result in some restrictions.¹⁸ The drawback is that these cases take almost as long as litigation. So limits on time would be a good thing, says Merrill. He says that the benefits of improving patent quality are clear: One is that it results in more valuable patents once they are issued. Secondly, it eliminates many costly lawsuits. Thirdly, it increases the overall reputation and confidence in the patent system.

Improving the patent system to better support invention

When it comes to making change to intellectual property laws and practices, especially the patent system, it first helps to keep in mind how difficult it is to bring about wholesale change, says Todd Dickinson, who ran the USPTO under President Clinton from 1998 through 2000.

“There are several reasons for that,” Dickinson says. “First of all, success itself. The U.S. patent system has been around for 220 years. There's a huge mythology about patents. If you went out and polled the average person on the street about patents -- and they do this sometimes with juries -- you find that people have a huge respect for what they believe the system to be. They think the system is great and working well and that it serves the purpose of not only advancing the technological interests and the economic interests of the United States and has for a long time, but it provides that one great opportunity -- which is the greatest of all American myths -- for the little guy with the great idea, to take it and run with it, and build a business or become a billionaire. And that mythology is very hard to overcome.”

The other roadblock is “the conservative nature of the folks who are in the system,” he adds. “Corporations by their very nature are risk averse. The lawyers in this area who practice are a major constituency, and they are generally more conservative than

The Lemelson-MIT Program Intellectual Property Workshop

members of the bar in general, in my belief. Most of them have to be engineers and scientists, which gives them a certain respect for inventors. But lots of them don't like the rules to change because if the rules change they've got to learn new rules. Now sometimes that's beneficial in terms of billing new clients. But it can be a headache." He cites a case of new legal rules that prompted attorneys to retire rather than learn and implement them. Finally, he says, "the highly vocal independent inventors community has proven that they can mobilize their forces when they feel threatened." Even if you could get all of these major constituencies to agree on something, "to get the Congress to focus on this issue [of patent reform] is next to impossible," says Dickinson.

That said, the system can be changed if it's done in a highly targeted and disciplined way, says Dickinson. The three areas of change that our participants have targeted are:

- New standards for searchability, making it easier to search the patent applications themselves as well as databases of prior art that include technical journals and other sources outside the patent office.
- Better compliance and incentives for full disclosure of searches, so that prior art is uncovered during the search and examination process.
- Higher standards for non-obviousness, so that inventions that are clearly obvious don't find their way into patents that may have to be litigated or invalidated later.

An example of a plausible change that could alleviate the problem of low-quality or obvious patents is the implementation of a post-grant review process. "We tried to get a much more expansive re-examination system in place the last go-around and [the independent inventors] were adamant in protest," says Dickinson. "They believe that they'll be abused by large corporate interests. They like having that million dollar piece of paper in their hands. They don't want it to cost fifty thousand dollars to undermine that. They want it to cost a million dollars. And that's obviously not so good for the system."

Fixing this problem of low-quality patents is going to take time and money. Whether the solution lies in hiring more examiners, or in paying them more to better retain them as they gain experience, or instituting a new post-grant review process, the solution is going to require investment. Under the current director James Rogan, the USPTO has published its "21st Century Strategic Plan."¹⁹ Among the most important issues it addresses is "fee

The Lemelson-MIT Program Intellectual Property Workshop

diversion,” which is the process of skimming millions of dollars from the patent office’s revenue and diverting it to other areas of the government. It’s not that the patent office lacks funds; it’s more that its funds are being taken and used for entirely non-related purposes. “If you have a hundred million dollars that is being diverted,” says Dickinson, “then you have a big opportunity to devote some of that to [fund] additional examination time.”

Other reforms proposed by the Strategic Plan include the outsourcing of the search function to private companies or to the European Patent Office. “The theory being, presumably, that outsourcing will free up additional examiner time for examination,” says Dickinson. He doesn’t think it is a good idea to separate searching, a core chore, from the overall examination process and that this won’t improve patent quality.

David Staelin says that poor searchability is a big concern in and of itself, no matter who does it. “We need better search techniques, including natural language search,” he says. The patent office already spends \$15 million per year on its databases, he says, but perhaps this needs to be increased. “This should be a slam dunk. We need clarity standards.” Should the government fund free database and search tools? He also recommends that the search domain be expanded to include a wide range of academic papers, journals, and research reports. “The [the government] has already begun to establish these databases. They should be expanded. I think we should also link to auxiliary information, like independent reviews, technical publications, product literature. I believe either the Patent Office or the Library of Congress are the potential owners.”

Staelin emphasizes searchability standards for each patent application. Some patentees don’t use clear language and obvious search terms. Then, when others receive patents in the same area, the original patentee pops up and sues the new patentee. “If you cannot search and find the disclosed art, then it is arguably undisclosed,” says Staelin. “If you can't find it -- you can't hide something in plain sight -- then you haven’t disclosed it.” There needs to be real incentive and penalties for making patents searchable.

Dickinson and others have already supported new incentives to disclose prior art searches. “I spent a huge amount of time, and still continue to spend a huge amount of time hectoring and testifying about these obligations,” he says. “There is an institutional resistance, I think, to doing it. There are attorneys who advise clients not to do searching,

**The Lemelson-MIT Program
Intellectual Property Workshop**

because the client could be subject to treble damages if it's proven they knew about prior art. Such advice is subject to discipline; it's a serious offense." When a corporation performs a prior art search or a law firm does a search for a client, those searches should be handed over to the patent office and put online.

Recommendations for further study

Our participants have recommended that the following set of issues be the subject of further research on the basis of their national and global importance. Not enough is known about the ramifications associated with the options being proposed to address these issues:

- **International patent “harmonization”**
 - How much money would a harmonized international patent treaty forged by the World Intellectual Property Organization, the World Trade Organization, or the European Union save users in terms of duplicate filing and issuance fees? Are there simpler ways of devising a system in which people file only once worldwide, without total harmonization?
 - Should the U.S. drop its current requirement for disclosing the “best mode” of practicing the patent invention, something no other country requires?
 - What are the best compromises, if any, for the controversy over “patentable subject matter?” (Most countries don’t agree with the U.S. on business method patents, certain software patents, genetic materials, etc.)
 - Should we drop the idea of an international treaty and instead come up with simpler ways of getting the big three patent offices – U.S., European, Japanese – to cooperate?
 - Will U.S. inventors give up our “first to invent” patent standard in favor of the simpler “first to file” standard of the rest of the world?
 - Do developing countries have a valid claim on their insistence on protecting so-called genetic resources, such as native foods, medicinal plants, and “traditional knowledge” such as tribal teachings.
- **Raising the “inventive step” to reduce low-quality patents**

The Lemelson-MIT Program Intellectual Property Workshop

- How do you define higher steps such as an increased non-obvious standard?
- Could the patent office faithfully execute new standards?
- Is there a way to prevent patents that are too broad or too strong from being issued?
- Would a new post-grant review process address this issue, or would it simply add a layer of bureaucracy between inventors and innovation?
- **The impact of eliminating the non-commercial research exemption**
 - How do we keep critical scientific research projects in the “public domain?”
 - Are innovation markets becoming too exclusive?
 - Do large numbers of patents (due to non-payment of maintenance fees) and large numbers of trade secrets (due to early disclosures) fall into the public domain faster than people realize, thus reducing the urgency of this issue?
 - Should universities be treated like businesses from the patent office’s point of view?
 - Should all manifestations of creativity be protectable, no matter where they occur and who creates them?
 - Should the U.S. adopt the Australian model in which professors must grant their universities perpetual use of the inventions they create?
 - Is the defense that “you cannot sue the government for patent infringement” a valid one for keeping government-funded research in the public domain?
- **Patenting moving “upstream” into basic science**
 - What are the effects of patents on basic science? (i.e. techniques for isolating or manipulating a gene, basic DNA patents)
 - Does it make sense to carve out a scientific commons -- specific areas of public knowledge in which patent rights are waived and thus are not protectable? (Is this similar to the approach that some copyright experts

The Lemelson-MIT Program Intellectual Property Workshop

are now pushing for “copyleft” works²⁰ that are specifically given to the world?)

Notes

- ¹ National Research Council of the National Academies; *Patents in the Knowledge-Based Economy*; Wesley M. Cohen and Stephen A. Merrill, editors, (National Academies Press, 2003). More specific paper citation needed.
- ² Reference to study needed.
- ³ Reference to study needed.
- ⁴ C&F Packing Co. v. IBP, Inc. (a large Pizza Hut supplier), 2000 U.S. App. LEXIS 21527 (United States Court Of Appeals For The Federal Circuit) (August 25, 2000). In December 1998, a jury determined that IBP had misappropriated C&F's trade secrets and awarded C&F \$10.9 million in damages for unjust enrichment.
- ⁵ Study citation needed.
- ⁶ *Diamond v. Chakrabarty*, 447 U.S. 303 (1980), Docket number 79-136; Argued March 17, 1980; Decided June 16, 1980
- ⁷ *Diamond v. Diehr*, 450 U.S. 175 (1981) Docket number 79-1112; Argued Oct. 14, 1980; Decided March 3, 1981; *AT&T Corp. v. Excel Communications*, 50 U.S.P.Q. 2d 1429 (Fed. Cir. 199), cert. Denied, 68 U.S.L.W. 3249 (Oct. 12, 1999)
- ⁸ *Polaroid Corp. v. Eastman Kodak* (DC Mass) 12 USPQ2d 1711; Decided Jan. 11, 1991; No. 76-1634-MA
- ⁹ *State Street Bank & Trust v. Signature Financial Group*, 149 F.3d 1368 (Fed. Cir. July 23, 1998)
- ¹⁰ Merz, J., and N. Pace (1994) “Trends in Patent Litigation: The Apparent Influence of Strengthened Patents Attributable to the Court of Appeals for the Federal Circuit.” *Journal of the Patent and Trademark Office Society* 76: 579-590; Moore, K. (2001) “Forum Shopping in Patent Cases: Does Geographic Choice Affect Innovation?” *North Carolina Law Review* 79: 889
- ¹¹ U.S. Patent & Trademark Office data, 2002
- ^{11A} Study citation needed for correlation between patenting, R&D spending, and GNP. Citation needed for Maloney and Lederman study by the World Bank.
- ¹² “Small Firms and Technical Change”, Hicks D, Breitzman A, Albert M, and Thomas P., Ongoing research for the Small Business Administration under solicitation SBAHQ-02-Q-0028.
- ¹³ “Small Firms and Large Chandlerian Firms: Structures and Strategies”; dissertation submitted to the Doctoral Program in Economics and Management, Scuola Superiore Sant'anna Pisa, by Marco S. Giarratana, September 9, 2003. Part II: "The Evolution and Birth of a New Industry. The Case of the Encryption Software"
- ¹⁴ Robert Barr, VP of Cisco Corp., quote citation needed
- ¹⁵ Study citation needed.
- ¹⁶ *Madey v. Duke University* (2002) 301 F. 3d 1351, 1362; No. 01-1567, Fed. Cir., Oct. 3, 2002
- ¹⁷ Study citation needed.
- ¹⁸ Study citation needed.
- ¹⁹ For a copy of the 21st Century Strategic Plan, see USPTO.gov

Appendix A

**THE LEMELSON-MIT PROGRAM WORKSHOP -
“HOW DOES INTELLECTUAL PROPERTY SUPPORT
THE CREATIVE PROCESS OF INVENTION?”**

Questions

1. What are the forms of intellectual property? How are these different forms most suitable to the creation of original new concepts and works?
2. What rights do patents offer to the inventor? How do these rights support the process of invention? How do they inhibit the process of invention?
3. Where does the process of patenting fit into the processes of invention?
4. How does the U.S. patent system support the work of an inventor and what difficulties does it create?
5. What are the differences and similarities of the US, European, and Japanese patent systems? How do the differences enable or hinder the work of invention?
6. What is a strong patent? What are its characteristics? What is a weak patent? What are its characteristics? How are the strengths and weaknesses of patents related to the process of invention?
7. Does the formal process of patenting support the education of students in the process of invention? Does it stand in their way? How do we educate students on what patenting means? How does this knowledge support their growth in inventiveness?
8. How do the acquisition of patents support the educational and research goals of the university? How does it stand in the way?
9. Where is most of the patenting going on? Large organizations? Small organizations? Individuals? Universities? Are there correlations between organizations creating large numbers of patents and other measures of inventiveness, invention and innovation?

Appendix B: Participant Biographies

Anthony Breitzman

*Vice President and Chief Technology Officer
CHI Research, Inc.*

Anthony Breitzman has a B.S. in mathematics from Stockton State College; an M.A. in mathematics from Temple University; and an M.S. and Ph.D. in computer science from Drexel University. He joined CHI Research, Inc. as an associate analyst in 1993, and in 1996, became the youngest vice president in the company's 30-year history. Breitzman has three major responsibilities at CHI—working as a competitive intelligence consultant for commercial clients, generating new business for the company, and steering the technical direction of the company.

Breitzman has worked extensively with Fortune 500 companies. He is an expert in constructing quantitative evaluations of clients' technological strengths and weaknesses, and identifying potential competitors on the technological horizon. A mathematician and computer scientist by training, with teaching experience at Temple University, he has also developed many of CHI's quantitative patent indicators. These indicators form the basis for a great deal of the company's consulting work. He is a leading figure in the company's software development, which involves developing toolsets and querying capabilities to handle CHI's extensive in-house patent databases.

As primary inventor of CHI's landmark patent for choosing stock portfolios based on patent indicators, Breitzman was one of the pioneering figures in CHI's introduction of products aimed at the financial community. He is currently CHI's Project Manager for the Patent Quality Select Trust, a unit trust sold through First Trust Portfolios L.P. (formerly Nike Securities L.P.).

Q. Todd Dickinson

*Patent Attorney
Howrey Simon Arnold & White*

Q. Todd Dickinson helps lead the Intellectual Property Practice Group at Howrey Simon & White, where he is a partner. He has more than 25 years of experience in all aspects of intellectual property law and public policy, including patents, trademarks, copyrights and trade secrets.

Prior to joining Howrey, Dickinson was under secretary of Commerce for Intellectual Property and director of the United States Patent and Trademark Office (USPTO),

The Lemelson-MIT Program Intellectual Property Workshop

nominated by President Clinton and confirmed by the U.S. Senate. At the USPTO, Dickinson was principal policy advisor to the President on all intellectual property matters, as well as representing the U.S. government internationally in IP matters.

Dickinson earned a B.S. degree in chemistry from Allegheny College in 1974 and a J.D. from the University of Pittsburgh School of Law in 1977. He is a member of the bars of Pennsylvania, California, Illinois, the District of Columbia, and is registered to practice before the U.S. Patent and Trademark Office.

Prior to joining the Commerce Department, he was with the Philadelphia-based law firm of Dechert Price & Rhoads, where his practice included all aspects of intellectual property law and management. From 1990 to 1995, Dickinson was chief counsel for Intellectual Property and Technology at Sun Company, Inc., where he had legal and managerial responsibility for all intellectual property matters worldwide. From 1981 to 1990, he served as counsel to Chevron Corporation in San Francisco, CA, focusing on domestic and international intellectual property matters. Prior to 1981, he was a patent and trademark practitioner with Baxter Travenol Laboratories, Inc., Deerfield, IL, and the Pittsburgh, PA law firm of Blenko, Buell, Ziesenheim and Beck.

Dickinson is an active member of a number of intellectual property organizations and has written and spoken extensively on intellectual property issues, especially those affecting emerging technologies. He has testified before Congress, the Federal Trade Commission and the National Academy of Sciences on the impact of IP policies. He has also taught or lectured at various universities including Stanford, Yale, Berkeley, MIT, Georgetown, George Washington and Tokyo University.

Rochelle Cooper Dreyfuss

*Pauline Newman Professor of Law
New York University School of Law*

Rochelle Cooper Dreyfuss' research and teaching interests include intellectual property, civil procedure, privacy, and the relationship between science and law. She holds a B.A. and M.S. degrees in chemistry and spent several years as a research chemist before entering Columbia University School of Law, where she served as articles and book review editor of the *Law Review*. After graduating, Dreyfuss was a law clerk to Chief Judge Wilfred Feinberg of the U.S. Court of Appeals for the Second Circuit and to Chief Justice Warren E. Burger of the U.S. Supreme Court. During her time at N.Y.U., she served as the director of the Engelberg Center on Innovation Law and Policy at N.Y.U., and as a member of the New York City Bar Association, the American Law Institute, and BNA's Advisory Board to USPQ. She was a consultant to the Federal Courts Study Committee, to the Presidential Commission on Catastrophic Nuclear Accidents, and to the Federal Trade Commission. She is a past-chair of the Intellectual Property Committee of the American Association of Law Schools. Dreyfuss is currently a member of the National Academy of Sciences' Committee on Intellectual Property Rights in the

The Lemelson-MIT Program Intellectual Property Workshop

Knowledge-Based Economy and one of the reporters on the American Law Institute's Project on Intellectual Property: Principles Governing Jurisdiction, Choice of Law, and Judgments in Transnational Disputes. She has visited at the University of Chicago Law School, University of Washington Law School, and Santa Clara School of Law. In addition to articles in her specialty areas, she has co-authored casebooks on civil procedure and intellectual property law.

Merton C. Flemings

Director, Lemelson-MIT Program

Massachusetts Institute of Technology

Merton C. Flemings is Toyota Professor of Materials Processing emeritus at M.I.T., where he has been a member of the faculty since 1958. Flemings established the Materials Processing Center at M.I.T. in 1979 and was its first director. He served as Head of the Department of Materials Science and Engineering from 1982 to 1995, and from 1998 to 2001 as M.I.T. director of the Singapore-MIT Alliance, a major collaboration between M.I.T. and Singapore in distance engineering education and research. He is author or co-author of 300 papers, 26 patents and two books in the fields of solidification science and engineering, foundry technology, and materials processing. Flemings has received numerous awards and honors, including election to the National Academy of Engineering and to the American Academy of Arts and Sciences. He has worked closely with industry and industrial problems throughout his professional career. Flemings is Chairman of the Silk Road Project, a not-for-profit corporation devoted to fostering creativity and celebrating local cultures and global connections.

Robert Gundlach

Senior Research Fellow (Retired)

Xerox Corporation

Robert Gundlach retired from Xerox Corporation Research Laboratories in 1995 after a career of 43 years. He was one of the most productive inventors in the history of Xerox, with 163 U.S. patents (as of Nov. 2002). Gundlach was one of the early pioneer researchers into the science and art of xerography, joining the Halide Corporation in 1952, which latter became Xerox. He is a member of the National Academy of Engineering and has received many awards including the Chas. E. Ives award of the PS&E Journal, Inventor of the Year Award of the Rochester Patent Law Association, Carlson Memorial Award of the SPSE, Johan Gutenberg Prize of the Society For Information Display and the Xerox President's Award for Outstanding Career Achievement. Gundlach is the former President of the Electrostatics Society of America. He received a B.A. in physics from the University of Buffalo in 1949.

**The Lemelson-MIT Program
Intellectual Property Workshop**

Bronwyn H. Hall

*Professor of Economics
University of California, Berkeley*

Along with her professorship at University of California at Berkeley, Bronwyn H. Hall is a Research Associate of the National Bureau of Economic Research and the Institute for Fiscal Studies, London. She is also the founder and partner of TSP International, an econometric software firm. Hall received a B.A. in physics from Wellesley College in 1966 and a Ph.D. in economics from Stanford University in 1988. She is currently a member of the Science, Technology, and Economic Policy (STEP) Board of the National Research Council, where she has served on the Intellectual Property and R&D statistics committees.

During the past 15 years, Hall has published numerous articles on the economics and econometrics of technical change in journals such as *Econometrica*, *American Economic Review*, *Rand Journal of Economics*, and *Research Policy*. Her current research includes comparative analysis of the U.S. and European patent systems, the use of patent citation data for the valuation of intangible (knowledge) assets, comparative firm-level investment and innovation studies (the G-7 economies), measuring the returns to R&D and innovation at the firm level, analysis of technology policies such as R&D subsidies and tax incentives, and of recent changes in patenting behavior in the semiconductor and computer industries.

Karl F. Jorda

*David Rines Professor of Intellectual Property Law
Director, Germeshausen Center for the Law of Innovation and Entrepreneurship
Franklin Pierce Law Center*

Karl F. Jorda teaches primarily IP Licensing, IP Management and International IP Law at Franklin Pierce Law Center and at the Fletcher School of Law and Diplomacy at Tufts University, where he is adjunct professor.

Before joining Franklin Pierce in 1989, Jorda was Chief IP Counsel for 26 years at Ciba-Geigy Corporation (now Novartis). He was president of the Pacific Intellectual Property Association (PIPA) and the New York Intellectual Property Law Association. He has served on the Boards of Directors of AIPLA, ABA-IPL Section, INTA, IPO, ACPC, and AIPPI-American Group.

Jorda is the recipient of the 1989 PIPA Medal for “Outstanding Contributions to International Cooperation in the Intellectual Property Field,” the 1996 Jefferson Medal of the NJIPLA for “extraordinary contributions to the U.S. intellectual property law system” and the 1998 Distinguished Alumni Award of the University of Great Falls.

The Lemelson-MIT Program Intellectual Property Workshop

Jorda is a frequent speaker in IP programs in foreign countries under e.g. WIPO, USAID, USIA, etc. auspices and has served as a consultant to the Indonesian and Bulgarian IP offices. In 1999, the U.S. Arms Control and Disarmament Agency appointed him as the U.S. representative to the Commission on the Settlement of Disputes Relating to Confidentiality of the Organization for the Prohibition of Chemical Weapons, located in The Hague, Holland.

Jorda received his undergraduate degree (summa cum laude) from the University of Great Falls, and his M.A. and J.D. from Notre Dame University. He is admitted to the bars of Illinois, Indiana and New York as well as to practice before the U.S. Supreme Court, the Court of Appeals for Federal Circuit and the USPTO.

Stephen A. Merrill

Executive Director

Board on Science, Technology, and Economic Policy

National Academies

Stephen Merrill has led the National Academies' Board on Science, Technology, and Economic Policy (STEP) since its formation in 1991. In this capacity, Merrill has directed several STEP projects and publications, including *Investing for Productivity and Prosperity* (1994); *Improving America's Schools* (1995); *Industrial Research and Innovation Indicators* (1997); *U.S. Industry in 2000: Studies in Competitive Performance and Securing America's Industrial Strength* (1999); and *Trends in Federal Support of Research and Graduate Education* (2001). He is currently managing a three-year study of intellectual property policies. With Wesley Cohen, he has edited a volume of papers commissioned for that project, *Patents in the Knowledge-Based Economy* (2003).

Merrill was principal consultant on the National Academies' report, *Balancing the National Interest: National Security Export Controls and Global Economic Competition*, in 1985. As a consultant, he also contributed to Academy studies in the areas of science policy, manufacturing and competitiveness. In 1987, he was appointed to direct the Academies' first government and congressional liaison office.

Previously, Merrill was a Fellow in International Business at the Center for Strategic and International Studies (CSIS), where he specialized in technology trade issues. He served on various congressional staffs, most recently that of the Senate Committee on Commerce, Science, and Transportation, where he organized the first congressional hearings on international competition in biotechnology and microelectronics. He was additionally responsible for legislation on technological innovation and the allocation of intellectual property rights arising from government-sponsored research.

**The Lemelson-MIT Program
Intellectual Property Workshop**

Merrill holds degrees in political science from Columbia (B.A., *summa cum laude*), Oxford (M. Phil.), and Yale (M.A. and Ph.D.) Universities. From 1989 to 1996, he was an adjunct professor of international affairs at Georgetown University.

Mark B. Myers

Visiting Executive Professor

The Wharton School, University of Pennsylvania

Mark B. Myers' research interests include identifying emerging markets and technologies to enable growth in new and existing companies with special emphases on research, technology identification and selection, product development and technology competencies. Myers serves on the Science, Technology and Economic Policy Board of the National Research Council and currently co-chairs the National Research Council's study of "A Patent System for the 21st Century."

Myers retired from the Xerox Corporation at the beginning of 2000, after a 37-year career in its research and development organizations. Myers was the senior vice president in charge of corporate research, advanced development, systems architecture, and corporate engineering from 1992 to 2000. His responsibilities included the corporate research centers: PARC in Palo Alto, CA; Webster Center for Research & Technology near Rochester, NY; Xerox Research Centre of Canada in Mississauga and Ontario; and the Xerox Research Centre of Europe in Cambridge, UK and Grenoble, France. During this period he was a member of the senior management committee in charge of the strategic direction setting of the company.

Myers is chairman of the Board of Trustees of Earlham College and the Earlham School of Religion and has held adjunct and visiting faculty positions at the University of Rochester and at Stanford University. He received a Ph.D. degree in materials science from Pennsylvania State University in 1964 and was named an alumni fellow there in 1997.

Lita L. Nelsen

Director, Technology Licensing Office

Massachusetts Institute of Technology

Lita L. Nelsen earned a B.S. (1964) and M.S. (1966) in chemical engineering from M.I.T., and an M.S. in management (1979) from M.I.T. as a Sloan Fellow. In her role as director of the Technology Licensing Office, Nelsen manages over 450 new inventions per year from M.I.T., the Whitehead Institute and Lincoln Laboratory. Typically, her office negotiates over 100 licenses and over 20 start-up companies per year.

Prior to joining the M.I.T. Technology Licensing Office, Nelsen spent 20 years in industry, primarily in the fields of membrane separations, medical devices and

**The Lemelson-MIT Program
Intellectual Property Workshop**

biotechnology, at such companies as Amicon, Millipore, Arthur D. Little, Inc., and Applied Biotechnology.

Nelsen was the 1992 President of the Association of University Technology Managers. She has served on the boards of the State of Massachusetts Technology Development Corporation, Massachusetts Biotechnology Corporation, M.I.T. Enterprise Forum, Cornell Research Foundation and others. Nelson served as advisor to the NIH, the National Academy of Sciences and the Office of Technology Assessment, and was elected a fellow of the American Institute for Medical and Biological Engineering. She is widely published in the field of technology transfer and university/industry collaborations.

Nelsen is also the Intellectual Property advisor to the International AIDS Vaccine Initiative, and a (founding) board member of the Center for the Management of Intellectual Property in Health Research and Development for developing countries. Additionally, she is a fellow of the Cambridge MIT Institute, working with UK university technology transfer organizations.

Evan I. Schwartz

Author and Independent Journalist

Evan I. Schwartz received his B.S. in computer science from Union College in 1986. He is an author and journalist who writes about innovation and the impact of technology on business and society. He is currently a contributing writer for MIT's Technology Review. A former editor at Business Week, he covered software and digital media for the magazine and was part of teams that produced 12 cover stories and won a National Magazine Award and a Computer Press Award. He has also published articles in The New York Times and Wired.

Schwartz' most recent book, *The Last Lone Inventor: A Tale of Genius, Deceit, and the Birth of Television* (HarperCollins, 2002) tells the story of television inventor Philo T. Farnsworth and his epic battle against RCA tycoon and NBC founder David Sarnoff. His first book, *Webonomics* (Broadway Books, 1997), anticipated the emergence of the Internet economy. His second book, *Digital Darwinism* (Broadway Books, 1999), anticipated the Darwinian shakeout among the dotcom species. Each was translated into nine languages and named as a finalist for a Computer Press Award for non-fiction book of the year. He is currently working on a book about the culture of invention, for the Harvard Business School Press. He has recently served as an adjunct lecturer at Boston University's College of Communication.

**The Lemelson-MIT Program
Intellectual Property Workshop**

David H. Staelin

*Professor of Electrical Engineering
Massachusetts Institute of Technology*

David H. Staelin's work is concentrated in the areas of remote sensing, estimation and telecommunications. He was assistant director of the M.I.T. Lincoln Laboratory from 1990 to 2001. He co-founded PictureTel Corporation, where he served as Chairman from 1984 to 1987 and also the M.I.T. Venture Mentoring Service, dedicated to assisting technology-based start-up companies. Staelin has served as chair of the National Academy of Sciences Committee on Radio Frequency Requirements for Research, and has been nominated by the White House for the President's Information Technology Advisory Committee. He is a fellow of the Institute of Electrical and Electronics Engineers and the American Association for the Advancement of Science. His S.B., S.M., and Sc.D. degrees in electrical engineering were earned at M.I.T.

Sidney G. Winter

*Deloitte and Touche Professor of Management
Co-Director, R. H. Jones Center for Management Policy, Strategy, and Organization
The Wharton School, University of Pennsylvania*

Sidney G. Winter received his B.A. from Swarthmore College (1956), his M.A. from Yale University (1957), and his Ph.D. from Yale University (1964)—all in economics. He had held previous appointments at Yale University, the University of Michigan, and the University of California, Berkeley. He also worked in policy research, as research economist at the RAND Corporation (1959-61, 1966-68). Winter was also a staff member at the Council of Economic Advisors, and more recently chief economist of the U.S. General Accounting Office (1989-93). He has been a consultant to various publicized private organizations and an expert witness in antitrust, regulatory and contract litigation.

Winter is co-author of *An Evolutionary Theory of Economic Change* and has published articles in organization theory, management and microeconomic theory. His current research areas include organizational learning and knowledge, technological change, and competitive advantage. He is a fellow of the Econometric Society and of the American Association for the Advancement of Science, and a member of other scholarly organizations. He serves as vice president of the International J.A. Schumpeter Society and as associate editor of *Industrial & Corporate Change*.