Engineering Economics and the Law

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Abstract

Patent and Trade Secret Law is an area of the Law that is very important to engineering and the economy, but it is not among the topics prominently covered (if at all) in a typical course in Engineering Economy (or “Engineering Economics”). To help remedy this apparent deficiency in course coverage, the author presents: a rationale for inclusion of this topic in such a course, an overview of patent and trade secret law, classroom suggestions, and steps for valuing a patent.

1. Why Patent & Trade Secret Law is an Apt Topic for Courses in Engineering Economics

It is widely recognized that relationships exist between law and economics. The University of Chicago, for example, has had a Journal of Law and Economics since 1958.¹ The Encyclopedia of Law and Economics, which is published in the Netherlands, has two Nobel Laureates in Economics on its Editorial Board.²

Because important relationships exist between law and economics, it is appropriate to inquire: What area(s) of the law (if any) are most relevant to a course in engineering economics? Environmental law might be a candidate, as it is relevant to environmental engineers, but it is too specialized to be of general interest in a course on engineering economics. Contract law is a possibility, but its appeal is too broad to properly fit into a focused course like engineering economics. Many other areas of the law are not good fits for similar reasons. Patent law and product liability law are good candidates, but as between these two areas of law, patent law is more highly relevant to both engineering and economics because of its unique links to both technology and monopoly. Also, as will be discussed in greater detail later, patent law and the related field of trade secret law are very important to the economy and to the new product decisions made by engineers. Thus, if one area of the law were to be singled out as most relevant to Engineering Economics, it would that of Patent and Trade Secret Law.

But what exactly is Engineering Economics? In 2000, Kim LaScola Needy, Heather Nachtmann, Jerome La Valle, and Ted Eschenbach published the results of a survey of how engineering economy is taught in U.S. universities.³ Questions included which textbook was being used and which chapters were generally covered. Topics were then summarized and tallied from the chapters listed by the respondents. Commonly covered topics (>60% of respondents) included benefit/cost rates, interest rates, present worth, cash flows, equivalence relationships, depreciation & depletion, sensitivity analysis, replacement analysis, rate of return, income taxes, inflation & deflation, evaluating multiple alternatives, after-tax economic analysis, and uncertainty & risk analysis. Of relevance to the present paper, is the fact that patents and trade secrets were not among the reported topics in the survey.
According to the same survey, in the U.S., engineering economics is taught predominantly to engineering students, including Mechanical (22%), Civil (19%), Industrial (18%), Electrical (15%), Chemical (7%), Engineering Management (4%), Other Engineering (8%), and Other (7%). It is often a required course for industrial engineering students, and an elective course for others. It provides principles and techniques useful in determining whether a proposed engineering-related alternative will be economical. Often, course problems are geared to situations that might be faced by practicing engineers, and are presented in the form of alternatives, such as whether it is more economical to buy, build or lease.

But engineers, as a group, do more than just buy, build or lease. Engineers also play a dominant role in the creation of new products, the investment in which is protected by patent and trade secret laws.

- “Engineers … are the bridge between scientific research and the creation of new products, translating technical principles into goods, processes and systems for the benefit of all people” [Emphasis added]
- “Engineers play a dominant role in creating and maintaining the products and systems necessary to sustain and enhance human life. … Engineers create new products, conduct scientific research, test and evaluate new systems, design and control manufacturing processes, clean and protect the environment and perform a host of tasks necessary to bring the benefits of technology to society.” [Emphasis added]

Of all the forms of intellectual property (IP), patents and trade secrets are those that are most relevant to new products and R&D, and thus perhaps, of greatest significance to engineering. Patent and trade secret laws help preserve the fruits of expensive R&D for the benefit of firms and their inventors, many of whom have engineering backgrounds. Moreover, a better understanding of these topics should help engineers avoid costly pitfalls—e.g., erroneously assuming that the most one has to pay for an infringement is a reasonable royalty, or that a patent grants one the right to manufacture and sell a patented product, or that a U.S. patent is sufficient to protect IP in an increasingly global economy.

Such mistakes can be very costly. During the prior decade, nine U.S. patent infringement cases with damages totaling over $100 million each were decided. Federal appeals courts have upheld, as reasonable, a lost profit rate of up to 60% of sales and a royalty rate of up to 25% for patent infringement. One jury awarded damages of $369 million in a trade secret case (reduced to $146 million following appeal). Polaroid Corp. v. Eastman Kodak Co. resulted in a monetary award of nearly a billion dollars ($909 million) for patent infringement.

Patents are pervasive. During the prior decade, over one million U.S. patents were issued. Laws protect patents and trade secrets against pervasive imitative behavior, thereby stimulating investment in new products and R&D. Patent and trade secret laws thus give impetus to the development of new products that benefit consumers, and accelerate technological change, a proven, major contributing factor to economic development. In view of such causes and
effects, a discussion of patents and trade secrets and how they can impact the economics of new product development is highly relevant to a first course in engineering economics.\textsuperscript{17}

2. **Overview of Patent and Trade Secret Law**

But what exactly is a *patent*? What is a *trade secret*?\textsuperscript{18}

In the U.S., a patent is a property right granted to an inventor “to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States.” The right is granted for a limited time in exchange for public disclosure of the invention when the patent is granted. The subject matter that patents can protect is *very* broad. Even *living organisms* can be patented as articles or compositions. See *Diamond v. Chakrabarty*, 447 U.S. 303, 206 USPQ 193 (1980). *Business method claims* can also be patented. See *State Street*, 149 F.3d at 1374-75, 47 USPQ2d at 1602 (Fed.Cir. 1998).

In the U.S., there are *three* kinds of patents. The most common kind of patent is a *utility* patent, which may be granted to anyone who invents or discovers any new, useful, and non-obvious process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof [35 U.S.C. § 101]. Usually when people speak of patents, they mean utility patents. A *second* kind of U.S. patent is the plant patent [35 U.S.C. § 161], which may be granted to anyone who invents or discovers and asexually reproduces any distinct and new variety of plant. The *third* kind of U.S. patent is the design patent [35 U.S.C. § 171], which may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture.

A *trade secret*, on the other hand, unlike a patent (which is both public and published information), is any information that a business keeps secret in order to gain an advantage over its competitors. Unlike a patent, a trade secret does *not exclude* others from using the item that is the subject of the trade secret if they fairly discover the secret—e.g., through independent R&D.

Although trade secret theft in the U.S. can be a federal crime [18 U.S.C. § 1832], the laws of the individual *states*, rather than those of the federal government, have afforded the primary *legal* means of protecting trade secrets. One can seek an injunction against theft of one’s trade secret if reasonable attempts have been made to maintain its secrecy. Of course, trade secrets are also protected by *physical* means.

3. **Classroom Suggestions**

But *how* can an engineering economics professor hope to incorporate patent and trade secret law into lecture materials and class assignments? Here are a few suggestions:

- Alternative 1 — Search [www.uspto.gov](http://www.uspto.gov) for registered patent attorneys employed by, or living in the locale of, the university offering the engineering economics course, and offer him/her the opportunity to come to a class and give a guest lecture on the topic of patents and trade secrets.
• Alternative 2 — Give students the opportunity to do a report on the economics of patents, perhaps as illustrated in the following patent damages cases: Georgia-Pacific Corp. v. United States Plywood Corp.\(^{19}\) and Panduit Corp. v. Stahlin Bros. Fibre Works, Inc.\(^{20}\)

• Alternative 3 — Give students the opportunity to attempt a detailed valuation analysis of a U.S. patent in which they are particularly interested, perhaps one owned by their employer or university, or in an industry of particular interest to them (see U.S. patent database at www.uspto.gov and discussion below.)

4. How to Value a Patent

Those interested in evaluating a patent should recognize that some investments in R&D or high-tech bear much fruit while many others do not. A project involving telecommunication satellites in which Motorola and others had invested $5 billion, for example, went into bankruptcy.\(^{21}\) Similarly, more than 862 dot-com companies reportedly failed during the 1-1/2 year period starting in January 2000.\(^{22}\) Moreover, merely obtaining a patent is no assurance that the underlying technology has any significant economic value. The top 10% of patents in both Germany and the U.S. accounted for over 80% of total patent value.\(^{23}\) One economist, Baruch Lev, suggests that “the majority of [those] patents were essentially worthless, rendering the investment in those patents a loss.”\(^{24}\)

When evaluating a patent, one may be able to deduce its value by comparing the economic performance of the company that is implementing the patent versus the performance of a hypothetical but similar company without the patent. However, a more analytical and generalized approach starts with reading the patent.

To efficiently read a patent, one should understand the purposes behind each section of the patent. For example, it is the claims section of the patent that defines the legal scope of the patent; if anyone infringes the patent, the claims will most likely come into play. Claims are typically arranged so that the first claim present is the broadest. A Background of the Invention section often gives insight into the patent’s economic potential. A Detailed Description section is there to give the preferred embodiment of the invention. Header information includes the name(s) of the inventor(s), and sometimes, an assignee, to whom the inventor(s) transferred ownership. The date of the patent gives insight into the patent’s remaining life. References Cited and Other References can give insight into the patent’s technological niche.

Sometimes, a good second step in evaluating the economic potential of a new patent is to talk to the patent attorney who is most familiar with the particular patent, about the various legal factors that may influence the value of the patent. In order to request the most pertinent data and to ask the right questions of the patent attorney, one has to be aware of the legal factors that impact patent value, including maintenance fees, scope of protection, remaining life, foreign patent protection, and the likelihood of invalidity and/or infringement. More specifically:\(^{25}\):

• Payment of Maintenance Fees—The value of a patent can be reduced to nothing by failure to pay maintenance fees to the U.S. Patent Office. A first fee is due at 3 ½ years,
a second at 7 ½ years, and a third, at 11 ½ years from issuance. Some delays in payment can be cured, for limited times. At the start of a valuation, it is vital to inquire about the payment status of maintenance fees—e.g., by phoning the Patent Office.

- **Scope of Protection**—A patent’s scope of protection is arguably the most important value-driver, since broad pioneering patents tend to forestall competition, while narrow, “me-too” patents tend not to have significant impacts on the marketplace. An understanding of a patent’s scope can be derived, in part, by analyzing the cited, related, and citing patents, and the extent to which the patentee limited the scope of his patent because of arguments made to the USPTO in obtaining the patent.  

- **Remaining Life**—One factor enhancing the value of a patent is its remaining life. In the U.S., the life of a utility patent applied for after June 7, 1995 ends twenty years after its earliest effective filing date [35 U.S.C. § 154]. Under transitional provisions, the term of any patent in force or pending on June 7, 1995, is the longer of 17 years from the date of issue or 20 years from the filing date. Previously, patents were granted for a term of seventeen years from the date of issuance. A patent’s term can be extended up to five years if issuance was delayed by pre-market regulatory review or to compensate for certain procedural delays that may arise within the USPTO in connection with processing of the patent application. A major risk, of course, is that the remaining useful life may be shortened due to technological developments that make the invention obsolete.

- **Foreign Patent Protection**—Another factor that affects the value of a patent is the extent of foreign patent protection. The right conferred by an American patent extends only to the United States and its territories and possessions. Because patents are enforceable only within the jurisdictions issuing them, valuable inventions are often patented in multiple, national jurisdictions. Is the invention protected in multiple foreign jurisdictions? If not, why? Is it because the invention was not considered valuable (or is there some other explanation)?

- **Invalidity**—Another factor that affects the value of a patent is the possibility that the patent may be held invalid if challenged in court. How likely is it that the patent may be held invalid, if challenged in court? If it were discovered, subsequent to the patent’s issuance, that the inventor did not meet the statutory requirements for obtaining a patent, e.g., the patentee was not the inventor [35 U.S.C. § 102(f)] or had published information about the invention, or offered it for sale more than one year before the date of application [35 U.S.C. § 102(b)], the patent would be invalid and substantially worthless.

- **Infringement**—Still another factor that can affect the value of a patent is the likelihood that practicing the invention of the patent may infringe another’s patent. The engineer needs to understand that merely owning a patent is no guarantee that practicing the invention will not infringe someone else’s patent. Accordingly, the engineer should ask: How likely is it that a reasonable implementation of the patent will infringe another’s patent?

At some point in the process of evaluating a patent, one has to do a patent niche analysis—i.e., analyze the market to identify competing technologies in order to determine where the patent fits
in. Some of this may have already been done in the process of reading the patent and talking to the patent attorney. In any event, things to be considered in doing a niche analysis include: the state of the art prior to the patent including the existence of any *blocking* patents; *alternative* technologies developed after the patent; and possible *future* competing technologies.

Another step in evaluating a patent is to investigate demand by talking to knowledgeable marketing professionals, searching the Internet, and/or conducting a marketing survey. From these investigations, one can determine prices and quantities as follows: Develop a *demand* curve (D), and from it, a Marginal Revenue (MR) curve. If feasible, separately, develop preliminary cost estimates as a function of production, and from them, derive a Marginal Cost (MC) curve. The price at which certain quantities are likely to be sold is indicated for each of two scenarios: *With* a patent at MR = MC and *without* a patent at D = MC. For example, *with* a patent, the patent owner might be able to sell about 2500 Widgets at $35 each (see Figure 1, Alt. I). *Without* a patent, however, competitive pressures could cause pricing to decrease to about $10 per Widget, in which case, total market sales would be about 5000 Widgets (see Alt. II, below).

![Widget Prices and Quantities](image)

If one were to do such analyses for each of several future years, and factor in likely competitive pressures, one could then use these analyses to forecast future revenues. Thus, one could begin to develop a Discounted Cash Flow (DCF) analysis for each alternative. Ideally, each DCF analysis would also consider likely expenses, capital expenditures, and working capital needs; and would utilize a discount rate consistent with the aggressiveness of the forecasted cash flows, the costs of capital, and the risks of the investment. One could then value the patent as the value difference between the two alternatives. Preferably, a written valuation report would be used to document the key conclusions, assumptions and limitations of the overall analysis. (Note: The above figure can also help explain the economic issues arising in a patent infringement case, including incremental lost income, lost profits due to lost revenues and price erosion.)
5. Conclusion

The author has identified Patent and Trade Secret Law as an area of the Law that, although it is very important to engineering and the economy, is not prominently covered (if at all) in a typical course in engineering economics. Having identified this deficiency and provided an outline for its remedy, the author believes that the time is right for Patent and Trade Secret Law to be included on the syllabus of a first course in engineering economics.

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References

4. Ibid., p. 79.
8. Other forms of IP include copyrighted works and trademarks. Trademarks (and service marks) are symbols that distinguish goods (and services), and are protected at the federal or state levels. Copyrighted works are writings, music, works of art, and the like, and are protected at the federal level in the U.S.
15. 90% of the increase in per capita output between 1909 and 1949 has been attributed to technological change. Solow, Robert, “Technical Change and Aggregate Production Function,” *Review of Economics and Statistics*, 1957 (Nobel-Prize...


17 Some might argue that an engineering economics course is not an appropriate venue for discussing patent and trade secret law. However, a good alternative means for engineering students to get such useful information is often not feasible, given the significant academic load carried by most engineering students.

18 The discussion about patents was derived from the author’s previous article entitled “Intellectual Property Law and Valuation,” Valuation Strategies, Warren, Gorham & Lamont, July / August 2003, p. 25, and about trade secrets, from the same article, pp. 24-25.


24 Lev, p. 38.


27 Patent Act, 35 USC § 156, cited in Petry, “§ 1.04[2], Tax Characteristics of a Patentable Invention.” It should be noted that accounting authorities in the U.S. recognize two income approach variations—i.e., traditional and expected cash flow. See “Appendix E,” Statement of Financial Accounting Standards No. 142, Financial Accounting Standards Board of the Financial Accounting Foundation, Norwalk Connecticut, June 2001. In its traditional form, a single discount rate and a single set of cash flows are used to reflect all the expectations about the future cash flows. In the probabilistic variation, the analyst develops alternative DCF scenarios and then estimates the probability of each. The discount rate in a probabilistic model should be less than that in a traditional model, by an appropriate amount, to avoid double counting risks. (As discussed in the author’s previous article entitled “Professional Patent Appraisal,” Business Valuation Review, American Society of Appraisers, March 2002, pp. 25–32.)


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