Does Lord Darcy Yet Live - The Case against Software and Business-Method Patents

Jay Dratler Jr.

Follow this and additional works at: http://digitalcommons.law.scu.edu/lawreview

Part of the Law Commons

Recommended Citation

This Article is brought to you for free and open access by the Journals at Santa Clara Law Digital Commons. It has been accepted for inclusion in Santa Clara Law Review by an authorized administrator of Santa Clara Law Digital Commons. For more information, please contact sculawlibrarian@gmail.com.
DOES LORD DARCY YET LIVE?
THE CASE AGAINST SOFTWARE AND BUSINESS-METHOD PATENTS

Jay Dratler, Jr.*

I. THE DIVIDING LINE BETWEEN PROHIBITED MONOPOLY AND PERMISSIBLE PATENTS: TECHNOLOGICAL RISK
II. DO SOFTWARE PATENTS ENTAIL TECHNOLOGICAL RISK?
III. TECHNOLOGICAL RISK AND BUSINESS METHODS
IV. THE FEDERAL CIRCUIT'S QUEST FOR CERTAINTY: A REFUSAL TO EXERCISE DISCRIMINATING JUDGMENT?
V. CONCLUSION

More than four centuries ago, Queen Elizabeth I had a brilliant idea. She wanted to reward loyal subjects who had rendered special service to the Crown. Yet new land was becoming scarce, and nascent democracy prevented taxing the many to reward the few. So how could the Queen meet her goal?

The idea she conceived was startling in its simplicity. She would grant her favored subjects a monopoly—the exclusive right to manufacture and sell common articles of commerce, such as soap and playing cards, although those subjects had not invented them. By exploiting these monopolies, the favored

---

* Goodyear Professor of Intellectual Property, University of Akron School of Law; J.D., Harvard Law School; Ph.D., University of California at San Diego; M.S., University of California at San Diego; A.B., University of California. I would like to acknowledge the helpful suggestions of my colleagues here at the University of Akron on early drafts of this article. The suggestions of A. Samuel Oddi, Giles Sutherland Rich Professor of Intellectual Property, and Richard L. Aynes, Dean and Professor of Law, were particularly helpful. I would also like to acknowledge my copyright professor of some twenty-four years ago, Professor Arthur Miller of Harvard Law School, whose insightful questions back then got me thinking, and kept me thinking, about the appropriate regime of intellectual property protection for computer programs.

1. See 1 WILLIAM C. ROBINSON, THE LAW OF PATENTS FOR USEFUL INVENTIONS 6-7 (photo. reprint 1972) (1890) (describing effects of Crown-granted monopolies on
grantees could use the laws of economics to extract their own rewards from the public.2

Armed with modern economic theory, we understand much better today how the Queen's scheme was supposed to work. As compared to competition, monopoly produces higher prices and a lower output of goods or services.3 It also transfers wealth from consumers to producers, in the process producing some "dead loss" in social welfare.4 The result is, among other things, an indirect "tax" on the public, which must pay the higher prices, to the monopolist's benefit. No doubt Queen Elizabeth did not understand these points with today's near-mathematical precision. Yet she seemed to understand that monopoly would allow favored grantees to charge higher prices than competition would have allowed and therefore to reap greater profit.5

Unfortunately for the Queen, her plan did not reckon with the rise of democracy and the rule of law. The matter came to a head in the case of Lord Darcy, to whom the Queen had granted the exclusive right to make and sell playing cards, although Lord Darcy had not invented them or anything about them.6 In 1602, in Darcy v. Allein, the King's Bench declared this grant contrary to the common law and therefore void.7 Twenty-one years later, the English Parliament passed the Statute of Monopolies, declaring crown-granted monopolies generally contrary to the common law and void.8 So ended the Crown's flirtation with

---

2. See ROBINSON, supra note 1, at 7 (photo. reprint 1972) (1890) (describing effects of monopolies on such things "as salt, iron, powder, vinegar, bottles, saltpetre, oil, starch, and paper"); see also PETER MEINHARDT, INVENTIONS, PATENTS AND MONOPOLY 30-36 (1946) (discussing the history of British patent law).


4. See id. at 174. (A "dead loss" is a loss to both consumers and producers. In a monopoly, it represents goods that, because the monopolist would overprice them as compared to a competitive producer, the monopolist does not sell and consumers do not buy.)

5. Modern economic theory is well supported by the actual effects of Crown-granted monopolies in raising prices and reducing output. See, e.g., ROBINSON, supra note 1, at 6-7.


indirect taxation through monopoly.

To the student of antitrust law, the English Statute of Monopolies that ended this gambit is startling in its modernity. Every major feature of modern antitrust law appears in it. Among other things, it has a general prohibition against monopoly, a reluctance to define the term too closely (lest a precise definition be circumvented), trust in common-law courts and juries to apply the prohibition, and awards of treble damages and costs to aggrieved parties. Reading the Statute of Monopo-

9. The Statute of Monopolies provides the following:

And be it declared and enacted by authority of this present Parliament, That all Monopolies, and all Commissions, Grants, Licences, Charters and Letters Patents heretofore made or granted, or hereafter to be made or granted, to any Person or Persons, Bodies Politick or Corporate whatsoever, of or for the sole Buying, Selling, Making, Working or Using of any Thing within this Realm... are altogether contrary to the Laws of this Realm, and so are and shall be utterly void and of none Effect, and in no wise to be put in Use or Execution.

Statute of Monopolies, 21 Jam., c. 3, § 2, reprinted in 4 STATUTES OF THE REALM, supra note 8, at 1212. *Compare* Statute of Monopolies with Act of July 2, 1890 (Sherman Act), ch. 647 § 2, 26 Stat. 209, 209 (current version at 15 U.S.C. § 2 (2000)) ("Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a felony ... ").


11. The Statute of Monopolies provides:

And be it further declared and enacted by the Authority aforesaid, That all Monopolies, and all such Commissions, Grants, Licences, Charters, Letters Patents, Proclamations, Inhibitions, Restraints, Warrants of Assistance, and all other Matters and Things tending as aforesaid, and the Force and Validity of them and of every of them, ought to be and shall be for ever hereafter examined, heard, tried and determined by and according to the Common Laws of this Realm, and not otherwise.


Any person who shall be injured in his business or property by reason of anything forbidden in the antitrust laws may sue therefor in any district court of the United States in the district in which the defendant resides or is found or has an agent, without respect to the amount in controversy, and shall recover threefold the damages by him sustained, and the cost of suit, including a reasonable attorney's fee.

Id. § 4.

12. Section 4 of the Statute of Monopolies provides:

And be it further enacted by the Authority aforesaid, That if any Person or
lies today thus gives one the distinct impression that not much besides detail has changed in basic economic law in nearly four centuries.

Yet the Statute of Monopolies differs from modern antitrust law in one important respect. It contains what we now know as intellectual property—patents and a precursor to copyrights—as explicit exceptions to its general prohibition on state-granted monopolies. It carved out of its general prohibition against

Persons at any Time... shall be hindered, grieved, disturbed or disquieted, or his or their Goods or Chattels any way seized, attached, distrained, taken, carried away or detained, by Occasion or Pretext of any Monopoly, or of any such Commission, Grant, Licence, Power, Liberty, Faculty, Letters Patents, Proclamation, Inhibition, Restraint, Warrants of Assistance, or other Matter or Thing tending as aforesaid, and will sue to be relieved in or for any of the Premises; That then and in every such Case, the same Person and Persons shall and may have his and their Remedy for the same at the Common Law, by any Action or Actions to be grounded upon this Statute; the same Action and Actions to be heard and determined in the Courts of King's Bench, Common Pleas and Exchequer or in any of them... wherein all and every such Person and Persons... shall recover three Times as much as the Damages which he or they sustained by means or occasion of being so hindred, grieved, disturbed, or disquieted, or by means of having his or their Goods or Chattels seized, attached, distrained, taken, carried away or detained, and double Costs.


13. The first true copyright statute was not enacted until nearly a century later. See Statute of Anne, 1710, 8 Ann. c. 19, reprinted in 9 STATUTES OF THE REALM, supra note 8, at 256.

14. The Statute of Monopolies describes the excepted intellectual property in the following manner:

[B]e it declared and enacted, that any Declaration before-mentioned shall not extend to any Letters Patents and Grants of Privilege for the Term of fourteen Years or under, hereafter to be made, of the sole Working or Making of any manner of new Manufactures within this Realm, to the true and first Inventor and Inventors of such Manufactures, which others at the Time of Making such Letters Patents and Grants shall not use, so as also they be not contrary to the Law, nor mischievous to the State, by raising Prices of Commodities at home, or Hurt of Trade, or generally inconvenient; the said fourteen Years to be accounted from the Date of the first Letters Patents, or Grant of such Privilege, hereafter to be made, but that the same shall be of such Force as they should be, if this Act had never been made, and of none other... Provided also, and be it enacted, That this Act, or any Declaration, Provision, Disablement, Penalty, Forfeiture, or other Thing before-mentioned, shall not extend to any Letters Patents or Grants of Privilege heretofore made, or hereafter to be made, of, for or concerning Printing.

Statute of Monopolies, 21 Jam., c. 3, §§ 6, 10, reprinted in 4 STATUTES OF THE REALM, supra note 8, at 1213. The Statute of Monopolies also contained a similar exception for patents previously granted for a term of twenty-one years or more, upon the condition that their terms be limited to twenty-one years. See id. § 5.
monopoly an exception for
any Letters Patents and Grants of Privilege for the Term of
fourteen Years or under, hereafter to be made, of the sole
Working or Making of any manner of new Manufactures
within this Realm, to the true and first Inventor and Inven-
tors of such Manufactures, which others at the Time of Mak-
ing such Letters Patents and Grants shall not use.\textsuperscript{15}

It thus recognized explicitly, over 150 years earlier, what the
Patent and Copyright Clause of the United States Constitution\textsuperscript{16}
recognizes implicitly: monopolies on existing articles of com-
merce are bad,\textsuperscript{17} but temporary\textsuperscript{18} monopolies on innovations

\textsuperscript{15} Statute of Monopolies, 21 Jam., c. 3, § 6, reprinted in 4 STATUTES OF THE
REALM, supra note 8, at 1213; see also statute quoted supra note 14.

\textsuperscript{16} Ratified in 1791, the Patent and Copyright Clause of the United States Con-
stitution authorizes the Congress, "[t]o promote the Progress of Science and useful
Arts, by securing for limited Times to Authors and Inventors the exclusive Right to
their respective Writings and Discoveries." U.S. CONST. art. I, § 8, cl. 8.

\textsuperscript{17} It is generally recognized that this Clause contains implicitly a prohibition
against state-granted monopolies for purposes other than "promot[ing] the Pro-
gress of Science and useful Arts." \textit{Id.} See Graham v. John Deere Co., 383 U.S. 1, 5-6
(1966), for a discussion of the contours of the U.S. Constitution’s Patent and Copy-
right Clause:

The clause is both a grant of power and a limitation. This qualified author-
ity, unlike the power often exercised in the sixteenth and seventeenth cen-
turies by the English Crown, is limited to the promotion of advances in the
"useful arts." It was written against the backdrop of the practices—
eventually curtailed by the Statute of Monopolies—of the Crown in grant-
ing monopolies to court favorites in goods or businesses which had long
before been enjoyed by the public. The Congress in the exercise of the pat-
ent power may not overreach the restraints imposed by the stated constitu-
tional purpose. Nor may it enlarge the patent monopoly without regard to
the innovation, advancement or social benefit gained thereby. Moreover,
Congress may not authorize the issuance of patents whose effects are to
remove existent knowledge from the public domain, or to restrict free ac-
cess to materials already available. Innovation, advancement, and things
which add to the sum of useful knowledge are inherent requisites in a pat-
tent system which by constitutional command must "promote the Progress
of . . . useful Arts." This is the standard expressed in the Constitution and
it may not be ignored. And it is in this light that patent validity "requires
reference to a standard written into the Constitution."

\textit{Id.} at 6, 16 (citations omitted); see also \textit{Bonito Boats, Inc. v. Thunder Craft Boats, Inc.,
489 U.S. 141, 151, (1989), where the Court writes:

The attractiveness of [patent law], and its effectiveness in inducing creative
effort and disclosure of the results of that effort, depend almost entirely on
a backdrop of free competition in the exploitation of unpatented designs
and innovations. The novelty and nonobviousness requirements of pat-
entability embody a congressional understanding, implicit in the Patent
Clause itself, that free exploitation of ideas will be the rule, to which the
protection of a federal patent is the exception.

\textit{Id.} at 151.
may be necessary to provide an incentive to create them.

In limiting excepted innovations to "new Manufactures within this Realm . . . which others at the Time of Making such Letters Patents and Grants shall not use," the Statute of Monopolies also suggested two important features of modern patent law. First, it suggested that the subjects of a legitimate patent monopoly must be made by Man, not a natural law or product of nature—a rule that American patent law still observes today. Second, it suggested that patentable inventions must be "new" and not earlier used, i.e., they must be true innovations. This fundamental requirement is not only part of our nation's patent law, but a fundamental international norm.

18. The Constitution permits Congress to grant patent and copyright protection only "for limited Times." U.S. CONST. art. I, § 8, cl. 8; see also supra note 16; cf. Eldred v. Ashcroft, 123 S. Ct. 769, 778-81 (2003) (implicitly recognizing that Congress may not grant perpetual copyright protection, but holding that retroactive extension of existing copyrights by 20 years did not do so); id. at 800 (Stevens, J., dissenting) (noting that "[t]he express grant of a perpetual copyright would unquestionably violate the textual requirement that the authors' exclusive rights be only 'for limited Times,'" and arguing that statutory extension reached same illegitimate end indirectly).


The laws of nature, physical phenomena, and abstract ideas have been held to be unpatentable. Thus, a new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, Einstein could not patent his celebrated law that E=mc²; nor could Newton have patented the law of gravity. Such discoveries are "manifestations of . . . nature, free to all men and reserved exclusively to none."

Chakrabarty, 447 U.S. at 309 (citations omitted) (quoting Funk Bros., 333 U.S. at 130).


22. See Agreement on Trade-Related Aspects of Intellectual Property Rights, art. 27:1, Annex 1C to Agreement Establishing the World Trade Organization [hereinafter TRIPS Agreement], reprinted in 1 H.R. DOC. No. 316, at 1621, 1633 (1994) (noting that, subject to member States' right to make certain exclusions, "patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step, and are capable of industrial application") (footnote omitted). The omitted footnote accommodates United States law by permitting "the terms 'inventive step' and 'capable of industrial application' [to] be deemed by a Member to be synonymous with the terms 'nonobvious' and 'useful' respectively." Id. art. 27:1 n.5; see also 35 U.S.C. § 101
Our Patent and Copyright Clause echoed these basic principles by requiring intellectual property protection to be "for limited Times" and "[t]o promote the Progress of Science and useful Arts."23

It is odd that the Statute of Monopolies expresses far more directly than our Constitution the relationship of rule and exception between antitrust and intellectual property law. For the statute was no stranger to those who helped shape our Constitution. Thomas Jefferson was so opposed to monopolies that he wanted to include a prohibition against them in the Bill of Rights.24 As our Supreme Court has noted in a key patent decision,25 Jefferson later approved the Patent and Copyright Clause, which granted Congress the power to enact temporary monopolies to encourage innovation and creativity, but he did so only after James Madison convinced him that "ingenuity deserves liberal encouragement."26 Given this history, it seems a mere

(2000) (permitting patents for "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof"); 35 U.S.C. § 103(a) (2000) (setting forth requirement that patentable invention have been "nonobvious" to person of ordinary skill in the art at the time it was made); infra note 185 (quoting § 103(a)). See generally 1 DRATLER, supra note 21, § 2.03 (discussing in depth three fundamental substantive criteria for patent protection in United States: novelty, utility, and nonobviousness).

23. See supra note 16.


I sincerely rejoice at the acceptance of our new constitution by nine states. It is a good canvas, on which some strokes only want retouching. What these are, I think are sufficiently manifested by the general voice from North to South, which calls for a bill of rights. It seems pretty generally understood that this should go to Juries, Habeas corpus, Standing armies, Printing, Religion, and Monopolies. I conceive there may be difficulty in finding general modification of these suited to the habits of all the states. But if such cannot be found then it is better to establish trials by jury, the right of Habeas corpus, freedom of the press and freedom of religion in all cases, and to abolish standing armies in time of peace, and Monopolies, in all cases, than not to do it in any. The few cases wherein these things may do evil, cannot be weighted against the multitude wherein the want of them will do evil . . . . The saying there shall be no monopolies lessens the incitements to ingenuity, which is spurred on by the hope of a monopoly for a limited time, as of 14 years; but the benefit even of limited monopolies is too doubtful to be opposed to that of their general suppression.


quirk of fate that our Patent and Copyright Clause expresses the rule—that monopolies are bad—only by negative implication, while explicitly stating the exception to the rule—that patents and copyrights may be good. It took the United States yet another 100 years for the main principle of the Statute of Monopolies to appear as positive law in our Sherman Act of 1890.27

Yet despite the United States' late start in making the rule of free competition explicit in its law, the principles of competition have proved their worth in the court that counts the most: the real world. From a standing start in the Statute of Monopolies of 1623, the principles of legally-enforced free competition—"antitrust law" in the United States, "competition law" in Europe, and anti-monopoly law in Japan—have swept the industrially developed world.28 In four centuries, the legal-economic principles spawned by a small island nation have come to dominate the world, precisely because they are based upon the primacy of competition.29


The stipulation that patent and copyright protection be granted only "for limited Times," only to "authors" and "inventors," and only "[t]o promote the Progress of Science and useful Arts," appears to have been aimed at preventing the kinds of abuses that had prompted the Statute of Monopolies 150 years earlier. It is clear that many of the Framers were concerned with restraining monopolies of all kinds.

Id. at 691.

28. For an overview of competition law in these three jurisdictions, with emphasis on major points of similarity and difference, see JAY DRATLER, JR., LICENSING OF INTELLECTUAL PROPERTY §§ 5.01, 5.02[1], [4], 5.03, 7.01 (rel. 15, 2002) (1994).

29. Competition in business and the marketplace is the prime motivating factor in antitrust law. See Nat'l Soc'y of Prof'l Eng'rs v. United States, 435 U.S. 679, 695 (1978), in which the Court states:

The Sherman Act reflects a legislative judgment that ultimately competition will produce not only lower prices, but also better goods and services.... The assumption that competition is the best method of allocating resources in a free market recognizes that all elements of a bargain—quality, service, safety, and durability—and not just the immediate cost, are favorably affected by the free opportunity to select among alternative offers. Even assuming occasional exceptions to the presumed consequences of competition, the statutory policy precludes inquiry into the question whether competition is good or bad.

Id.; see also, e.g., Nat'l Collegiate Athletic Ass'n v. Board of Regents of the Univ. of Okla., 468 U.S. 85, 104 (1984) (noting that "whether the ultimate [antitrust] finding is the product of a presumption or actual market analysis, the essential inquiry remains the same—whether or not the challenged restraint enhances competition").
One can argue incessantly, of course, about the real reasons for Anglo-American economic dominance since the Industrial Revolution. It may have been better education; it may have been the benefits of representative democracy; it may have been the Protestant (and immigrant) work ethic. But no objective view of history can ignore the strong possibility that free markets fueled by competition—and the unrelenting hard work that they inevitably foster—brought us to where we are today.

For participants in a competitive economy, competition is no fun. It is a relentless, grueling, often brutal, and ever-demanding struggle for economic survival, in which a single misstep can devalue a lifetime of hard work. For this reason, private actors continually seek to shelter themselves from the harsh wind of competition through private restraint and government largesse. This wholly understandable private impulse to escape the rigors of competition—which, if indulged by society, would cause economic stagnation—is the reason for our antitrust laws. Those laws are the whip that keeps industry striving in continual, self-interested rivalry, despite the natural human desire to rest.

This brief historical background suggests that the task of balancing competition (and the concomitant prohibition on monopoly) against the legal protection of intellectual property is of vital importance in economic law. The Statute of Monopolies

United States v. Philadelphia Nat’l Bank, 374 U.S. 321, 372 (1963) ("Subject to narrow qualifications, it is surely the case that competition is our fundamental national economic policy, offering as it does the only alternative to the cartelization or governmental regimentation of large portions of the economy.").

30. Perhaps the best judicial description of the process was penned by Judge Easterbrook in the famous “egg case”:

Rivalry is harsh, and consumers gain the most when firms slash costs to the bone and pare price down to cost, all in pursuit of more business. Few firms cut price unaware of what they are doing; price reductions are carried out in pursuit of sales, at others’ expense. Entrepreneurs who work hardest to cut their prices will do the most damage to their rivals, and they will see good in it. You cannot be a sensible business executive without understanding the link among prices, your firm’s success, and other firms’ distress. If courts use the vigorous, nasty pursuit of sales as evidence of a forbidden “intent,” they run the risk of penalizing the motive forces of competition.

A.A. Poultry Farms, Inc. v. Rose Acre Farms, Inc., 881 F.2d 1396, 1401-02 (7th Cir. 1989) (citations omitted).

31. After half a century, Professor Schumpeter’s wind metaphor is still as valid as ever. See JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 84 (3d ed. 1950) (describing competition as “the perennial gale of creative destruction”).
phrased these two values neatly as rule and exception. Although far less elegantly, the Patent and Copyright Clause, when combined with its own negative implication and the Sherman Act, did the same.

Neither the English nor the American law, however, sought to specify how to draw an appropriate balance between rule and exception. Nor could they. When Parliament adopted the Statute of Monopolies in 1623, modern science and technology were still in the womb. Galileo’s discovery of the heliocentric solar system, and with it the experimental-observational method of science, had yet to achieve wide acceptance. Chemistry was not as we know it today, but was closer to alchemy. All the basic tenets of science that we take for granted today—electromagnetism, subatomic particles, quantum mechanics, evolution, and the chemical basis of life—lay in the future, as did the resulting technological discoveries: electricity, electric lighting, radio, television, antisepsis, surgery, telephones, x-rays, aeronautics, astronautics, and biotechnology. The innovations of the seventeenth century consisted primarily of simple mechanical and optical devices for agriculture, industry, warfare, and navigation.

Parliament merely recognized a fundamental, objective principle of economics: that monopolies are bad and to be prohibited, except when they encourage the creation of something new, the creation of which requires economic encouragement. The same principle applies today.

32. See supra notes 8-12 and accompanying text for discussion of the Statute of Monopolies.
33. The English courts’ and Parliament’s recognition of the objective laws of economics made an historically striking juxtaposition with the Catholic Church’s reaction to Galileo’s introduction of the “experimental method” of scientific discovery. Both events marked departures from traditional thinking based upon faith and intuition in favor of observation of objective reality, and both occurred at precisely the same historical epoch. Yet the two met with very different receptions in their respective governmental jurisdictions. In the decade before Parliament adopted the Statute of Monopolies, the Church put Galileo under the Inquisition and prohibited him from engaging in further scientific research. See BERNARD GRUN & WERNER STEIN, THE TIMETABLES OF HISTORY 275, 277 (new 3d rev. ed. 1991) (reporting Galileo’s first subjection to Inquisition in 1615 and research prohibition in 1616). A clearer difference among polities in the type of intelligent, adaptive behavior that promotes the survival of our species would be hard to find.
34. Lavoisier was not to produce the first table of chemical elements (composed of thirty-one different elements) until 1790, and Mendeleyev did not introduce the modern periodic table of elements until 1869. See id. at 367, 433.
35. See A. Samuel Oddi, Beyond Obviousness: Invention Protection in the Twenty-
Despite their genius, the leading minds of those earlier times could scarcely imagine the scope of science, technology, and industry today. Whole realms of modern science, such as atomic and molecular physics, organic chemistry, physical chemistry, electronics, and biotechnology simply did not exist when the Statute of Monopolies was adopted. The same is true of much of modern technology and industry. Yet now, as then, the basic question of policy remains the same: how to distinguish ventures in ordinary business and commerce, in which competition should reign supreme, from the invention of "new manufactures" not before used, which needs and deserves the incentive of a temporary state-granted monopoly.

Two recent developments in patent law put this question in stark relief. Despite the misgivings of a reluctant and begrudging Supreme Court, the Federal Circuit has thrown the door

First Century: A Review of Recent Decisions of the United States Court of Appeals for the Federal Circuit, 38 AM. U. L. REV. 1097, 1101 (1989) (recognizing, based on review of economic literature, as "of general accord" the proposition "that a patent system produces a net benefit to society provided patents are granted only for those inventions induced by the patent system," i.e., "ones that would not have been made but for the availability of patents").

36. The Supreme Court has addressed software-related inventions in only three decisions. See Diamond v. Diehr, 450 U.S. 175 (1981); Parker v. Flook, 437 U.S. 584 (1978); Gottschalk v. Benson, 409 U.S. 63 (1972). In two of them—Benson and Flook—the Court ruled that the inventions at issue were not patentable subject matter because patents would have amounted to monopolies on a mathematical algorithm or formula. Flook, 437 U.S. at 594-95; Benson, 409 U.S. at 71-72. Only in Diehr did the Court uphold a patent, and it did so expressly because the invention (a process for curing rubber in a mold) involved physical systems and significant "post-solution" activity in addition to the computer program itself. Diehr, 450 U.S. at 187, 191-92. Thus, the decision was explicitly founded on the fact that the computer program was but part of a larger physical process. As the Court described its reasoning:

[T]he respondents here do not seek to patent a mathematical formula. Instead, they seek patent protection for a process of curing synthetic rubber. Their process admittedly employs a well-known mathematical equation, but they do not seek to pre-empt the use of that equation. Rather, they seek only to foreclose from others the use of that equation in conjunction with all of the other steps in their claimed process. These include installing rubber in a press, closing the mold, constantly determining the temperature of the mold, constantly recalculating the appropriate cure time through the use of the formula and a digital computer, and automatically opening the press at the proper time.

Id. at 187. The Court also attempted to distinguish this case from both Flook and Benson:

We view respondents' claims as nothing more than a process for molding rubber products and not as an attempt to patent a mathematical formula. We recognize, of course, that when a claim recites a mathematical formula (or scientific principle or phenomenon of nature), an inquiry must be made
into whether the claim is seeking patent protection for that formula in the abstract. A mathematical formula as such is not accorded the protection of patent laws and this principle cannot be circumvented by attempting to limit the use of the formula to a particular technological environment. Similarly, insignificant post-solution activity will not transform an unpatentable principle into a patentable process.

Id. at 191-92 (citations omitted). This last passage, explicitly reaffirming the subject matter rejections in *Flook* and *Benson*, demonstrates the severe limitations of the Supreme Court’s tolerance for software-related patents. For a more complete discussion of how narrow it was, see 1 *DRATLER*, supra note 21, § 2.02[2][b][i]. For an excellent analysis of how inconsistencies and anomalies in these three seminal opinions led to confusion and inconsistency in the lower courts, see Robert A. Kreiss, *Patent Protection for Computer Programs and Mathematical Algorithms: The Constitutional Limitations on Patentable Subject Matter*, 29 N.M. L. REV. 31, 33-48 (1999).

37. In three decisions, beginning with *In re Alappat*, 33 F.3d 1526 (Fed. Cir. 1994) (en banc), the Federal Circuit essentially threw out all previous attempts (largely unsuccessful) at line drawing and opened the door to any computer-program-related invention that produces a “useful, concrete, and tangible result.” *Id.* at 1544 (holding that general-purpose display using programmed mathematical formula to smooth waveform was not “[A] disembodied mathematical concept which may be characterized as an ‘abstract idea,’ but rather a specific machine to produce a useful, concrete, and tangible result.”). *See also* State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368, 1371, 1373 (Fed. Cir. 1998) (approving as patentable subject matter “system” using programmed general-purpose computer to calculate daily routine accounting items for hub-and-spoke investment partnership, and explicitly “hold[ing] that the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces ‘a useful, concrete and tangible result’”) (quoting *Alappat*, 33 F.3d at 1544); AT&T Corp. v. Excel Communications, Inc., 172 F.3d 1352, 1359 (Fed. Cir. 1999) (reversing subject-matter invalidation of patent on “process” for adding field to telephone-call message-control records to specify, using simple Boolean logic, whether and how primary inter-exchange carrier is used, and basing decision on conclusion that, “after Diehr and Alappat, the mere fact that a claimed invention involves inputting numbers, calculating numbers, outputting numbers, and storing numbers, in and of itself, would not render it nonstatutory subject matter, unless, of course, its operation does not produce a ‘useful, concrete and tangible result’”) (quoting *State St. Bank*, 149 F.3d at 174; quoting *Alappat*, 33 F.3d at 1544).

The Federal Circuit also suggested that any computer programming converts a general-purpose computer into a “new machine” that may be patentable. *See Alappat*, 33 F.3d at 1545 (noting with approval prior holdings that “programming creates a new machine, because a general purpose computer in effect becomes a special purpose computer once it is programmed to perform particular functions pursuant to instructions from program software”) (citations omitted).

Other commentators agree, as these quoted excerpts suggest, that these decisions impose little or no limitations on the patenting of inventions that are, or use, computer programs. *See* Kreiss, *supra* note 36, at 73 (noting that the current liberal trend toward patenting is inconsistent with the Supreme Court’s decisions but nevertheless encouraging it); John R. Thomas, *The Patenting of the Liberal Professions*, 40 B.C. L. REV. 1139, 1153-55, 1175-85 (1999) (recognizing same trend but recommending its reversal through remedial restrictions or importing the foreign requirement
time, it has endorsed patents on new business methods,\textsuperscript{38} deeming that a supposed prohibition against such patents never really existed.\textsuperscript{39} Then Congress, in an amendment to the patent statute ostensibly designed to limit such patents,\textsuperscript{40} has by implication endorsed them.\textsuperscript{41}

On its face, each of these developments appears to have shifted the delicate balance between free competition for business in general and temporary monopoly for genuine innovation, which the Statute of Monopolies decreed and the Patent and Copyright Clause continued. In modern industry, virtually every business uses computer programs in its operations. If computer programs are patentable, and if patent law (as it now appears to do) permits broad claims to computer programs performing specified business functions—without any limiting details as to how those functions are performed—a person can monopolize a particular line of business simply by being the first to write a computer program to perform the functions required in that line of business and broadly claiming the computer pro-

---

\textsuperscript{38} See State Street, 149 F.3d at 1375-77 (Fed. Cir. 1998) (taking the opportunity to "lay . . . to rest" what the court saw as an "ill-conceived exception" to patentable subject matter for business methods, and approving as patentable subject matter "system" for calculating routine accounting items for hub-and-spoke investment partnerships despite district court's finding that patent would be tantamount to monopoly of line of business using such partnerships); see also Thomas, supra note 37, at 1141, 1169, 1177 (recognizing and criticizing growing trend of expanding patentable subject matter to include business methods).

\textsuperscript{39} See State Street, 149 F.3d at 1375-76 (reviewing cases cited as creating "business-method" exception to patentable subject matter and finding them based on outmoded or different aspects of patent law).


\textsuperscript{41} The 1999 amendment was intended to absorb some of the negative economic impact of patent monopolies on business methods by granting a limited defense to persons who had used patented method in business at least one year before the effective filing date of the application on which the patent issued. See 1 DRATLER, § 2.02\[2]\[c]\[i][i] (discussing 35 U.S.C. § 273). Ironically—or perhaps intentionally—the amendment may have precisely the opposite effect by providing grist for argument that Congress considered and impliedly endorsed business-method patents. Prior to enactment of the "defense," there had been no sound basis on which such arguments could be made. See id.
gram in a patent. The same result can be achieved even more directly by patenting the essential features of the new line of business as a "business method." In either case, the result—monopolization of a line of business through development of related abstractions (software program or method)—does not obviously fall within a reasonable extrapolation of the exception to the prohibition against monopoly for "new manufactures" that the Statute of Monopolies endorsed and American law continued.

Two thoughtful articles have summarized and addressed these developments. Taking a doctrinal approach, Professor Kreiss has well and amply demonstrated the inconsistency, indeed incoherence, among the judicial decisions on software-related inventions in both the Supreme Court and lower courts. His proposed "solution," however, is to continue the trend begun by the Federal Circuit, overturning inconsistent Supreme Court precedent and expanding the scope of patent protection.

42. I am not alone in suggesting that this is precisely what happened in State Street. See infra Part III; see also Thomas, supra note 37, at 1157:

Signature's invention marked no advance in computer technology or mathematical calculations. The basis for patentability was the uniqueness of the investment package Signature claimed in its patent. The same functions could be performed, albeit less efficiently, by an accountant armed with pencil, paper, calculator, and a filing system.

Id. (footnote omitted) (quoting district court's opinion in State Street).

43. See infra Part IV.

44. See Thomas, supra note 37, at 1162:

It is one thing for courts to place biotechnologies and computer-related inventions within the patent system, but quite another to hold that business methods may be patented. One need only recall the techniques of the Hanseatic League or the theory of mercantilism to realize that such methods are far older than the patent system itself. Yet only recently has it been suggested that this sort of practical knowledge may be appropriated by way of the patent system.

Id. (footnotes omitted).

45. See Kreiss, supra note 36; Thomas, supra note 37.

46. See Kreiss, supra note 36, at 31-53 (1999) (discussing inconsistencies in detail); id. at 54 (indicating that the PTO's Guidelines, the United States Patent and Trademark Office Examination Guidelines for Computer-Related Inventions, 61 Fed. Reg. 7478 (Feb. 28, 1996), are "muddled because they track the inconsistency and the poor reasoning" of Federal Circuit and Supreme Court precedent).

47. Professor Kreiss recommends overruling Parker v. Flook, 437 U.S. 584 (1978): [T]his article urges the Supreme Court to overrule Flook and move in the direction taken by the Flook dissenters and the judges on the Federal Circuit who have apparently decided that they need not follow Flook. In its next decision, the Court should decide that claims involving mathematical calculations will generally be treated as patentable subject matter if those numbers are part of technological processes and represent real-world phe-
without apparent limit. Professor Thomas has recognized the dangers of such an expansive approach, but his solution is

Kreiss, supra note 36, at 72 (footnote omitted).

48. See id. at 66 ("In today's world, information processing and computer technologies are a major portion of the economy. There is no reason why the constitutional terms 'discoveries' and 'inventors' should not be expanded to include significant portions of these areas."); id. at 73 (listing nine applications of computer programs—such as air traffic control, medical diagnosis, seismographic prospecting, and detecting insurance fraud—and concluding that "[t]hese examples involve very practical uses of computers and are the kind of things that the patent system should encourage. It seems counter-productive to leave these things outside the subject matter of patents simply because they are primarily just mathematical calculations.").

Professor Kreiss' article focuses primarily on software-related inventions and does not treat business-method patents in depth. However, the article does suggest that the Constitution does not contemplate patents on business methods because they are not the types of "invention" or "discovery" that traditionally had been eligible for patent protection. Professor Kreiss writes:

This article has argued that the Constitution provides the limits of patentable subject matter, but the possibility that the Constitution may be indeterminate should not be ignored. If it is indeterminate, then we should rely upon our conventional understanding of what kinds of things must be patentable. In this context, the repeated comments made by courts, commentators, and the PTO over the years to the effect that business methods are not patentable subject matter should be taken as strong evidence that business systems are perceived to be far outside the bounds of the "useful arts." Similarly, the fact that patents have virtually never been sought for accounting systems and sports moves suggests that these should also be treated as far outside the scope of patentable subject matter. Sports and entertainment equipment, on the other hand, have been accepted as patentable subject matter for a long time and a deference to this conventional view is equally appropriate.

Id. at 85-86 (footnote omitted).

49. Professor Thomas writes:

Among the more reviled Patent Office grants has been its 1968 patent on a method of swallowing a pill. Now we need scant imagination to envision patents on corporate ingestion of poison pills as well. With business and medical techniques firmly under wing, and patents on sports methods and procedures of psychological analysis trickling out of the Patent Office, patents appropriating almost any sort of communicable practice seem easily attainable. Claims to methods within the disciplines of sociology, political science, economics and the law appear to present only the nearest frontier for the regime of patents. Under increasingly permissive Federal Circuit case law, techniques within such far-flung disciplines as language, the fine arts and theology also now appear to be within the realm of patentability.

Thomas, supra note 37, at 1163-64 (footnotes omitted); see also id. at 1141 ("The decision to subject particular areas of endeavor to the patent system is...of great moment, in effect subjecting entire industries to a private regulatory environment with constantly shifting contours."); id. ("[T]he trend toward accepting business-method patents] is a disturbing one, for unlike breakthroughs in computer or biotechnologies, business methods are vastly older than the patent system itself.").
He attempts to cabin patent protection by providing a restrictive definition of the concept of "technology," derived from philosophical and social perspectives. He also makes a useful practical suggestion: incorporating the concept of "industrial application" into our law from European and Japanese patent law. While this suggestion of Professor Thomas may have some practical utility in the short term, in the long term it cannot solve the problem of line drawing that lies at the heart of the patent system. Our own courts have struggled with and abandoned the definitional approach, and attempts in both Europe and Japan to exploit the "industrial application" requirement to limit patent protection have been unsuccessful.

50. See id. at 1170 ("A reasoned epistemology of human activity that reflects both our sense of the technological order and the traditions of the patent system would allow us to better define those subject matters that can be patented and those that can not.").

51. See id. at 1162-63, 1166-67. Much of Professor Thomas' article is directed towards defining "what is technology." See id. at 1163-75; id. at 1170-73 (attempting to define "technology" for purposes of patent system by using modern epistemological definitions, and concluding that "[t]echnology is . . . concerned with design, fabrication and transformation" of matter and energy in the physical world).

52. See id. at 1178-80.

53. Among other things, it would make United States law literally consistent with the TRIPS Agreement and avoid the necessity of having a footnote in that international convention accommodating the peculiarities of our law. See sources cited supra note 22; see also Thomas, supra note 37, at 1178 (noting compatibility of "industrial application" requirement with TRIPS Agreement).

54. Professor Thomas himself recognized the difficulty of the definitional approach:

[A]rticulation of a useful typology between technology and other aspects of human culture has proven exceptionally difficult. Human engagement with the artificial is now so complete that distinguishing things that are technological from those that are not has perplexed not only the courts, but even epistemologists and the most accomplished of technological observers.

55. The last federal decision to rely heavily on defining "technology" was In re Musgrave, 431 F.2d 882, 893 (C.C.P.A. 1970) ("All that is necessary, in our view, to make a sequence of operational steps a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of 'useful arts.'"). As a concurring judge in that case noted, what lies within the "technological arts" is hardly self-evident. Id. at 895-96 (Baldwin, J., concurring) ("Promulgation of any all-encompassing definition has to be impossible . . . . I think it is apparent that what the majority has done will only substitute for one set of problems another possibly more complex set. Because the problems will be new, they will add confusion to the law.").

56. Professor Thomas himself describes the same sort of creeping expansion of the "industrial application" requirement in Europe and Japan that infected the
This article takes a different approach. As the juxtaposition of rule and exception in the Statute of Monopolies so amply demonstrates, both antitrust law (the rule) and intellectual property law (the exception) are facets of economic law. They are both intensely practical, and their effect in practice, to the extent it is beneficial, is almost entirely economic. Therefore any deviance or breakdown in either must be addressed using sound economic principles. Attempts to resolve the present difficulties of unclear and inconsistent doctrine by resorting to abstract philosophizing or legal definitions, without a firm foundation in economics, are as likely to succeed as were ancient astronomers in developing a heliocentric theory of the solar system without telescopes.

Accordingly, this article addresses the current explosion in patent coverage from an economic and practical perspective. It seeks sound economic principles, based upon the notion of entrepreneurial risk, to explain how the patent-law exception to the general prohibition on monopolies should be construed and to determine whether the exception, as properly extrapolated to modern science and technology, ought to encompass computer programs and business methods. Part I examines the nature of the balance between prohibited monopoly and the protection of intellectual property and concludes that the balance between rule (monopoly is bad) and exception (temporary patent protection may be good) depends on the concept of technological risk,
as distinguished from market risk. Part II examines computer programs, compares them to other modern innovations, as well as to the building of skyscrapers and bridges, and concludes that computer program development does not involve the same level of technological risk as do other industries now supported by patent protection. Part III examines business methods and concludes that, in general, their exploitation entails only market risk—a risk ordinarily left to free competition in the marketplace, not avoided by monopoly. Part IV explores how two interacting trends in the Federal Circuit—the "suggestion" test for nonobviousness and the court's reluctance to exercise judgment in determining patentable subject matter—exacerbate the problem of distinguishing innovations that need and deserve temporary monopoly for their creation from those that do not. Part V concludes with some observations about the results of current trends if continued.

I. THE DIVIDING LINE BETWEEN PROHIBITED MONOPOLY AND PERMISSIBLE PATENTS: TECHNOLOGICAL RISK

Like the words "discovery" and "invention," the word "innovation" has a wide range of meanings. Long tail fins on various makes and models of cars in the late 1950s were innovations, as were the sport utility vehicles (SUVs) of the 1990s. So were fifteen-year and variable-term mortgages and prepaid funerals. Without stretching the language too far, one could even characterize the opening of a supermarket or bank branch in a new community as an "innovation," especially if that community had no similar branch previously.

Yet few would argue that it would be good economic policy for all these "innovations" to have broad patent protection. Should the first private firm to produce a car with long tail fins or an SUV, the first bank to offer fifteen-year or variable-term mortgages, or the first undertaker to offer prepaid funerals have a twenty-year monopoly on them? Should the first supermar-
ket or bank to open a branch in a particular community have a monopoly on opening branches anywhere in that community? Traditionally these "innovations" in business and marketing have been left to the free market to exploit under the rule of competition, not the exception for patentable inventions.

To be sure, particular aspects of these innovations, or the means for providing them, might be patented. The particular shape of a tail fin might be the subject of a design patent, as might the details of the aesthetic design of a particular make and model of sport utility vehicle. Similarly, an improved engine for an SUV might merit a patent, as might an improved computer for the mortgage lender, funeral home, bank or supermarket. In the old words of the Statute of Monopolies, all these might qualify as "new Manufactures within this Realm," eligible for patent protection.

The distinction seems intuitive and relatively straightforward. The "ideas" of having long tail fins on cars or producing large, box-like vehicles with plenty of power and space for people and baggage are business concepts open to any business firm that can realize them. So are providing a shorter-term mortgage, providing prepaid funerals, or opening a branch in a particular community. Giving any single firm a monopoly of these ideas would be tantamount to granting a monopoly over a line of business, with the same bad effects as Queen Elizabeth I's granting monopolies over soap, salt and playing cards in the seventeenth century. The distinction between monopolies like these, which Anglo-American law has prohibited for almost four centuries, and "legitimate" patent monopolies over inventions lies at the heart of our economic law.

Yet how can we articulate a principled basis for this distinction? In addressing software-related innovations, the courts have tried and rejected so many formulas that the list appears endless.66

---

20 years from the patent application date. 35 U.S.C. § 154(a)(2) (2000). Because of complex rules for determining which application date governs in the event of multiple applications, as well as various possible adjustments to the patent term, computing the actual term of a particular patent is, in the general case, a matter of some complexity. See 1 DRATLER, supra note 21, § 2.05[2].


Perhaps the solution lies in considering the underlying purpose of the law. Why does the law make an exception, for true invention, to the general rule of free competition and its concomitant prohibition against monopoly? The answer has three parts.

The first and most important reason for excluding invention from the prohibition against monopoly is that invention itself promotes competition, which is the goal of prohibiting monopoly. Competition is fostered by stimulating inventive activity through, e.g., the need to design around a patented idea. Firms compete in part by innovating, and innovation advances competition. Thus innovation is not an end in itself, but a means to the same end that justifies the general prohibition against monopoly, namely, the promotion of consumer welfare through competition.67

Almost equally important, however, is a second reason: unless protected by temporary monopoly, innovation would not be economically rational and therefore would occur much less often. Innovation costs money. If competitors are free to copy the results of innovation, i.e., innovative products and services, they can offer those products and services without the "often enormous costs in terms of time, research, and development,"68

67. For elaboration of this point see DRATLER, supra note 28, §§ 6.01, 6.02[2] (discussing rules of free competition and protection of innovation as having complementary goals but using potentially conflicting means).

68. Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 480 (1974) ("The patent laws promote... progress by offering a right of exclusion for a limited period as an in-
undercut the innovator's prices, and destroy the innovator's market. If the law allows this to happen, firms and individuals will soon learn the rules of the game, decrease their investment in innovation, and increase their investment in copying. Capital will flow away from innovating industries and toward those that copy others' innovations. This is the generally accepted rationale for patents and copyrights, denoted in shorthand by the constitutional phrase requiring them to "promote the Progress of Science and useful Arts." 69

Yet understanding this point alone does not appreciably advance our inquiry. All business effort incurs costs and requires investment. These points are just as true of making tail fins or SUVs or building a new branch of a supermarket or bank as they are of finding a cure for cancer. Why should the inventor of the cure get a patent while the maker of the fins or SUV or the builder of the new branch does not?

To answer this question we must turn to a third, less often appreciated, feature of intellectual-property monopolies. The state-granted monopolies that patents and copyright provide are substantial in both geographic scope and duration. They apply throughout the United States, 70 and they last for substantial times—twenty years for patents 71 and as much as 150 years or more for copyrights. 72 In addition, patents may cover a broad range of subject matter, particularly on pioneering inventions.
including things that the patentee did not invent but that perform the same function in the same way.\textsuperscript{74} Why do inventors and authors need such substantial encouragement, when all the builder of a car, branch bank, or branch supermarket requires is a reasonable chance to recover costs plus a reasonable profit? In other words, why doesn’t intellectual property protection just reimburse innovators and creators for their sunk costs, plus a reasonable profit?

For an answer, we must turn to risk-reward theory. Modern economic theory teaches us that the reward for assuming a risk must be proportional to the risk undertaken if an entrepreneur is to be induced to assume the risk.\textsuperscript{75} The greater the uncertainty that a reward will be received, the greater that reward must be in order to motivate taking the risk and suffering the uncertainty.

The rewards offered by intellectual property monopolies are unlimited, but so are the risks.\textsuperscript{76} A book or movie that is a “hit” may garner tens or hundreds of millions of dollars in revenue within a few months or even weeks; a “flop” may fail to recover the cost of production. Similarly, the invention of a cure for cancer or AIDS will no doubt make the inventor rich, while the inventor of a hula hoop with rotating lights or a toothbrush with a light on the end likely will not recover the cost of getting a patent. Unless Anglo-American economic law is irrational (and the success of Anglo-American industry suggests it is not!), the fact that it provides potentially unlimited rewards suggests there is something unusual about the risks taken by innovators. So it is to risk that we now turn.

All businesses take risks. The Edsel maker took a risk in designing and producing an ugly car with long, prominent tail fins. An SUV maker takes a risk in building a plant to produce yet another 50,000 large, gas-guzzling mobile boxes per year. The bank or supermarket takes a risk in planning, building and

\textsuperscript{74} Under the “doctrine of equivalents,” an accused device may infringe a patent even if the patent’s claims do not literally cover it, if the accused device “performs substantially the same function in substantially the same way to obtain the same result.” Graver Tank & Mfg. Co. v. Linde Air Products Co., 339 U.S. 605, 608 (1950) (quoting Sanitary Refrigerator Co. v. Winters, 280 U.S. 30, 42 (1929)). See generally 1 DRATLER, supra note 21, § 2.05[3][b][i] (discussing doctrine of equivalents).

\textsuperscript{75} See, e.g., JOHN CRAVEN, INTRODUCTION TO ECONOMICS: AN INTEGRATED APPROACH TO FUNDAMENTAL PRINCIPLES 248 (Basil Blackwell ed., 1984).

\textsuperscript{76} For elaboration of this point, see DRATLER, supra note 28, § 3.02[1].
opening a new branch in a community. How does the risk of an inventor or creator differ from these ordinary, pedestrian risks that every firm takes in every new business venture and in constructing every new plant and outlet?

The difference lies in the certainty of the projected outcome looking forward. The maker of cars or SUVs, or the builder of the new branch, knows at the outset that the job can be done. He or she can predict, at least roughly, the cost of completing the project and providing the desired product or service. Lightning or fire may destroy the plant or the nascent branch during construction, but those risks are remote and insurable.

The primary risk for the ordinary business firm is therefore market risk. Will consumers buy cars with long tail fins? Will they continue to buy gas-guzzling SUVs despite a faltering economy and increasing public concerns about the availability of fossil fuels and the pollution that they cause? Will consumers patronize a new branch of a supermarket or bank in a new community? The risk that consumers will not accept the results of these projects—whose successful conclusion (apart from market risk) is foreordained—is one that every business in a free market necessarily accepts.

In contrast, the true inventor does not know at the outset whether the job can be done at all, let alone what—if the job can be done—the cost of doing it might be. Can I find a cure for cancer, or AIDS? Can I power an automobile economically with a fuel cell? Can I use the sun’s source of energy, thermonuclear fusion, to generate electricity on Earth? Each of these questions has been the subject of decades of research and countless millions of dollars in investment, with no clear answers yet in sight.

The inventor’s type of risk, called “technological risk,” has two features that distinguish it from marketing or market-acceptance risk. First, unlike market risk, it addresses whether

77. Patent law already recognizes the distinction between technological and market risk in a different and much narrower context. Section 102(b) of the Patent Act—the so-called “one year statutory bar”—requires a patent applicant to file his patent application within one year after publishing his invention or putting it “in public use or on sale,” or forever forego the right to obtain a patent. See 35 U.S.C. § 102(b) (2000); see also 1 DRAFTER, supra note 21, § 2.03[1][b]. A judge-made exception to that bar excludes sales or uses in the course of experiments to perfect the invention. See id.; Elizabeth v. Am. Nicholson Pavement Co., 97 U.S. 126, 133-37 (1877) (seminal case holding six years’ use by public of “test section” of toll road paved by inventor on private property at his own expense was for experimental use and did not create bar to patent). The experiments, however, must be for the purpose of perfecting the invention technologically; if they are for the purpose of test-
the project at issue will work at all, for any purpose. Whereas the results of building a new production plant or a new bank or supermarket branch are predictable—and success in completing the project is normally foreordained, unless the money runs out—neither the results nor success in completion are predictable in genuine invention. Unlike building yet another car with long tail fins, yet another model of SUV, or yet another branch office in a new community, some things just cannot be done, at least not with current technology and scientific knowledge.

The second feature that distinguishes technical risk from market risk is the nature of the endeavor. Invention involving technical risk normally involves a question of science or technology. Distinguishing between patentable and unpatentable inventions on this basis, however, is fraught with definitional difficulties, and attempts at line drawing by defining "technology" have generally been unsuccessful. Accordingly, the first feature—risk of total failure—provides the best basis for a workable economic distinction.

The first feature also is notable economically because it justifies the potentially unlimited rewards of intellectual property protection. A business innovator whose project fails the test of market acceptance still has something. Long-finned Edsels and surplus SUVs may be unpopular, but they are still cars. They are capable of locomotion and therefore can be sold to consumers, perhaps in other countries, albeit at reduced prices. Their producer therefore may avoid a total loss of the investment in marketing or testing consumer acceptance, the judge-made "experimental use" exception does not apply. See, e.g., In re Smith, 714 F.2d 1127, 1135-36 (Fed. Cir. 1983) (holding that unsupervised household testing of "Powdered Carpet Composition" used in vacuum cleaning and related pricing survey was not experimental use); In re Theis, 610 F.2d 786, 792 (C.C.P.A. 1979) (testing of voice recording system involving comparative evaluation by customers was not experimental use); cf. Grain Processing Corp. v. Am. Maize-Products Co., 840 F.2d 902, 906 (Fed. Cir. 1988) (holding that manufacturer's shipment of small quantities of free samples of starch hydrolylates to food processors for short-term testing of possible adverse reactions with other food ingredients, which was customary in industry, was experimental use).


78. See supra text accompanying notes 48-56.
their production and perhaps even make a profit—albeit a smaller profit than the producer would have received had the vehicles enjoyed great popularity. Similarly, an unsuccessful branch supermarket or bank may still make money—and may eventually garner a profit if the community grows—even though its initial popularity may be low. Or the buildings and land may be sold for other uses, thereby avoiding a total loss of investment. In contrast, an inventor whose research-and-development project fails to produce a workable innovation usually has nothing, except perhaps some useful negative information about what not to do in the next experiment, and maybe some helpful hints for future research. In the general case, he or she has little or nothing that can be sold for value in the here and now. Without success, an inventive project and its sunk costs are virtually a total loss.

The same is true of copyrighted properties, but to a lesser extent. A failed book or movie is still a book or movie, but no one may want to read or see it. It differs from the long-finned cars, the surplus SUVs, and the new bank or supermarket branch in that it has no intrinsic useful function other than to entertain or educate. Consumer acceptance is the essence of its value; it therefore has little or no value if not accepted.

Investment sunk in a copyright is therefore at risk almost as totally as that in patentable innovation. There is, however, a difference of degree: while a failed book or movie may appeal to the tastes of a minority of consumers, a failed cure for cancer or non-operative means of powering an automobile are of no use other than to a technology museum or perhaps to subsequent inventors as advice on what not to do. In addition, copyrighted properties differ from patentable inventions in that their creation generally does not involve the application of scientific or technical principles; but, as we have seen, this criterion does not provide an economically useful distinction.

With this analysis, it becomes easier to discern the line between pedestrian business innovations that should be subject to the rule of free competition in the marketplace and inventions that need and deserve the special incentive of temporary monopolies. Business innovations are subject only to market risk, not technological risk. There is little or no risk that they will fail to work at all and so will fail to produce anything of market value. Even surplus hula-hoops have some value as toys, or simply as scrap for recycling plastic, and therefore their un-
timely producer may avoid a total loss. Similarly, most real products and services have some intrinsic or residual value, whatever their level of market acceptance. Though lack of consumer acceptance may decrease their value from that planned or anticipated, that lack is unlikely to reduce the innovations’ economic value to zero. Their intrinsic or residual value allows their producer to make a small profit or avoid a total loss, whatever the level of market acceptance.

In contrast, a patent-eligible inventive project is one that involves technological risk. At the outset of the project, there is a significant risk that the project will achieve no useful result whatsoever and that, regardless of market acceptance, the work and sunk investment will be a total loss. Thus, the inventor, as distinguished from the business innovator, faces a realistic possibility of a total loss, and he does so for technological, not economic, reasons.

This real risk of total loss explains the potentially unlimited rewards of patent protection. No rational entrepreneur would accept real technological risk, and therefore the risk of a total loss, in the mere hope of recovering costs or some fixed return set, for example, by a board or commission. The old Soviet system tried such a risk-reward system, and it failed to motivate innovation outside the richly-financed military sector. Why accept a risk of total loss in the hope of no profit or a small, fixed return when a “normal” profit is available from any ordinary business enterprise incurring no technological risk? A system providing no more than a fixed return in the face of unlimited risk will only motivate flows of capital away from risky inventive activity into ordinary business, in which risks are more limited and returns more secure. Only the hope of “ringing the bell” with a major, pioneering invention, and thereby earning potentially unlimited returns, can provide strong enough motivation for accepting real risks of total loss.

79. For more on this point, see Dratler, supra note 28, § 3.01[2].

80. Under the old Soviet system, which has been replaced by modern Russian intellectual property laws, most Russian inventors received “inventors’ certificates” (авторские свидетельства) rather than patents, under which their institutions controlled their inventions and provided them with fixed payments (usually lump sums) determined by a manager or committee. See Andrei A. Baev, Recent Changes in Russian Intellectual Property Law and Their Effect upon the Protection of Intellectual Property Rights in Russia, 19 SUFFOLK TRANSNAT’L L. REV. 361, 366-67 (1996).

81. Sometimes an inventor seeking one thing stumbles upon another. In that case, the inventive project may be a total loss insofar as concerns its original goal,
Not only does technological risk explain economically the potentially unlimited rewards of intellectual property protection. It also helps explain the differences in the strength of patent and copyright protection. Patent protection is strong and near absolute. The first inventor of a thermonuclear generator, for example, will have a monopoly on all thermonuclear generators that use equivalent means. In addition, the patent will prevent not only copying of the invention, but development of equivalent devices by independent research or reverse engineering of the patentee's products as well. In contrast, copyright protection is relatively narrow and weak. One author's copyright on a situation comedy, for example, does not prevent another author from developing a situation comedy, as long as the

but the serendipitous discovery may have some value. In rare cases the serendipitous discovery may have greater value than that anticipated for the project had it achieved its original goal. These facts, however, do not change the analysis in the text. From an economic perspective, the chance of a useful serendipitous discovery in the course of a research-and-development project may increase slightly the chance of a successful outcome, i.e., something other than a total loss. The increased chance of avoiding a total loss, however, does not belie the fact that the risk of total loss still exists and is very real.

Moreover, the very serendipity of the unexpected discovery renders it useless from the perspective of planning and investment. Since by definition the discovery could not have been anticipated and planned for, it cannot have influenced the decision to make the initial investment in the research-and-development project. At most, the small chance of making a valuable serendipitous discovery will, in the general case, increase the chance of avoiding a total loss by some small but unknown amount, but it can never eliminate the real risk of total loss, which requires the motivation of unlimited reward.

82. If a patent's claims "read on" an accused device, or if the accused device is "equivalent" to the invention claimed, patent law generally requires injunctive relief. See W.L. Gore & Assocs., Inc. v. Garlock, Inc., 842 F.2d 1275, 1281 (Fed. Cir. 1988) ("an injunction should issue once infringement has been established unless there is a sufficient reason for denying it") (citations omitted); Windsurfing Int'l, Inc. v. AMF, Inc., 782 F.2d 995, 1003 & n.12 (Fed. Cir. 1986) (where plaintiff and one defendant were both small companies whose primary business was producing patented products, failure to enjoin defendant's production upon finding infringement was abuse of discretion); KSM Fastening Sys., Inc. v. H.A. Jones Co., 776 F.2d 1522, 1524 (Fed. Cir. 1985) (stating that permanent injunction should be granted in ordinary case); Trans World Mfg. Corp. v. Al Nyman & Sons, Inc., 750 F.2d 1552, 1564-65 (Fed. Cir. 1984) (holding it abuse of discretion not to grant injunction against unauthorized use of patented design, unless jury awards damages for use over entire life of patent). See generally 2 DRATLER, supra note 21, § 13.01, [2].

83. See supra note 74.

84. See Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 490 (1974); 1 DRATLER, supra note 21, § 2.05 [1].

second author's expression differs from the first. The second author's work may even be identical without infringement, if the similarity derives from independent creation, not copying, or (in the case of computer programs) reverse engineering.

The economic rationale for the difference in this strength of protection lies in the different levels of risk. Unlike a failed invention, a failed copyrighted property is generally not totally worthless, and its sunk cost is not totally lost. The audience for a "flop" may be small, but as long as it does not vanish entirely, the copyrighted property has some value. Nor is the risk of the copyright proprietor technological risk, with its all-or-nothing character; rather, it is a special type of market risk, exacerbated by the fact that the "product" has no intrinsic value except by virtue of consumer acceptance. (Unlike an ugly or unpopular SUV, which can still provide useful transportation, a failed book or movie has little or no value, for its scrap value as paper or celluloid is normally negligible compared to its total production cost, including the cost of authorship.) Accordingly, with respect to risk, copyright-related projects occupy an intermediate level between ordinary, pedestrian business projects like building a plant or a new bank branch, on the one hand, and inventive projects with real technological risk and the real possibility of a total loss on the other.

The foregoing analysis suggests an economic basis for ex-

86. See generally 1 DRATLER, supra note 21, § 5.01[2][a].
87. See Sheldon v. Metro-Goldwyn Pictures Corp., 81 F.2d 49, 54 (2d Cir. 1936) ("[I]f by some magic a man who had never known it were to compose anew Keats’s Ode on a Grecian Urn, he would be an 'author,' and, if he copyrighted it, others might not copy that poem, though they might of course copy Keats's.").
88. See Mazer, 347 U.S. at 217-18 (comparing strength of copyright and patent protection); DRATLER, supra note 28, § 2.02 [1][a][ii], [b][i].
89. See, e.g., Sega Enterprises, Ltd. v. Accolade, Inc., 977 F.2d 1510, 1518, 1520, 1521-27 (9th Cir. 1992) (holding that intermediate copying and disassembly of copyrighted object code for video game console were fair use where purpose was to make original but competing game cartridges compatible with console and doing so was "the only way to gain access to the [unprotected] ideas and functional elements embodied in [the] copyrighted computer program"); Atari Games Corp. v. Nintendo of Am. Inc., 975 F.2d 832, 843 (Fed. Cir. 1992) (dictum: preliminary injunction granted on other grounds) ("When the nature of a work requires intermediate copying to understand the ideas and processes in a copyrighted work, that nature supports a fair use for intermediate copying. Thus, reverse engineering object code to discern the unprotectable ideas in a computer program is a fair use."). But cf. DSC Communications Corp. v. Pulse Communications, Inc., 170 F.3d 1354, 1363 (Fed. Cir. 1999) (distinguishing Sega from case in which defendant made copies of copyrighted software "as part of the ordinary operation" of system cards, and "not as part of an effort to determine how the ... system worked").
trapolating to modern conditions the distinction made in the Statute of Monopolies between inventive "new manufactures," which may be patented, and monopolies on other aspects of business, which are prohibited. An innovative project is a proper candidate for patent protection (and therefore for exception from the general prohibition against state-granted monopolies) if it entails significant technological risk and therefore bears a significant risk of total failure and consequent worthlessness of its result. If there is little or no technological risk, and therefore no chance of total failure, the project may be eligible for copyright protection if there is a significant risk of market nonacceptance and the project has little or no intrinsic value apart from its chance of market acceptance. If there is no technological risk, but only market risk, and the project has significant intrinsic value apart from its market acceptance, then it is a pedestrian business project that should be subject to the general prohibition against monopoly, i.e., to free and open competition on the merits.

Cognoscenti of the patent system may object that many patents issue for, among other things, mechanical and electrical inventions, of which the construction and production involve little or no technological risk. That may well be so, particularly for "inventions" that constitute but minor improvements on existing items of commerce. To the extent that it is so, however, the patent system is economically irrational in providing potentially unlimited rewards—at the public's expense—to motivate the acceptance of limited risk. If success in making and producing a minor improvement in a mechanical or electrical device is foreordained, the business of making and producing the improvement is no different from an economic perspective than building and opening a branch bank or supermarket in a new neighborhood. Neither such enterprise, by itself, merits the potentially infinite rewards of patent protection.

90. I am indebted for this observation to my colleague, Professor A. Samuel Oddi, the Giles Southerland Rich Professor of Intellectual Property at the University of Akron.

91. Improvements are classic patentable inventions. See 35 U.S.C. § 101 (2000) (listing as patentable subject matter "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof") (emphasis added). A patent on an improvement is like a copyright on a derivative work; while in force it prevents others from using the improvement without the patentee's permission, but it is subject to any patents on the underlying invention that it improved. See 1 DRATLER, supra note 21, § 2.05[1][a].
Yet there may be cases in which such rewards are justified on average. Invention is not a single event, but a process. Moreover, modern investment seldom commissions an inventive enterprise to support a single invention. Rather, investors today support general "research and development" enterprises in specific fields of industry, and those enterprises engage in a wide range of inventive activity over a significant period of time. Over the course of years, the activities of a single such enterprise may produce a number of minor improvements to existing technology and—with greater uncertainty and therefore greater risk—one or more pioneering inventions. Each invention may fall somewhere in a broad spectrum of technological risk from zero (i.e., no more than the market risk of ordinary business enterprise) to considerable (for example, in developing and producing a pioneering invention involving new technology of construction and production). As a result, the enterprise as a whole may involve a level of technical risk, averaged over all of its many projects, significantly greater than the bare market risk borne by ordinary, noninventive businesses. In such a case it may be economically rational to provide patent protection for minor improvements in order to motivate investors in large research-and-development enterprises to undertake the supra-

92. For further discussion of this point, see DRATLER, supra note 28, § 3.02[1]; Jay Dratler, Jr., Note, Incentives for People: The Forgotten Purpose of the Patent System, 16 HARV. J. ON LEGIS. 129, 168-72 (1979).

93. From an economic standpoint, patent law serves primarily to motivate investment in private inventive activity. Even some courts recognize this point. See Fromson v. Western Litho Plate & Supply Co., 853 F.2d 1568, 1575 (Fed. Cir. 1988) ("Corporations don't invent; people do. Yet, the patent system also encourages corporations and investors to risk investment in research, development, and marketing without which the public could not gain the full benefit of the patent system."); SCM Corp. v. Xerox Corp., 645 F.2d 1195, 1206 n.9 (2d Cir. 1981): Investors ... play a key role, if not an indispensable one today, in both the inventive process and the commercialization of inventions. And it is fair to say, we think, that the contribution of the investor in both the funding of research that leads to inventions and the promotion that necessarily must follow to achieve successful commercialization is of comparable value.

Id. (citation omitted); Mannington Mills, Inc. v. Congoleum Indus., Inc., 610 F.2d 1059, 1070 (3d Cir. 1979) (stating that the purpose of patent grant is "to provide an incentive for private enterprise to devote resources to innovative research, to make the investments required to put new inventions into practice, and to make the benefits of the invention available to a wider public"); see also Hearings before the Temporary National Economic Committee, 76th Cong. 857-58 (1939), quoted in United States v. Line Material Co., 333 U.S. 287, 352 (1948) (Burton, J., dissenting) ("[S]peculative capital will not back new inventions without patent protection.").
normal average level of risk.\textsuperscript{94} The extent to which, and the conditions under which, such an approach may be economically rational is obviously not susceptible to precise determination without empirical economic research. From a legal perspective, however, the requirement for patentable subject matter is not the only feature of the patent system that addresses this issue. Section 103’s basic requirement—that patentable inventions be “nonobvious” at the time they were made\textsuperscript{95}—is designed to codify legal precedent that distinguishes the work of a “skillful mechanic” from that of the true inventor.\textsuperscript{96} Moreover, the historical origins of this requirement suggest that it was added to the basic requirement that inventions be new, precisely to separate important from run-of-the-mill advances.\textsuperscript{97} This effect of the requirement appears to have fallen into desuetude, especially under the Federal Circuit’s “suggestion” test for nonobviousness.\textsuperscript{98} Whether the current trend away from the lone inventor toward larger and more diverse research-and-development enterprises justifies enfeebling this basic legal requirement, or whether its enfeeblement represents an economically dangerous trend away from fundamental legal and economic principles, are again questions that only empirical economic research can answer definitively.

II. DO SOFTWARE PROJECTS ENTAIL TECHNOLOGICAL RISK?

The foregoing analysis suggests that two factors should determine whether an innovative project is eligible for the state-granted monopoly of a patent, or whether it should be subject to the general rule of free competition in business. First, does the project entail significant technological risk, or just market risk,

\begin{flushleft}
\textsuperscript{94} Consider, for example, the large numbers of scientists, engineers, and technicians employed in today’s research-and-development laboratories. Their sole work is to invent. In the ordinary course of their jobs, they produce nothing that can be sold for profit; only their inventive output, if any, justifies the considerable expense of their salaries and benefits. Even if much of what they produce constitutes minor improvements of existing technology with little technical risk, it may still be economically rational to protect some of the results of their work with patents, in order to keep them employed in the search for pioneering advances.

\textsuperscript{95} 35 U.S.C. § 103(a) (quoted in full infra note 185). In 1995, Congress amended § 103 to put the substance of the nonobviousness requirement into what is now subsection (a), but practitioners still refer to the requirement as that of “section 103.” See infra note 187.

\textsuperscript{96} See infra note 193 and accompanying text.

\textsuperscript{97} See infra text accompanying notes 185-197.

\textsuperscript{98} See infra Part IV.
\end{flushleft}
i.e., the risk of consumer nonacceptance? Second, is there a risk of total failure of the project, leaving the investor with nothing of intrinsic value and therefore a total sunk loss? Only if both questions have affirmative answers does the project fall within the modern extrapolation of the exception in the Statute of Monopolies for "new manufactures" not before used.

Do computer programs generally meet the first test, that of technological risk? Before addressing this question, it is helpful to consider two areas of unquestionable patent protection: mechanical inventions and pharmaceuticals. Both are unquestionably proper subject matter for patents because they entail substantial technological risk in the real world.

Machines and pharmaceuticals must overcome a substantial number of real-world obstacles in order to work properly. While a machine's design may appear operable in concept, in order to work in the real world it must successfully address such practical problems as: metal fatigue, strain, bending, stress fractures, vibration, corrosion, pollution, spalling, differential thermal expansion and contraction, unintended electrolysis, dust, dirt, friction, ablation, evaporation, deterioration of lubricants, electric arcing, unwanted generation of static or other electricity, and aging. Similarly, pharmaceutical and related inventions often must overcome one or more of the following obstacles: impurities, contamination, dust, unanticipated chemical reactions, metabolic changes, mutation, genetic variation, polymorphisms (natural variation in DNA sequences), allergies, chemical sensitivities, temperature sensitivity, reactions with adjuvants, "fillers" and encapsulating compounds, and deterioration and loss of potency with aging.

When they occur, these obstacles are nearly always unanticipated and sometimes difficult to overcome. Removing them often creates other obstacles. Among other things, these unanticipated real-world difficulties are what give invention in these fields—particularly pharmaceuticals and biotechnology—substantial technological risk in the general case.99

99. The Supreme Court has recognized that pharmaceutical inventions may entail a high level of technological risk. In Brenner v. Manson, 383 U.S. 519, 521-22 (1966), the patent applicant argued that a process for making a particular steroid compound with no known use was "useful," as required by patent law, see 35 U.S.C. § 101 (2000), because adjacent homologues to the compound showed activity in inhibiting the growth of tumors in mice. The Brenner Court rejected this argument, reasoning that pharmaceutical development is an uncertain field, and that speculation as to physical properties of pharmaceutical compounds based on
The striking thing about computer software is that, in contrast, its development entails none—not one!—of these real-world risks or uncertainties. Although computers operate in the real world in which machines and pharmaceuticals do, the software that runs them does not. Rather, it operates in the abstract world of logic and numbers, divorced from all the dust, dirt, temperature variation, electric potentials, and contamination of the real world in which people live and invent and machines and other inventions operate.

It is well known enough to be reported in case law that software development is a highly structured, artificial, and abstract process dependent not upon fickle nature but upon well-determined, systematic man-made rules and procedures. It begins with an abstract, logical plan, called a “specification and flow chart,” in which abstract variables representing real things like the prices of stocks or stress levels in bridge beams are listed, and their format and relationships described. Much like the plan for a building, the flow chart specifies how these variables are to relate to each other and to the program operator’s input, and how the program is to handle them. The coding, or writing of the actual code, then follows this predetermined abstract plan, filling in the detailed steps to bring about the numerical manipulations and operations outlined in the flow chart, in accordance with the rules for a particular source-code programming language and the conventions for programming generally. Although there is some flexibility in how the precise sequence of coding instructions is written, the ultimate code (and whether it operates successfully) is largely determined, in advance, by the specification, the flow chart, the rules of the programming language, the programming conventions, and the dictates of logic and mathematics.

In none of this process is there anything like the uncertainty chemical analogies does not always pan out. See 383 U.S. at 522 n.3, 531; see also id. at 532 (“[R]espondent himself recognized that the presumption that adjacent homologues have the same utility has been challenged in the steroid field because of ‘a greater known unpredictability of compounds in that field.’”) (quoting the applicant’s patent-office correspondence) (footnote omitted); id. at 532 n.19 (quoting the opinion of Board of Patent Appeals that “minor changes in the structure of a steroid may produce profound changes in its biological activity”).


101. See sources cited supra note 100.
and trial and error of real-world invention. No real experimentation need be done because there is nothing in software that touches the real world, with all its manifold uncertainties. All is controlled by logic and mathematics—purely abstract creations of Man—that for that reason are not themselves eligible for patent protection.

The closest thing to experimentation that occurs in the course of software development is the "debugging" process, in which programmers may try different variations in coding or "step through" a program one step at a time in order to determine how to fix a logical error. But that process hardly reflects real-world uncertainty or technological risk. Rather it is the result of inattention (improper program logic in the first place) and the inability of the human mind to hold the whole of a large and complex abstract logical puzzle and solve it at one time.

An anecdote from a colleague's personal experience illustrates this point. A brilliant physicist, he later became a founder and chief programmer for the firm that developed one of the first commercially successful electronic-mail programs. Although the program was large and complex, he had written or supervised the writing of nearly all of it. When a customer or engineer reported a bug in the program, this colleague did not resort to trial-and-error methods to isolate and fix the bug. He did not even use a computer to test the program. Rather, he sat quietly in a chair and "thought through" how the program

102. When "run" on computers, of course, software must operate in the real world. Then its operation is subject to such unanticipated events as power outages, power surges, failures of computer components, and perhaps stray cosmic rays and quantum tunneling effects. Even if they occur, however—and they are rare—these events do not affect the software design. They represent glitches in the hardware only, not the computer program. They may make program debugging more difficult, but they are not obstacles to be overcome in making the computer program work. In practice, they can be overcome simply by using another computer in a more secure environment to run the software.

It is even possible to use a working computer to simulate the one on which the software will actually run. Accordingly, these "obstacles" represent no more technological risk in designing workable software than the risk of finding a large boulder in digging a foundation does in erecting a building.

103. Although the courts differ in their application of the principle, all courts agree that mathematical rules and formulae in the abstract are not proper subject matter for patent protection. See, e.g., Diamond v. Diehr, 450 U.S. 175, 185-187 (1981); Parker v. Flook, 437 U.S. 584, 588-589 (1978); Gottschalk v. Benson, 409 U.S. 63, 67-68 (1972); In re Alappat, 33 F.3d 1526, 1542-43 & n.18 (Fed. Cir. 1994) (en banc); see also infra note 214.

104. The program, called "cc:Mail," was eventually sold to Lotus Development Corp., which IBM later acquired.
worked and how it might have produced the reported error. When finished thinking, he made one or two necessary changes, which usually fixed the bug.¹⁰⁵

Nothing better illustrates the lack of real technological risk, and the dependence of computer programming on nothing more complex than human logic, than the ability to fix bugs and overcome obstacles by pure thought alone, with no experiment whatsoever. Although the ancient “natural philosophers” thought they could understand the natural world similarly, by pure cogitation and a priori reasoning, modern science and technology did not begin until scientists abandoned that conceit in favor of the experimental method. Today no inventor worth his or her salt would attempt to cure a disease or design a mechanical innovation in this way. Yet computer programs are designed and developed in this manner every day.

Computer programs also fail the test of technological risk in another, more fundamental, respect: if there is technological risk, there must be technical failure. After first programming computers as a high-school student in 1961, I have worked in and around the computer industry for over forty years. During all that time I have never heard of—let alone participated in or advised—a computer programming project that failed, once programming started, because the job could not be done. Many computer programs could not be completed on time or under budget, or failed as a commercial matter because they did not work well, were overpriced, or lacked features that consumers desired, but the same can be said of many commercial and residential building construction projects. Failure of business planning or market assessment does not demonstrate technological risk.

Sometimes a computer program fails to reach its real-world objectives because the computer’s memory is too small to hold all the necessary data, because the computer runs too slowly to keep track of real-world events, or because the sensors used to provide real-world data to the computer are insensitive, noisy, or subject to interference. But that is not a failure in the programming process to meet the program’s objectives; rather, it is a failure of the engineer to specify or design computer or exter-

¹⁰⁵. Private communication with Hubert Lipinski, Institute for the Future, Palo Alto. I myself have fixed bugs in computer programs that I have written in a similar way, although my simple programs were not nearly as long or complex as the electronic-mail program in this example.
nal hardware that could do the job. Sometimes it is an inability of hardware engineers, at our current state of knowledge, to design machines to do the job. When such problems occur, they may suggest technological risk, but that risk inheres in a real-world problem of engineering involving hardware, not in software development alone.

The Bush Administration's proposal to create a "Star Wars" antimissile shield over the continental United States illustrates the distinction. Much has been made of the failures of preliminary test systems to destroy incoming dummy missiles. Those failures, however, were not likely due to computer software that failed to meet its design objectives. With modern, high-speed computers it is a relatively straightforward matter to compute the trajectory of incoming and interceptor missiles to an arbitrarily specified level of accuracy. The necessary equations have been known for decades, if not for centuries. It is even possible to do the job in real time, although the timing of course is a matter of hardware, not software.\footnote{Being a logical system that operates in the abstract, and not in the real world, software is chronology-independent. The very same program, without modification, can operate quickly or slowly, depending upon the clock speed of the computer that runs it. Thus, one can speed up its operation just by running on faster hardware.}

What makes the job of hitting a missile with another missile so difficult is not the software design, but the fact that so many real-world variables affect the result. Unlike the computer programs that fire and direct the interceptor missile, both the incoming and interceptor missiles do not operate in the abstract world of mathematics. They fly in the real world. Therefore they are subject to wind, weather, atmospheric density fluctuations, water vapor, differential solar heating, and possible collisions with birds, insects and their droppings. The radar and optical sensors that provide the data on the incoming missile's trajectory must overcome similar obstacles, in addition to physical problems in their own design, such as electronic noise, flaws in materials, differential heating, condensation, raindrops, snow, ice, failure of components, power outages, etc. Even this list of potential problems neglects the very real possibility that, in an actual wartime setting, an incoming missile would use deceptive devices, such as decoys, "chaff," and electronic countermeasures, to fool the defensive system. There is undoubtedly technological risk in the "Star Wars" system, from these and other
sources, but it does not inhere in the design of the controlling computer programs, except insofar as those programs must be modified to overcome these real-world obstacles. The technological risk involved is the same sort of technological risk that affects any complex system that must operate in the real world.

Accordingly, a working “Star Wars” system as a whole might merit patent protection, but the computer program that runs it, by itself, ordinarily should not. The reason is that the technological risk inheres in understanding and incorporating into the program the real-world physical parameters needed to make the system operate with acceptable reliability. Once those parameters are known, incorporating them into the program is a straightforward matter, like building a bridge from a blueprint, which entails little or no technological risk.

In this respect computer programming is less like inventing than like undertaking a construction project. A construction project begins with a blueprint, designed by an architect or engineer in accordance with rules of design. Contractors, following conventional work rules, complete the project in a straightforward manner. When the project is completed (or when each phase is done) the architect or engineer inspects the job and changes are made to fix any problems found. Just so, computer programming proceeds according to a blueprint (the specification and flow chart), prepared by a software engineer in accordance with the rules and conventions of system design and programming. Once this “plan” is approved, programmers consummate it (usually in teams), in a straightforward manner, following conventional “work” rules of modular program design.

107. If the computer programmer developed new and nonobvious algorithms or programming techniques to overcome real-world obstacles, and if that development involved real technological risk, those algorithms or techniques might merit patent protection. The entire “Star Wars” system might merit protection for similar reasons. See supra text accompanying notes 106-107.

108. For example, suppose the technological obstacle to be overcome is correcting a predicted missile trajectory for variations in wind resistance with changes in altitude. The difficult part is predicting from a combination of theory and experiment—and with sufficient accuracy to make the system work reliably—what abstract equations represent with sufficient accuracy the changes in wind resistance in the real world, as atmospheric characteristics vary with altitude and weather conditions. Once those equations have been discovered—a matter of aeronautical, not software, engineering—programming the computer to calculate the trajectory from those equations is a straightforward matter with virtually no technological risk whatever. There is little chance of failure; writing the program just takes time. See O.J. DAHL, E.W. DIJKSTRA, & C.A.R. HOARE, STRUCTURED PROGRAMMING 14-16 (1972).
When the job (or each phase) is done, the program (or module for that phase) is tested, and changes are made through "debugging" to fix any problems found. At no stage in either endeavor—the construction project or the programming—is there any substantial risk that the result will be worthless, i.e., that the building will not stand or the program will not run. In both cases, following pedestrian procedures in a straightforward, conventional way invariably leads to success, unless the money runs out or the rare case of a lightning strike intervenes. In neither case is there anything resembling the technological risk of true invention.

This is not to say that projects involving computer programming never entail technological risk. Sophisticated problems in technology, like predicting the weather or modeling nuclear explosions, the performance of national economies or large-scale telecommunications networks, may entail conceptual and mathematical complexities that require the development of new algorithms or programming techniques. Those algorithms and techniques may require testing for efficacy and efficiency, in a process analogous to (but not precisely the same as) experimentation in real-world inventions. Some may work to meet the stated objectives, while others may not. In that case there may be technological risk, i.e., the risk of total failure, that economically justifies patent protection.

But programming problems that require the development of new and nonobvious algorithms and programming techniques are relatively rare in the field of computer software. When they occur, they too have analogues in the field of architecture. A new and nonobvious method of designing a truss for greater strength, or a new and nonobvious method of building a bridge with greater strength but lighter and less costly materials, may merit a patent. The patent, however, does not cover the whole building using the truss, or the whole bridge, but only the new and inventive architectural method. Similarly, if technological risk inheres in the development of new and nonobvious algorithms or programming techniques, they may qualify for patent protection, but their qualification does not necessarily render the entire computer program in which they are used a patentable

109. The primary risk of failure is that the money will run out before the job is done, but that risk—well known in construction contracting—is not the kind of technological risk that justifies patent protection.
invention. To think the contrary would be to reason that the inventor of a novel truss, who uses it to construct a building, could prevent others on patent grounds from constructing duplicates of the building even if they use a different and non-infringing truss design.

In any event, most computer programs (and most modules thereof) bear no more resemblance, insofar as technological risk is concerned, to these novel and nonobvious techniques than a standard tract home does to the gantry that hauls multi-ton space vehicles onto the launch pad at the Kennedy Space Center. While that gantry (or construction techniques used in it) might qualify for patent protection, the best the tract home's design can hope for is a copyright.110

110. Two other kinds of protection might be possible. The ornamental design for a tract home might be eligible for design patent protection. See 35 U.S.C. §§ 171-173 (2000) (provisions of patent act governing design patents, as distinguished from utility patents, which are better-known patents on inventions). Section 171 provides that design patents are available for "any new, original, and ornamental design for an article of manufacture." Id. § 171; see also 1 DRATLER, supra note 21, § 2.02[1] (discussing distinctions among design, utility and plant patents). In order to qualify for design protection, the design would have to be both new and nonobvious in light of earlier designs—an unlikely proposition for a standard tract home. See § 171; 1 DRATLER, supra note 21, § 2.02[1][b].

A second possible alternative for legal protection might be registration or protection as "trade dress" under trademark principles. See generally id. §§ 9.01[2], 9.02[3][b], 9.02[4]; Jay Dratler, Jr., Trade Dress Protection for Product Configurations: Is There a Conflict with Patent Policy?, 24 AM. INTELL. PROP. L. ASS'N. Q. J. 427 (1996). The Supreme Court, however, has ruled that trade-dress protection for the configuration of a product, such as a home design, requires proof of "secondary meaning," i.e., proof of consumers' recognition of the design as a brand. See Wal-Mart Stores, Inc., v. Samara Bros., Inc., 529 U.S. 205, 216 (2000) ("We hold that, in an action for infringement of unregistered trade dress under § 43(a) of the Lanham Act [the United States trademark statute], a product's design is distinctive, and therefore protectible, only upon a showing of secondary meaning.").

Thus neither design-patent nor trade-dress protection would be available for a standard tract home's design upon its mere adoption. As a result, in the general case only copyright protection would be possible.


This sort of copyright, however, is subject to, inter alia, three limitations. First, like all copyrighted subject matter, copyrighted building designs must be original. See 17 U.S.C. § 102(a) (2000) (copyright subsists in "original works of authorship"); 1 DRATLER, supra note 21, § 5.02[4][a], at 5-55. Second, the copyright does not protect "individual standard features" such as common doors, windows and other staple building components. See 17 U.S.C. § 101 (2000) (definition of "architectural work," with explicit exclusion); H.R. REP. NO. 101-735, at 18 (1990), re-
So should it be with the vast majority of computer programs, which implement well-known business, accounting, or engineering procedures. Nothing in them entails technological risk or a real risk of failure. Just like buildings and culverts, these pedestrian computer programs are built according to a preconceived plan, in a methodical process following preset, man-made rules of logic and program design. Their development entails virtually no risk of failure, other than the inherent risks of any business—that the money or time allotted will run out before the job is done, or that consumers will not accept the results. If they work for their intended purpose (which they generally do, unless the money or time runs out), they generally have intrinsic value apart from consumer acceptance. Indeed, increasingly, with greater experience in the industry, computer program development is a routine matter, performed on time and under budget—hardly a mark of invention involving real technological risk.

The computer-program "system" in State Street Bank & Trust Co. v. Signature Financial Group, Inc. was just of this sort. All it had to do was calculate, on a daily basis, "data regarding daily incremental income, expenses, and net realized gain or loss for the portfolio and for allocating such data among each fund" in a hub-and-spoke investment system.

This was worlds away from the proverbial rocket science. It was not calculus; it was not even algebra. It was a problem in complex arithmetic. Furthermore, the rules governing the calculations were standard accounting rules, prescribed in part by the Securities and Exchange Commission and the Financial Accounting Standards Board. Programming a computer to do these

---

printed in 1990 U.S.C.C.A.N. 6935, 6949. Finally, the copyright does not protect functional or utilitarian features of the building design, which must be protected, if at all, by patents. See id. at 20-21, reprinted in 1990 U.S.C.C.A.N. 6951-52.

This treatment closely parallels the treatment of computer programs under copyright law, which precludes protection of function. See, e.g., Computer Assos. Int'l, Inc. v. Altai, Inc., 982 F.2d 693, 708-10 (2d Cir. 1992) (functional features must be "filtered out" before comparing remainder of plaintiff's program to defendant's). See generally 17 U.S.C. § 102(b) (2000) (denying copyright protection to, inter alia, ideas, methods, techniques, and processes); 1 DRATLER, supra note 21, § 5.02[1][b] (discussing application of idea/expression dichotomy of § 102(b) to computer programs).

113. Id. at 1372 (detailing part of patent claim).
114. I am not the only commentator to notice this point. Professor Thomas has
arithmetic calculations was something any competent college graduate in computer science—and many high-school “nerds”—could do, with virtually no chance of failure. It involved less technological risk—and was far easier—than building a tract home. Yet for doing that job (or commissioning an employee or consultant to do it) the Federal Circuit rewarded Signature Financial Group with an effective monopoly over the hub-and-spoke partnership investment business.\textsuperscript{115}

From the perspective of technological risk, In re Alappat\textsuperscript{116} was not much better. There the “invention” consisted of a neat mathematical trick for giving curves on display screens a smooth appearance, despite their construction from numerous illuminated dots known as “pixels.”\textsuperscript{117} The trick consisted of calculating the theoretical trajectory of the curve (which the computer must do to display it in any event) and illuminating pixels near the calculated trajectory in inverse proportion to their distance from the calculated trajectory. This technique made pixels closer to the curve brighter and those farther away dimmer, thereby observed:

Economists might ... express concerns over the similarities between the claims of Signature's patent and portions of the Internal Revenue Code. The individual who drafted Signature's claims was keenly aware of tax law, for portions of the claim read word-for-word with the pertinent tax statute and regulations. This attempt at private appropriation of the tax laws brings to mind efforts to claim copyright to jump citations. Thomas, supra note 37, at 1165 (citation omitted). For discussion of efforts to protect jump citations, rejected in Matthew Bender & Co. v. West Pub'l'g Co., 158 F.3d 693, 699, 701 (2d Cir. 1998), but accepted for purposes of a preliminary injunction in West Pub'l'g Co. v. Mead Data Cent., Inc., 799 F.2d 1219, 1226-27 (8th Cir. 1986), see 1 DRATLER, supra note 21, § 5.02[2][c][i].

115. The district court, which the Federal Circuit reversed, had found as follows:

If Signature’s invention were patentable, any financial institution desirous of implementing a multi-tiered funding complex modelled [sic] on a Hub and Spoke configuration would be required to seek Signature’s permission before embarking on such a project. This is so because the... Patent is claimed [sic] sufficiently broadly to foreclose virtually any computer-implemented accounting method necessary to manage this type of financial structure.


117. The word “pixel” is a contraction of the words “picture element.” Each pixel is represented by a dot of phosphor on a cathode ray tube or a similar physical element in other types of screens. See Webopedia, at http://www.pcwebopedia.com/TERM/p/pixel.html (last modified May 21, 2002).
tricking the eye into seeing a thicker but smoother curve.\textsuperscript{118}

This formula involved a bit more mathematics than the one in \textit{State Street}. Some knowledge of algebra and geometry—but still not calculus or higher mathematics—was required to calculate the curve’s trajectory and the distances of the various nearby pixels from it. Yet again, any competent college graduate in computer science could have programmed a computer to do the job with absolutely no risk of failure. While there might have been some difficulty in performing the calculations quickly enough to display rapidly-changing curves on a high-speed oscilloscope, nothing in the claims before the \textit{Alappat} court suggested any timing difficulty or claimed any solution for it.\textsuperscript{119} This was a straightforward programming task, with no technological risk, for which \textit{Alappat} got a putative monopoly affecting every one of the hundreds of millions of computer screens that might benefit from visual perception of smoother curves.

Nothing about either of these so-called inventions suggested an iota of technological risk, real risk of failure, or anything other than the sort of market risk to which every ordinary business project is subject. Rather, everything suggested the normal, routine risks of ordinary business activity, such as building a plant, shopping center, or skyscraper.\textsuperscript{120} The policies underlying the protection of intellectual property suggest that those risks ought to be subject to the normal rule of free competition or, if significantly dependent upon consumer acceptance, copyright protection at best.

Before we turn to business methods patents, a further point is worth noting. The difference in technological risk between

\begin{itemize}
\item \textsuperscript{118} See \textit{Alappat}, 33 F.3d at 1537-39.
\item \textsuperscript{119} This possible obstacle was not even remotely present in \textit{State Street}, since the calculations had to be performed only once a day:
In some instances, a mutual fund administrator is required to calculate the value of the shares to the nearest penny within as little as an hour and a half after the market closes. Given the complexity of the calculations, a computer or equivalent device is a virtual necessity to perform the task. \textit{State Street}, 149 F.3d at 1371.
\item \textsuperscript{120} Indeed, comparing the two innovations insults the skyscraper. Unlike the utterly pedestrian applications of straightforward arithmetic and algebra involved in \textit{State Street} and \textit{Alappat}, the construction of a skyscraper involves risks in the real world, some of which cannot be foreseen. For example, the discovery of a huge boulder, underground cavern, or underground spring might vastly increase the costs of constructing the foundation or even make it impossible to erect a building of the specified shape and height. No such unanticipated obstacle was even remotely possible in \textit{State Street} or \textit{Alappat}.
\end{itemize}
software development and invention in the real, physical world is not only an enormous difference in magnitude, but also a decisive difference in kind. Those readers who remember high-school chemistry will recall that a mole of any compound, such as pure water, contains $6.02 \times 10^{23}$ molecules (Avogadro's number).\textsuperscript{121} Except at a temperature of absolute zero (zero degrees Kelvin, or minus 273.15 degrees Centigrade—a temperature that is physically unattainable, according to the third law of thermodynamics, and is therefore found naturally nowhere in the solar system, let alone on Earth), all of those molecules are in constant, random thermal motion. To specify accurately the precise physical state of the mole of water would require specifying the location, and the direction and speed of motion, of each of those molecules at any time. If we specified each of these variables using the normal three-dimensional Cartesian coordinates, to an accuracy of one part in 256 (equivalent to an eight-bit computer “byte”), we would need six times Avogadro's number, or $3.6 \times 10^{24}$ bytes, to do so.

In comparison, Microsoft's Windows 2000 Server operating system is reported to have 30 million, or $3 \times 10^7$, lines of computer code.\textsuperscript{122} If we assume that each line of code contains 256 one-byte characters—surely an overestimate—\textsuperscript{123} that operating system, described as “Microsoft Corp.’s premier network operating system,”\textsuperscript{124} contains about $7.6 \times 10^9$ bytes of information. Thus, our hypothetical mole of pure water—an absurdly simple physical system, which most physicists and chemists would describe as of trivial complexity in comparison to physical systems under current study in the real world—contains more than $4 \times 10^{14}$ times more information than Microsoft’s “premier” operating system.

Now a mole of any substance has a mass equal to its molecular weight in grams. Water of normal isotopic composition has a molecular weight of eighteen,\textsuperscript{125} so our hypothetical mole would have a mass of eighteen grams and occupy about eight-

\textsuperscript{121} See Dorothy M. Feigl & John W. Hill, General, Organic, and Biological Chemistry: Foundations of Life 161 (1986).

\textsuperscript{122} See Dan Verton, How to Lock down Windows 2000, COMPUTERWORLD, Nov. 19, 2001, at 38.

\textsuperscript{123} Few lines of computer code are that long. Usually programmers try to write short lines in order to make the source code easier to understand and maintain.

\textsuperscript{124} Verton, supra note 122, at 38.

\textsuperscript{125} See Feigl & Hill, supra note 121.
een cubic centimeters—a very small demitasse cup. If one considers the amount of information contained in it to be a measure of its complexity, that demitasse cup of water, just sitting there doing nothing, contains more than 400 trillion times as much information as the source code for Microsoft's premier operating system.

Moreover, this example seriously underestimates the complexity of the mole of water. It ignores the information contained in the atoms that make up the water molecules, and in all the subatomic particles comprising those atoms. A more complete analysis would add orders of magnitude to the difference in complexity noted here. This example provides just an inkling of how much more complex is nature than the largest and most complex purely logical systems ever created by Man.

A cup of pure water at rest is of course a very simple system for many physical and chemical purposes. Scientists may describe that system usefully, for some purposes, using only a few physical parameters, such as temperature and pressure. But as soon as one begins to study the cup of water at the level of detail and sophistication required to solve real problems in modern physics, physical chemistry, or engineering, let alone bioengineering, some of the complexity inherent in its detailed submicroscopic structure emerges. If, for example, one wishes to study the transport of viruses or dye molecules across the cup of water from top to bottom, one must begin to understand detailed microscopic thermal transport processes, as well as larger processes such as convection and turbulence. Then the gross approximation of the cup of water as a uniform physical system characterized by pressure and temperature alone becomes useless.

The point of this example is not to insist that a cup of pure water at rest is harder to understand for all purposes than Microsoft's premier operating system. Such a claim would be absurd. Rather, it is to illustrate with numbers that anything in the real world—even such an apparently simple system as a demitasse cup of water—has unfathomable intrinsic complexity that systems of pure logic like an operating system inherently lack, however complex they may seem when they do not work.

A complete physical or physical-chemical description of any real-world system, such as might be achieved by solving a massive version of Schrödinger's Equation for it, would comprehend all known natural phenomena in it. Yet we use abstract and im-
precise concepts like "metal fatigue," "strain," "bending," "stress fractures," "vibration," and "friction" precisely because solving such equations in reality is far beyond our cognitive and computing power. Indeed, solving such an equation exactly is so difficult that to do so is beyond present human capability even for a single, complex organic molecule, such as might be found in a human being.126

Certainly some problems in physics, chemistry and biology may be solved satisfactorily, for practical purposes, using these approximation techniques, just as, for some purposes, our highly complex demitasse cup of water can be described usefully (but falsely) as a uniform system characterized by its temperature

126. In 1998, the author’s former teacher, Professor Walter Kohn (now at the University of California at Santa Barbara) and Professor John Pople received the Nobel Prize in chemistry for developing methods and computer programs to solve an approximation of Schrödinger’s Equation for chemical bonds in complex organic molecules. Solving this single problem took over thirty years of research by a large number of researchers. The press release made by the Royal Swedish Academy of Sciences in connection with the award described this problem and its solution:

One of the founders of quantum physics, Dirac, expressed the problem in 1929 as follows: "The fundamental laws necessary for the mathematical treatment of large parts of physics and the whole of chemistry are thus fully known, and the difficulty lies only in the fact that application of these laws leads to equations that are too complex to be solved."

Things began to move at the beginning of the 1960s when computers came into use for solving these equations and quantum chemistry (the application of quantum mechanics to chemical problems) emerged as a new branch of chemistry. As we approach the end of the 1990s we are seeing the result of enormous theoretical and computational development, and the consequences are revolutionising the whole of chemistry. Walter Kohn and John Pople are the two most prominent figures in this process. W. Kohn’s theoretical work has formed the basis of simplifying the mathematics in descriptions of the bonding of atoms, a prerequisite for many of today’s calculations. J. Pople developed the entire quantum-chemical methodology now used in various branches of chemistry.

Computer-based calculations are now used generally to supplement experimental techniques. For several decades they have been developed and refined so that it is now possible to analyze the structure and properties of matter in detail. . . . Today, for example, calculations can be used to explain how enzymatic reactions occur. It has taken more than thirty years for a large number of researchers to render these calculations practicable, and the method is now one of the most widely used in quantum chemistry.

and pressure, without regard to its unfathomable internal complexity. But in modern science and technology, no one can predict for certain whether and when the unfathomable internal complexity of real matter in the real world (including complexity at or below the molecular level) may emerge and challenge the inventor with unresolvable uncertainty that only laborious experiment can conquer.

In contrast, the operating system has nothing like such unfathomable internal complexity. A line of source code is a line of source code. When it does not work properly, it might need to be broken down as far as individual characters. For example, when a programmer types an asterisk by mistake, rather than a semicolon, to delineate separate data fields, one might have to correct that individual character to delineate the line into two separate commands and make the system work. But beyond this, the operating system has no more inherent complexity than is suggested by the sum of its logical, abstract parts: lines, statements, and (when commands are improperly written) characters. There are no smaller building blocks, extending downward into virtually infinite tininess. In contrast, all real matter has an apparently infinite series of smaller and smaller building blocks—protons, neutrons, electrons, quarks, and strings—which seem to increase in complexity and uncertainty as they get smaller.

In comparison with the multi-layered complexity of the real world, software is as pure and simple as an ideal Platonic form. Its failure to operate properly sometimes takes time to understand. Yet it operates not according to the infinitely complex laws of nature, but according to plans and designs made by Man. Any difficulty in correcting errors in this plan derives from the limited capacity of the human mind, not the hidden but inherent complexity of the object of study.

Nor does the difference in complexity stop with degree. Like the water molecules in our hypothetical cup of pure water, all molecules in our everyday world (the world in which inventors operate) are in constant, random Brownian motion.127 This

127. This thermal motion stops at a temperature of absolute zero (zero degrees Kelvin or minus 273.15 degrees Celsius), but except in scientists' experimental apparatus, and then only approximately and temporarily, that temperature is never reached on Earth; absolute zero is a temperature that is unattainable. See KURT MENDELSSOHN, THE QUEST FOR ABSOLUTE ZERO: THE MEANING OF LOW TEMPERATURE PHYSICS 101-04 (1977).
motion is responsible for, among other things, irreducible "noise" in both electronic and mechanical equipment. Sometimes noise of this sort can be circumvented by clever design, but it can never be entirely eliminated. It is an inherent feature of nature that infects all human measurement and renders that measurement inherently and inevitably inaccurate and, at some level, unpredictable. There is no analog to "noise" in software programming.

Still the relative complexity of the real world does not stop. Under Werner Heisenberg's uncertainty principle, the precise location and velocity of subatomic particles can never be known simultaneously, even in theory, with absolute accuracy.\textsuperscript{128} Rather, the uncertainty in one—location or velocity—increases proportionally to the certainty of the other.\textsuperscript{129} Physicists now believe that this uncertainty derives neither from an experimental flaw (such as might derive from a failure to account for random "noise" in experiments) nor from a lack of human understanding. Rather, they think this uncertainty is an inherent property of nature on the subatomic level, responsible for such phenomena as the "tunneling" of subatomic particles in semiconductors.\textsuperscript{130} Heisenberg's principle thus teaches that nature has an inherent randomness and indeterminability, which no human effort or stratagem can reduce, making real world physical reality fundamentally different in kind from, and incomparably more complex in form than, any logical or abstract system, such as software, that humans have ever devised.

This analysis suggests that computer programs, no matter how complex they may seem to the layperson, have nothing like the complexity of the simplest systems in the real world. It also suggests why their development does not entail anything like the same level of technological risk. To be sure, errors do occur

\textsuperscript{128} See Werner Heisenberg, Remarks on the Origin of the Relations of Uncertainty 3-6, in \textsc{The Uncertainty Principle and Foundations of Quantum Mechanics: A Fifty Years' Survey} (William C. Price & Seymour S. Chissick eds., 1977).

\textsuperscript{129} See id.

\textsuperscript{130} See CPS Science, \textit{The Modern Action of the Atom}, available at http://216.239.53.100/search?q=cache:c8NAjB7ocJ0C.chem.thisness.com/material/lecture/LT06schr.doc+heisenberg+uncertainty+principle+%22inherent+property%22&hl=en&ie=UTF-8 at 6.2. ¶3 ("Don't think that it is our experimental inadequacies that cause the uncertainty. Earlier scientists who opposed the principle kept trying to think of an experiment that didn't affect the object. They were mistaken. The uncertainty of an object is an inherent property of the object itself.") (last visited Feb. 11, 2003).
in software systems, but they are avoidable errors, avoidable with greater care in software design and coding and greater attention to modular software development. They are correctable both in theory and in practice; the theory and practice are well known, highly structured and man-made. Moreover, error-correction can sometimes be accomplished by contemplation alone, and sometimes it can be automated.

From a practical perspective, bugs in computer programs can be analogized to flaws in building construction. Just as a computer programmer may forget the name of a variable, carelessly mistype a command, or intermingle code for two separate subroutines, a building contractor may place joists too far apart or pour a concrete foundation too thin, so that it cracks. Both types of errors may require correction, and the correction may require effort and expense. In neither case, however, does the effort involve technological risk (i.e., a risk of failure for unknown technological reasons), or is the outcome of the effort ever in doubt. Just as the supervising architect or engineer will find the flaw and insist that joists be rebuilt properly spaced, or that the foundation be poured again (and properly), the computer programmer will find the logical flaw, rewrite one or several lines of code, and fix the bug. In neither case does the temporary flaw, caused by human error or carelessness, make the project as a whole subject to technological risk or any real risk of total failure.

This analysis suggests three economic rules of thumb for software-related patents. First, since the design and development of most computer programs entails minimal technological risk and virtually no risk of failure and total loss, patents claiming computer programs or their operations should be rare. They should be reserved for complex and inventive physical systems that operate in the real world, of which a computer program is only a part. The rubber-molding system in Diehr\(^1\) may have been such a system, but a better example would be the "Star Wars" antimissile system, if it is ever made to work.\(^2\) Second, since no technological risk or risk of failure inheres in the ordinary process of computer programming, computer programs that implement business, commercial, or engineering methods should not be patentable unless those methods them-

\(131\) Diamond v. Diehr, 450 U.S. 175 (1981); see also supra note 36.

\(132\) See supra text accompanying notes 105-108.
DOES LORD DARCY YET LIVE?

selves involve substantial technological risk of failure and total loss. Mere market risk, which is inherent in any business venture, does not justify patents for these projects. Finally, if the development of particular aspects of computer programs (such as algorithms or programming techniques) entails technological risk requiring repeated trial and error testing analogous to real-world experiments (or if the development of a real-world project involving a program entails such risk as a whole), and if there is significant risk of total failure and worthlessness of the result, then the aspects (or program) having those risks—but not necessarily the computer program as a whole—may be economically worthy of patent protection.

III. TECHNOLOGICAL RISK AND BUSINESS METHODS

The second category of computer programs discussed above—those that may be economically worthy of patents if the methods they implement are—raise squarely the issue of so-called "business method" patents. In order to understand the issue, it is best to return briefly to the Federal Circuit’s State Street decision that raised it. 133

In State Street, the patentee, Signature Financial Group, conceived of a new business structure for pooled investment partnerships. 134 Evocatively called a “hub and spoke” investment partnership, the structure allowed various independent entities along the “spokes” to pool their investment funds in a “hub.” In this way, the pooled investment fund could be divided among a number of independent investment vehicles. This structure required two levels of accounting: the patentee had to keep track of the amount of pooled funds allocated to each investment vehicle, and, of that amount, the amount owned by each entity along the “spokes.” 135 Apparently in order to meet SEC and ac-

134. See id. at 1370.
135. See id. at 1371. The court described the described the monitoring system as follows:

The system additionally track[ed] all the relevant data determined on a daily basis for the Hub and each Spoke, so that aggregate year end income, expenses, and capital gain or loss [could] be determined for accounting and for tax purposes for the Hub and, as a result, for each publicly traded Spoke.

Id.
counting requirements, various standard accounting items, such as the net asset value of the investments, had to be calculated daily.

Nothing in the Federal Circuit’s opinion suggests that the required accounting operations were anything more than pedestrian calculations required by applicable regulations and accounting rules. The Signature Financial Group wrote (or had someone write) a computer program to perform them and patented the computer-cum-program as a "machine." The claims of its patent were not restricted to the particular programming code that it used; rather, the claims were broad enough to cover any computer program used to implement the accounting operations for that type of business.

While one might hypothesize a room full of Japanese accountants pounding away on abaci, the only practical way to implement daily accounting operations for such a business was and is to program a computer to perform them. Therefore a

136. The Federal Circuit described the need as follows:

It is essential that these calculations are [sic] quickly and accurately performed. In large part this is required because each Spoke sells shares to the public and the price of those shares is substantially based on the Spoke's percentage interest in the portfolio. In some instances, a mutual fund administrator is required to calculate the value of the shares to the nearest penny within as little as an hour and a half after the market closes. Given the complexity of the calculations, a computer or equivalent device is a virtual necessity to perform the task.

Id. See also supra note 114 (noting influence of tax requirements under Internal Revenue Code).

137. See id. at 1371-72. For example, step (e) of Claim 1 of the patent enumerated some of the items to be calculated: "data regarding daily incremental income, expenses, and net realized gain or loss for the portfolio and for allocating such data among each fund." Id. at 1372.

138. See also supra note 119.

139. State Street, 149 F.3d at 1371 (noting that six method claims had been cancelled and six machine claims remained on appeal).

140. See id.; see also id. at 1376-77 (reciting district court's conclusion that the claim was broad enough to provide practical control over hub-and-spoke business model); Thomas, supra note 37, at 1157 ("Signature's invention marked no advance in computer technology or mathematical calculations. The basis for patentability was the uniqueness of the investment package Signature claimed in its patent.") (citation omitted).

141. See Thomas, supra note 37, at 1157 ("The same functions could be performed, albeit less efficiently, by an accountant armed with pencil, paper, calculator, and a filing system.") (citation omitted) (quoting district court's opinion in State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 927 F. Supp. 502, 504 (D. Mass. 1996)).

142. Both the district court and the Federal Circuit acknowledged this point. See supra notes 115, 136.
broad patent on the computer program was, in effect, a patent on the type of business itself. The district court recognized this fact and invalidated the patent on two grounds: (1) absence of patentable subject matter; and (2) a perceived rule against “business method” patents. The Federal Circuit reversed, holding the program patentable subject matter because it produced “a useful, concrete, and tangible result,” namely, numbers corresponding to the accounting items to be calculated. It also laid to rest the “business method” exception to patentable subject matter, reinterpreting past cases and insisting that no such exception had ever existed. The court thus left the patentee with the power to monopolize a line of investment business because it had programmed (using pedestrian techniques and a language it had not invented) a computer (which it had not invented) to per-


144. State Street, 149 F.3d 1368, 1373 (Fed. Cir. 1998). In allowing the patent, the Federal Circuit held:

[T]hat the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces “a useful, concrete and tangible result” —a final share price momentarily fixed for recording and reporting purposes and even accepted and relied upon by regulatory authorities and in subsequent trades.

Id. (quoting In re Alappat, 33 F.3d 1526, 1544 (Fed. Cir. 1994) (en banc)).

Among the many objections to this formulation, two are readily apparent. First, the “useful, concrete, and tangible” mantra confuses the patent requirement of utility provided in 35 U.S.C. § 101 (2000) with the independent requirement that patentable inventions involve patentable subject matter. See also Thomas, supra note 37, at 1160 (“The difficulty with this approach is that, since the early nineteenth century, the utility standard has been understood to present a distinct, additional hurdle to patentability. This dramatic reinterpretation of the statute reduces the statutory categories of patentable subject matter to little more than claim-formatting protocols.”) (citations omitted). Second, and more fundamentally, this formulation nowhere addresses, from either a legal or economic perspective, whether the invention is of the type that the Framers and Congress intended to exclude from the general prohibition against state-granted monopolies. For elaboration of these points, see 1 DRATLER, supra note 21, § 2.02[2][b][iv].

145. See State Street, 149 F.3d at 1375:

We take this opportunity to lay this ill-conceived exception to rest. Since its inception, the “business method” exception has merely represented the application of some general, but no longer applicable legal principle, perhaps arising out of the “requirement for invention” —which was eliminated by § 103. Since the 1952 Patent Act, business methods have been, and should have been, subject to the same legal requirements for patentability as applied to any other process or method.

Id. (citation omitted).

146. See id. at 1375-76.
form routine accounting functions (which it had not invented) required for that line of business. Lest the panel’s decision be deemed an anomaly, the court went out of its way to reaffirm the result and reasoning of State Street in a subsequent case.147

The result in State Street bears little scrutiny under the economic test for patent-eligible subject matter discussed in this article. The computer and programming language were apparently standard off-the-shelf commercial items not invented or developed by the patentee. The accounting rules and regulations were developed and imposed by the tax authorities, the SEC and the Financial Accounting Standards Board.148 The actual programming of the arithmetic dictated by these accounting rules was a trivial task easily within the skill of any trained computer programmer. It is difficult to see an iota of technological risk or chance of total failure in any of these items, whether alone, in combination, or in their implementation.

Is there any technological risk in implementing such a business method, as distinguished from market risk, i.e., the risk that the business model simply won’t work as a business matter? Hardly. If the method could be implemented by hand (think again of that roomful of abaci) there would be nothing to prevent its implementation as long as there were at least two investors to provide funds and two investment vehicles to absorb them. If there were any risk at all, it would be a risk that investors would not like the investment vehicle and would shun it. But this is the precisely the sort of market risk that every business has taken in market competition since time immemorial. For nearly four centuries, businesses that take such risks have been subject to a mandatory rule of free markets. They have had no warm shelter from the cold winds of competition.

Moreover, the business method in State Street failed the economic criterion for patent eligibility in yet another respect. Like the Edsel (which, after all, was still a car), the pooled-investment partnership structure would have had intrinsic economic value even if poor consumer acceptance reduced its market value to an unprofitable state. This is true of most computer programs if they work at all; their utilitarian function gives them an intrinsic value apart from their market acceptance. In this respect they

147. See AT&T Corp. v. Excel Communications, Inc., 172 F.3d 1352, 1356 (Fed. Cir. 1999).
148. See supra note 114.
are economically even less worthy of legal protection than other copyright-protected property: an unpopular book or movie has no intrinsic value other than its negligible value as paper, celluloid, or other scrap.

As their name suggests, most business methods will be similar to that in State Street. They will not involve technological risk, but rather market risk of nonacceptance by consumer or other markets. Since the advent of the Statute of Monopolies, such new methods of doing business have not generally been considered proper subjects for state-granted monopolies, whether or not under the narrow exception for patents on "new Manufactures within this Realm."^{149}

To the extent that the development of new business methods, or systems or processes to implement them, does entail technological risk and the risk of total failure, those methods, systems, or processes may be economically worthy of patent protection. Yet even in that case, the patent protection should be narrowly confined to the aspects or means that entail the technological risk. To conclude otherwise is to turn four centuries of economic law on its head.

Another example from recent Federal Circuit jurisprudence further illustrates the pernicious economic effect of construing the scope of patentable subject matter too broadly. In Amazon.com v. Barnesandnoble.com, the Federal Circuit addressed Amazon's patent on one-click on-line shopping.^{150} The patent broadly claimed a system and method for shopping on the Internet that allowed a properly registered customer to purchase an item displayed for sale on a website simply by clicking only once on an icon with his or her mouse, without going through a more elaborate two-click or multiple-click "checkout" process.^{151} Apparently on the authority of State Street and its progeny, the Patent and Trademark Office had accepted this "invention" as patentable subject matter, and the infringer did not challenge the patent on subject-matter ground.^{152} The district court rejected

151. See id. at 1347-48. See also id. at 1349-50 (reciting claims).
152. The only mention of subject matter in the district court's opinion is that the patent examiner "conferred with more senior examiners and counsel to insure that the patent involved patentable subject matter." Amazon.com, Inc. v. Barnesandnoble.com, Inc., 73 F. Supp. 2d 1228, 1233 (W.D. Wash. 1999), vacated and remanded 293 F.3d 1343 (Fed.Cir. 2001).
challenges to the patent on the ground that the "invention" was obvious in light of prior art and lacked novelty\textsuperscript{153} and therefore enjoined Barnesandnoble.com from using a similar single-click website selling system.\textsuperscript{154} The Federal Circuit vacated the preliminary injunction and remanded, holding that the district court had failed to consider relevant prior art and construe the patent’s claims properly, and that Barnesandnoble.com had raised a substantial question whether the invention had been obvious and whether the patent therefore was invalid.\textsuperscript{155}

Although the question of patentable subject matter was not litigated, from an economic perspective this "invention" looks as shaky as those in \textit{State Street} and \textit{Alappat}. Did development of Amazon.com’s "one-click shopping" system entail any technological risk? At trial, the defendant’s expert testified that switching from multi-click to one-click programming was a "trivial" programming task.\textsuperscript{156} It seems unlikely that there would be any technological risk or significant risk of failure in such a project. To conceive it was to do it, budget and time permitting, and Amazon.com apparently had all the necessary money and time. Furthermore, the one-click shopping website had intrinsic value, apart from its consumer acceptance or lack thereof, because one-click shopping is easier, more efficient, and more convenient for consumers. (It is also better for vendors because it gives buyers less time for remorse.)\textsuperscript{157} Thus, according to the economic criteria developed in this article, Amazon.com’s one-click shopping "invention" was a classic business innovation, of the type that for 400 years has been subject to free competition.

IV. TH\textsc{e} FEDERAL CIRCUIT’S QUEST FOR CERTAINTY: A REFUSAL TO EXERCISE DISCRIMINATING JUDGMENT?

The United States Court of Appeals for the Federal Circuit opened for business in 1982.\textsuperscript{158} At that time, the various regional courts of appeals differed greatly in their approach to patent litigation, and consequently forum-shopping was rampant.\textsuperscript{159}

\begin{footnotesize}
\begin{enumerate}
\item See \textit{id.} at 1239-41.
\item See \textit{id.} at 1249.
\item See \textit{Amazon.com,} 239 F.3d at 1358-60, 1366.
\item See \textit{Amazon.com v. Barnesandnoble.com,} 73 F. Supp. 2d at 1241 (finding of fact 21).
\item See \textit{id.} at 1236-37 (summarizing evidence to this effect).
\item See Federal Courts Improvement Act of 1982, Pub. L. No. 97-164, 96 Stat. 25; \textsc{Dratler, supra} note 21, § 2.01, at 2-7.
\item See \textsc{Federal Courts Improvements Act of 1982, S. Rep. No. 97-275, at 3-6}
\end{enumerate}
\end{footnotesize}
Congress established the Federal Circuit and gave it exclusive jurisdiction over appeals in patent cases, in order to make patent law more uniform, clarify it where possible, and end the forum shopping that had plagued patent litigation.

The Federal Circuit has taken its job seriously and has striven mightily to perform those tasks. Indeed, many of the changes it has wrought in patent law during the past decade can be viewed as, inter alia, conscious attempts to make patent law more transparent and patent litigation therefore more certain.

Among other things, the court during the last decade has: (1) excluded juries from construing patent claims; (2) decreed that construing patent claims is entirely a matter of law for judges, whether or not it involves subsidiary factual issues; (3) disfavored "extrinsic" evidence in construing patent claims, including the testimony of experts and inventors, in favor of "intrinsic" evidence in the public record prior to litigation; (4) developed

\[1981\text{, reprinted in} \ 1982 \text{U.S.C.C.A.N. 11, 13-16.}\]


162. For an extensive discussion of the various "revolutions" in patent-infringement practice that the Federal Circuit has wrought, see 1 Dratler, supra note 21, § 2.05[3].

163. See Markman v. Westview Instruments, Inc., 52 F.3d 967, 979 (Fed. Cir. 1995) (en banc) ("[T]he court has the power and obligation to construe as a matter of law the meaning of language used in the patent claim.") , aff'd 517 U.S. 370 (1996). The Supreme Court unanimously affirmed the Federal Circuit on this point. See Markman v. Westview Instruments, Inc., 517 U.S. 370, 372 (1996) ("We hold that the construction of a patent, including terms of art within its claim, is exclusively within the province of the court.").

164. See Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1455-56 (Fed. Cir. 1998) (en banc). By a vote of nine to three, the Cybor majority rejected dissenters' argument that the definition of terms in claim construction involves subsidiary matters of fact, as to which the appellate court should defer to the district courts.

[W]e... reafirm that, as a purely legal question, we review claim construction de novo on appeal including any allegedly fact-based questions relating to claim construction. Accordingly, we today disavow any language in previous opinions of this court that holds, purports to hold, states, or suggests anything to the contrary...

165. See Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1583 (Fed. Cir. 1996). In Vitronics, the court observed that:

The [patent's] claims, specification, and file history, rather than extrinsic evidence, constitute the public record of the patentee's claim, a record on which the public is entitled to rely. In other words, competitors are entitled to review the public record, apply the established rules of claim construction, ascertain the scope of the patentee's claimed invention and, thus, design around the claimed invention... Allowing the public record to be altered or changed by extrinsic evidence introduced at trial, such as expert
a "suggestion" test for determining whether an invention was obvious at the time it was made, which looks for explicit or implied suggestions in patents and publications, including the technical literature; and (5) restricted the "doctrine of equivalents," which expands the coverage of patents beyond the literal meaning of their claims by strengthening the doctrine of "prosecution history estoppel," under which ground given up in patent prosecution cannot be regained by invoking the doctrine of equivalents. A common theme in all these developments

Id. at 1583 (citations omitted). A later en banc decision confirmed this panel's approach, rejecting the views of some dissenters who argued as follows:

Of course the primary source of information concerning the claimed invention is the patent documents. But such documents are directed to persons knowledgeable in the field; additional evidence and expert testimony as to their meaning should be the rule, not the exception. So-called "extrinsic" evidence—the evidence of expert witnesses and of experimentation, exhibits, demonstrations, and explanation—should be treated like any other evidence, and received and given weight and value as appropriate. Our broad constraint on resort to such evidence is an unnecessary bar to enlightenment. It is also an incursion into the authority of the trial court.

Cybor Corp. v. FAS Technologies, Inc., 138 F.3d 1448, 1481 (Fed. Cir. 1998) ("additional views" of Newman, J.) (emphasis added and citation omitted). In deciding that claim construction is purely a matter of law for the judge, not the jury, and is subject to de novo review upon appeal, the en banc majority necessarily rejected this approach. See id. at 1456; see also supra note 164. See generally 1 DRATLER, supra note 21, § 2.05[3][a][iii].

166. See 1 DRATLER, supra note 21, § 2.03[3][f]; infra text accompanying notes 197-200.

167. See, e.g., Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 21 (1997) ("Under this doctrine [of equivalents], a product or process that does not literally infringe upon the express terms of a patent claim may nonetheless be found to infringe if there is 'equivalence' between the elements of the accused product or process and the claimed elements of the patented invention."); see also id. at 24-26, 34-37, 39-40 (outlining history and contours of doctrine); Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608 (1950); supra note 74; 1 DRATLER, supra note 21, § 2.05[3][b][i] (discussing doctrine in depth).

168. The Federal Circuit strengthened prosecution history estoppel by: (1) applying it to all patent claim amendments for reasons of patentability, whether voluntary or in response to examiners' objections, (2) presuming that unexplained amendments are for reasons of patentability, and (3) requiring resort to public records of patent prosecution, rather than post-facto testimony, to explain reasons for claim amendments. See Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 234 F.3d 558, 563-64, 586 (Fed. Cir. 2000) (en banc), aff'd on this point and vacated and remanded on other ground, 535 U.S. 722 (2002). See generally 1 DRATLER, supra note 21, § 2.05[3][a][i] (discussing Festo decisions and their effects on patent practice). The Supreme Court either affirmed or did not review the Federal Circuit's decisions on these points. See id. The Supreme Court, however, vacated the Federal Circuit's decision to impose a complete bar to applying the doctrine of equivalents with respect to any claim element amended for reasons of patentability, preferring the
was an attempt to reduce uncertainty and the level of discretionary judgment required to decide patent cases.\(^{169}\)

Viewed in light of this history, the court’s rejection of subject-matter limitations on patenting computer programs and business methods is understandable. In a trilogy of well-known patent cases, the Supreme Court had twice rejected patents for software-related inventions and only once, in 1981, opened the door to patenting them.\(^{170}\) The decision that opened the door, *Diamond v. Diehr*,\(^{171}\) was a limited decision that gave few solid guidelines for determining when such inventions are patentable subject matter and when they are not.\(^{172}\) As a result, the lower courts, including the Federal Circuit, floundered for two decades trying to create workable rules, eventually abandoning every legal test that had been suggested.\(^{173}\)

The Federal Circuit’s ultimate solution—virtually abandoning judgment and rejecting all categorical subject-matter limitations for computer programs entirely\(^{174}\)—can be understood primarily as a desperate search for certainty in an uncertain world.\(^{175}\) The subject-matter question, particularly with regard

---

169. See 1 DRATLER, supra note 21, § 2.05[3] (elaborating on this point).
170. See supra note 36; see also 1 DRATLER, supra note 21, § 2.02[2][b][i].
172. See supra notes 36, 66, 103.
173. See supra notes 37, 66 and accompanying text; see also Kreiss, supra note 36, at 33 (“Now, more than twenty-five years after the Supreme Court first addressed the issue, we can say with some confidence that courts have no coherent methodology for deciding whether computer-related and mathematical algorithm-related inventions are patentable subject matter.”); Thomas, supra note 37, at 1141 (“[W]ithout more, the scope of the statutory term ‘process’ appears co-extensive with nearly any possible endeavor, as almost any imaginable function can be articulated in a series of steps in the fashion of a patent instrument.”).
174. See supra note 37 and accompanying text.
175. See AT&T Corp. v. Excel Communications, Inc., 172 F.3d 1352, 1360 (Fed. Cir. 1999) (referring to Diehr, 450 U.S. at 219 (1981) (Stevens, J., dissenting)): [Justice Stevens’] first concern, that the rules [for patentable subject matter] are not sufficiently clear to enable reasonable prediction of outcomes, should be less of a concern today in light of the refocusing of the § 101 issue that *Alappat* and *State Street* have provided. His second concern, that the ambiguous concept of “algorithm” could be used to make any process unpatentable, can be laid to rest once the focus is understood to be not on whether there is a mathematical algorithm at work, but on whether the algorithm-containing invention, as a whole, produces a tangible, useful, result.
to computer programs, had been a swamp of uncertainty. The Federal Circuit sought to drain the swamp by limiting judge-made exceptions to the generally broad scope of patentable subject matter to the narrowest and most literal terms expressed in precedent.176

In so doing, the court was not entirely unconscious that its rulings might permit patents for things that ought not to be patented. It appeared convinced, however, that “bad” patents may be avoided by applying the other, more certain, requirements for patent protection, primarily novelty and nonobviousness.177 The

176. See, e.g., id. at 1357 (reviewing and reaffirming Federal Circuit’s own precedent that limited “abstract idea” exception to inventions constituting “disembodied” abstract ideas without practical use); State St. Bank & Trust Co. v. Signature Financial Group, Inc., 149 F.3d 1368, 1373 (Fed. Cir. 1998) (“Unpatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not ‘useful.’”); In re Alappat, 33 F.3d 1526, 1544 (Fed. Cir. 1994) (impliedly limiting judge-made exception to “a disembodied mathematical concept which may be characterized as an ‘abstract idea’ as distinguished from ‘a specific machine to produce a useful, concrete, and tangible result’”).

177. See, e.g., AT&T, 172 F.3d at 1361: Since the case must be returned to the trial court for further proceedings, and to avoid any possible misunderstandings as to the scope of our decision, we note that the ultimate validity of these claims depends upon their satisfying the other requirements for patentability such as those set forth in 35 U.S.C. §§ 102, 103, and 112.
implication appears to be that throwing the subject-matter

doors wide open to software-related patents will not apprecia-

cbly change the volume of traffic because the other requirements
for patentability are the primary regulators of traffic flow.

There are two problems with this reasoning. First, in patent
litigation, attempting to close the most important two of the lat-


ter doors—novelty and nonobviousness—requires consider-

able time, effort, and expense. An invention's novelty and
nonobviousness can be judged only against the background of
the "prior art"—i.e., all relevant prior patents and published
technology.180 That judgment therefore requires a search of
prior art, proper construction of the patent claims (which itself
requires a Markman hearing, and perhaps an appeal), and
exhaustive comparison of the properly construed claims of the
patent with the prior art. If a patent covers an "invention"

See also State Street Bank, 149 F.3d at 1375 ("Section 101 specifies that statutory sub-
ject matter must also satisfy the other 'conditions and requirements' of Title 35, in-
cluding novelty, nonobviousness, and adequacy of disclosure and notice."); id. at
1377 ("Whether the patent's claims are too broad to be patentable is not to be
judged under § 101, but rather under §§ 102, 103 and 112."). Sections 102, 103, and
112, respectively, state the statutory requirements for novelty, nonobviousness, and
adequate disclosure of the invention in the patent itself. See 1 DRATLER, supra note
21, §§ 2.03[1], [3], 2.04[1].

178. The patent bar owes a debt to the late Judge Giles Sutherland Rich, who be-
queathed the profession a powerful metaphor, likening the various statutory re-
quirements for a valid patent to "doors" through which a patent applicant must
pass. See In re Bergy, 596 F.2d 952, 960-62 (C.C.P.A. 1979). As Judge Rich recog-

nized, the first "door" is the requirement for patentable subject matter, although he
appeared intent on confining that requirement to a narrow and literal construction
of the laundry list of nouns in § 101 of the patent statute. See id. at 960. His narrow
view of the subject-matter inquiry seems to have ripened in State Street, where he
tossed off the question in a single short paragraph, noting that the inventor claimed
a "machine"—one of the words in the list. See State Street, 149 F.3d at 1372.

179. See Bergy, 596 F.2d at 961-62 (citing 35 U.S.C. §§ 101-103). After amend-
ment, the requirement for nonobviousness appears primarily in subsection (a) of
§ 103. See infra note 187.

180. See 1 DRATLER, supra note 21, § 2.03[1], [3][a]-[b].

181. A so-called Markman hearing is a special hearing, usually held before com-
plete trial of the case, in which the court construes the meaning of the patent claims
as a matter of law, without interference by juries. See id. § 2.05[3], [a][ii]. It takes its
name from Markman v. Westview Instruments, Inc., 517 U.S. 370, 372 (1996), in which
the Supreme Court affirmed the Federal Circuit and held that "the construction of a
patent, including terms of art within its claim, is exclusively within the province of
the court." See also supra note 163.

182. Trial courts have considerable discretion as to whether and when to hold
Markman hearings. See 1 DRATLER, supra note 21, § 2.05[3][a][iv]. Often they occur
before trial of important issues of validity and infringement, so that complete resol-
ution of the case may require two or more appeals to the Federal Circuit. See id.

183. For a description of the process, see id. § 2.05[3][a], [b][i].
that clearly involves little or no technological risk, throwing it out as a preliminary matter may save the litigants an entire trial on the issues of novelty, nonobviousness, and infringement, as well as a hearing and appeal on claim-construction issues—no small savings in transaction costs. Where the patented "invention" clearly does not stand the test of a proper balance between competition and innovation, such a result promotes not only economic efficiency and competition in the marketplace, but efficiency in litigation as well.

The second problem with relying entirely on lack of novelty or obviousness to get rid of “bad” patents is that the Federal Circuit, in the course of its two decades of activity, has greatly reduced the restrictive impact of these two fundamental patent requirements. To understand how requires some explanation.

Under the doctrine of “complete anticipation,” a claimed invention is deemed “new” unless every element of the claim appears within the four corners of a single prior-art reference.184 Although well established as a matter of patent law, this doctrine makes no sense whatsoever as a matter of economics. Since the Statute of Monopolies was adopted in 1623, an invention that is “old” cannot justify an exception from the general prohibition against state-granted monopolies. The reason is simple: monopolies on “old,” i.e., pre-existing, commodities of commerce were exactly the type of monopolies that Parliament meant to outlaw in adopting the Statute of Monopolies. Yet an invention is no less old because one of its elements is found in one reference and another in another.

What saves patent law from economic irrationality is the re-

184. See, e.g., MEHL/Biophile Int'l Corp. v. Milgraum, 192 F.3d 1362, 1365 (Fed. Cir. 1999) (“To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either explicitly or inherently.”) (quoting In re Schreiber, 128 F.3d 1473, 1477 (Fed. Cir. 1997)); Verdegaal Bros., Inc. v. Union Oil Co. of Cal., 814 F.2d 628, 631 (Fed. Cir. 1987) (“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.”) (citation omitted); Rolls-Royce Ltd. v. GTE Valeron Corp., 800 F.2d 1101, 1105 (Fed. Cir. 1986) (“The district court correctly defined the test for anticipation as ‘disclosure in a single prior art reference of each element of the claim under consideration,’ and then correctly applied that test.”) (citation omitted); Structural Rubber Prods. Co. v. Park Rubber Co., 749 F.2d 707, 716 (Fed. Cir. 1984) (“In view of [defendant’s] admissions that no single prior art reference discloses each element of any claim of either [patent], the defense of invalidity for lack of novelty fails as a matter of law”); id. at 717 (granting judgment notwithstanding the verdict for failure to properly instruct jury that anticipation requires a single reference).
quirement that an invention have been nonobvious at the time it was made.\textsuperscript{185} Unlike the novelty requirement,\textsuperscript{186} the requirement for nonobviousness does permit combining references. Thus, under 35 U.S.C. § 103, which states the nonobviousness requirement, an invention can be obvious, and therefore ineligible for a patent, if its various elements are described in any number of separate papers published before the alleged invention.\textsuperscript{187} This rule is as well established under § 103 as the rule of complete anticipation, requiring a single reference, is established under 35 U.S.C. § 102, which sets forth the novelty requirement.\textsuperscript{188} Thus the requirement that an invention not have been obvious takes up the slack in the doctrine of complete anticipation by allowing a challenger to combine multiple prior-art references to invalidate a patent, or a patent examiner to do so to reject an application.

The rub, however, is that traditionally nonobviousness meant something substantially more than mere novelty. The very first patent act used the phrase "sufficiently useful and important,"\textsuperscript{189} and Thomas Jefferson, the father of our patent system, referred to inventions important enough to justify "the embarrassment of an exclusive patent."\textsuperscript{190} The clear implication

\textsuperscript{185} See 35 U.S.C. § 103(a) (2000):
A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

\textit{Id.}


\textsuperscript{187} See supra note 185. Before 1995, § 103 was not divided into subsections, and therefore the nonobviousness requirement was referred to simply as "§ 103." \textit{See Act of Nov. 1, 1995, Pub. L. No. 104-41, § 1, 109 Stat. 351, 351 (dividing then-existing § 103 into two subsections, (a) and (c), and adding present subsection (b)).}

\textsuperscript{188} See 35 U.S.C. § 102.

\textsuperscript{189} Patent Act of 1790, ch. 7, 1 Stat. 109, 109-10 (allowing any two of the Secretary of State, Secretary of War, and Attorney General to issue a patent if they found "the invention or discovery sufficiently useful and important").

\textsuperscript{190} Letter from Thomas Jefferson to Isaac M'Pherson (Aug. 13, 1813) (acknowledging the difficulty in "drawing a line between the things which are worth to the public the embarrassment of an exclusive patent, and those which are not"), \textit{reprinted in 6 WRITINGS OF THOMAS JEFFERSON, supra note 26, at 181. Jefferson's views are particularly important not only because of his influence on the drafting of the Constitution and the Bill of Rights. He was himself "an inventor of great note" and "might well be called the 'first administrator of our patent system.'" Graham v. John Deere Co., 383 U.S. 1, 7, (1966) (quoting P.J. Federico, \textit{Operation of the Patent Act}}
was that a patentable invention had to have something more than mere novelty.

In the early days of our patent system, the hope was that the courts would eventually develop clear rules for defining that "something more." The Supreme Court stated one aspect of the economic problem in 1966: "The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent." Yet the problem of drawing a clear line unfortunately remains unsolved. The requirement for "something more" than mere novelty evolved from something "important" in the first patent statute, to something beyond the skill of the "ordinary mechanic" in a seminal 1850 decision, to "invention"—meaning the quality of inventiveness—to something not "obvious" under the Patent Act of 1952. The latter verbal formulation remains in effect today.

Yet the underlying requirement was always a matter of judgment, discretion, and therefore, uncertainty. As the Supreme Court noted, the guiding economic principle was whether the incentive for innovation was needed and worthwhile.

It should come as no surprise to the reader, having seen how certainty is an underlying theme of much of the Federal Circuit's innovations in patent law, that that court has sought to squeeze uncertainty out of §103 as well. It has done so primarily in two ways. First and most important, it has developed a

---

of 1790, 18 J. PAT. OFF. SOC'Y. 237, 238 (1936)).
192. See supra note 189 and accompanying text.
[U]nless more ingenuity and skill . . . were required . . . than were possessed by an ordinary mechanic acquainted with the business, there was an absence of that degree of skill and ingenuity which constitute essential elements of every invention. In other words, the improvement is the work of the skilful mechanic, not that of the inventor.
Id. In this case, the Court upheld invalidation of a patent on doorknobs made out of clay or porcelain, instead of metal. See id. at 264, 266-67.
194. See Graham, 383 U.S. at 11-12 (describing evolution in use of the term "invention," meaning inventiveness, to describe, but not resolve, the line-drawing problem, during the interval between Hotchkiss and Congress' adoption of section 103).
196. Today the relevant portion of old § 103 appears in § 103(a). See supra notes 185, 187.
197. See supra note 191 and accompanying text.
"suggestion" test for obviousness.198 Under this test, an invention described in a combination of references was obvious at the time it was made—and therefore unpatentable—only if the references cited against it contain some suggestion to combine them to make the invention and, in addition, some suggestion that one making the combination would have a reasonable probability of success.199 The court has not adhered to this test obsessively in all cases, but by and large, in the vast majority of cases, the presence or absence of the necessary "suggestion" to combine the separate references has been determinative of obviousness vel non.200

The court's second way of reducing uncertainty has more economic relevance. It has relied heavily on objective factors, such as a long-felt need for the invention,201 its commercial success,202 prior art that "taught away" from the invention ("They

198. See, e.g., Ruiz v. A.B. Chance Co., 234 F.3d 654, 664 (Fed. Cir. 2000): [W]e have clearly established that the relevant inquiry for determining the scope and content of the prior art [in an obviousness assessment] is whether there is a reason, suggestion, or motivation in the prior art or elsewhere that would have led one of ordinary skill in the art to combine the references.

Id. (citations omitted); In re Dembiczak, 175 F.3d 994, 999 (Fed. Cir. 1999) ("Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references."). abrogated on other grounds, In re Gartside, 203 F.3d 1305, 1319 (Fed. Cir. 2000); In re Rouffet, 149 F.3d 1350, 1359 (Fed. Cir. 1998) ([T]he Board must identify specifically . . . the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious."). See generally 1 DRATLER supra note 21, § 2.03[3][f].

199. See, e.g., In re O'Farrell, 853 F.2d 894, 904 (Fed. Cir. 1988) ("For obviousness under § 103, all that is required is a reasonable expectation of success," which the combination of two references provided in this case.) (citing In re Longi, 759 F.2d 887, 897 (Fed. Cir. 1985) and In re Clinton, 527 F.2d 1226, 1228 (C.C.P.A. 1976)); In re Dow Chemical Co., 837 F.2d 469, 473 (Fed. Cir. 1988). In reversing the rejection for obviousness in Dow Chemical, the Federal Circuit stated that:

The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this process should be carried out and would have a reasonable likelihood of success, viewed in the light of the prior art. Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure.

Id. (citations omitted). See generally 1 DRATLER supra note 21, § 2.03[3][f].

200. See 1 DRATLER supra note 21, § 2.03[3][f].

201. See Dow Chemical, 837 F.2d at 472 ("Recognition of need, and difficulties encountered by those skilled in the field, are classical indicia of unobviousness.").

202. See, e.g., Pro-Mold Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573-74 (Fed. Cir. 1996) (finding that district court erred as matter of law in not specifying reasons to discount commercial success, which created genuine issue of fact
said it couldn’t be done”), etc. Before the Federal Circuit came into being, other courts had called these objective factors “secondary considerations,” and the Supreme Court had endorsed, but not required, their consideration in a seminal 1966 decision. The Federal Circuit, however, went further. It raised them to the status of mandatory factors to consider where present and, accordingly, changed their name from the slightly pejorative “secondary considerations” to the more neutral and approving phrase “objective factors.”

Yet at the same time that the Federal Circuit raised the status of objective factors and made their consideration mandatory, it reduced their importance in another respect. Although demanding that they be considered when present, the court decreed that their absence alone could not make an invention unpatentable for obviousness. This decree, re-emphasized (although without much discussion) in recent cases, makes objec-

precluding summary judgment of obviousness); Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc., 807 F.2d 955, 960 (Fed. Cir. 1986) (finding that district court’s failure to consider copying by others and commercial success was clear error); Windsurfing Int’l, Inc. v. AMF, Inc., 782 F.2d 995, 1000 (Fed. Cir. 1986) (holding that commercial success tends to show nonobviousness whether or not there was long-felt but unsatisfied need).

203. See Dow Chemical, 837 F.2d at 473 (“The skepticism of an expert, expressed before these inventors proved him wrong, is entitled to fair evidentiary weight.”).

204. For further citations and discussion of these and other objective factors, see 1 DRATLER, supra note 21, § 2.03[3][b].


206. See id. at 17-18 (“Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.”).

207. See Uniroyal, Inc. v. Rudkin-Wiley Corp., 837 F.2d 1044, 1053 (Fed. Cir. 1988) (“[O]bjective evidence of nonobviousness ’must always when present be considered en route to a determination of obviousness . . . . It is to be considered as part of all the evidence, not just when the decisionmaker remains in doubt after reviewing the art.’”) (quoting Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1538-39 (Fed. Cir. 1983)).

208. See sources cited supra note 207.

209. See Medtronic, Inc. v. Intermedics, Inc., 799 F.2d 734, 739 n.13 (Fed. Cir. 1986) (“Though the absence of objective evidence is a neutral factor, if present it ’may often establish that an invention appearing to have been obvious in light of the prior art was not.’”) (emphasis added) (quoting Stratoflex, 713 F.2d at 1538).

tive factors work like a one-way valve. If present, they can help prove an invention nonobvious and reject a challenge to a patent’s validity. Their absence, however, cannot prove the invention obvious and invalidate a patent.

Among other things, this one-way operation of objective factors increases the importance of the “suggestion” test. Since the absence of objective factors alone cannot prove obviousness, the “suggestion” to combine separate references is all the more necessary if “bad” patents are to be invalidated. Indeed, except in the rare case in which the Federal Circuit finds a “suggestion” implicit in the references or, even more rarely, in the background of ordinary skill in the art, the suggestion must be explicit in the references.

Like all the Federal Circuit’s other changes in patent jurisprudence, its limitation of the categorical subject-matter exclu-

211. Because of the effort that the Patent and Trademark Office devotes to examining patent applications for compliance with statutory requirements, the statute decrees that every patent—and each and every claim of every patent—be presumed valid. See 35 U.S.C. § 282 (2000); 1 DRATLER, supra note 21, § 2.04[4]. This fact only increases the pressure needed to open the “one-way valve” and invalidate an issued patent.

212. See, e.g., B.F. Goodrich Co. v. Aircraft Systems Braking Corp., 72 F.3d 1577, 1582 (Fed. Cir. 1996) (“This suggestion or motivation need not be expressly stated.”) (citing Cable Electric Prods., Inc. v. Genmark, Inc., 770 F.2d 1015, 1025 (Fed. Cir. 1985)); In re GPAC, Inc., 57 F.3d 1573, 1581 (Fed. Cir. 1995) (concluding that subject matter of asbestos containment claim was rendered obvious by implied suggestion in prior art to combine features of single reference).

213. See, e.g., Pro-Mold Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573-74 (Fed. Cir. 1996) (“[K]nowledge of one skilled in art may provide ‘teaching, suggestion, or inference’ to combine references.”) (quoting Ashland Oil, Inc. v. Delta Resins and Refractories, Inc., 776 F.2d 281, 297 n.24 (Fed. Cir. 1985); In re Jones, 958 F.2d 347, 351 (Fed. Cir. 1992) (indicating that there must be some suggestion to combine separate references “either in the references themselves or in the knowledge generally available to one of ordinary skill in the art”).

The Federal Circuit’s predecessor court seemed more amenable to finding a “suggestion” without direct textual support. See In re Rinehart, 531 F.2d 1048, 1054 (C.C.P.A. 1976):

[A suggestion] may come from knowledge of those skilled in the art that certain references, or disclosures in the references, are known to be of special interest or importance in the particular field .... It may also come from the nature of a problem to be solved, leading inventors to look to references relating to possible solutions to that problem.

Id. No doubt in the interest of greater certainty, however, the Federal Circuit seems to rely more on direct textual support. See, e.g., In re Raynes, 7 F.3d 1037, 1039 (Fed. Cir. 1993) (“The Commissioner [of Patents and Trademarks] bears the burden of showing that such knowledge provided some teaching, suggestion, or motivation to make the particular combination that was made by the [patent] applicant.”) (citing In re Oetiker, 977 F.2d 1443, 1445-47 (Fed. Cir. 1992); In re Piasecki, 745 F.2d 1468, 1471-72 (Fed. Cir. 1984)).
sion (at least for software-related and business-method inventions) and increasing reliance on the "suggestion" test for obviousness has had some benefits. They have decreased the need for judgment and discretion on the part of the district courts in patent cases, and thereby may have increased the certainty and predictability in outcome of patent litigation. No longer do courts have to make delicate and often policy-driven judgments whether a particular invention is of the kind for which the patent statute, the Constitution, and the policies underlying economic law for centuries support a state-granted monopoly. Instead, they consider whether the invention can be described as a "law of nature, natural phenomenon, or abstract idea," giving those terms the most narrow and literal construction. Similarly, no longer do courts have to determine, on some abstract and likely policy-based scale, whether an invention was "obvi-

214. Compare the more nuanced approach of then Chief Judge Archer, joined by the late Judge Nies, dissenting in part in Alappat:

In addition to the basic principles embodied in the language of § 101, the section has a pragmatic aspect. That subject matter must be new (§ 102) and nonobvious (§ 103) in order to be patentable is of course a separate requirement for patentability, and does not determine whether the applicant's purported invention or discovery is within § 101. Section 101 must be satisfied before any of the other provisions apply, and in this way § 101 lays the predicate for the other provisions of the patent law. In re Alappat, 33 F.3d 1526, 1553 (Fed. Cir. 1994) (Archer, C.J., dissenting in part). Judge Archer goes on to say:

Patent cases involving the distinction between idea or principle [and concrete invention] may involve subtle distinctions. Section 101 embodies the very soul of the intangible nature of invention. Without particular claimed subject matter in mind, it is impossible to generalize with bright line rules the dividing line between what is in substance the invention or discovery of a useful application within § 101 versus merely the discovery of an abstract idea or law of nature or principle outside § 101. Each case presenting a question under § 101 must be decided individually based upon the particular subject matter at issue.

Id. at 1554 (citation omitted).

215. Another commentator appears to concur that the Federal Circuit's primary motivation in relaxing subject-matter limitations was certainty:

The courts' early resistance to patents on computer-related inventions faded over time. By the early 1980s, Patent Office examiners found more favor in computer-related inventions and courts seemed more willing to uphold the issued patents. Although one might be tempted to see this willingness as a response to the increasingly important role that computer technology played in the United States economy, it is likely that both the Patent Office and the courts grew weary of the relentless argumentation of a bar that had scant motivation to favor restraints upon the scope of patenting.

Thomas, supra note 37, at 1150 (footnote omitted).
ous," at the time it was made in light of prior art. Instead, they are instructed to look for suggestions to combine multiple references in the prior art and, finding none, to declare the invention nonobvious and therefore patentable. These approaches resemble nothing so much as a futile attempt to find a formulaic, mechanical procedure to decide patent cases, all for the sake of certainty.

Yet while these developments have advanced the goal of certainty, they have removed the art of judgment from patent cases. Moreover, they have removed even the possibility of judgment by taping shut two of the most important safety values of the patent system, which keep it from exploding with economic monopolies prohibited in Anglo-American law for nearly four centuries.

Before the advent of the Federal Circuit, the question of subject-matter limitations allowed courts to develop a federal common law of patents that was economically rational. If an invention fell close to the line of judge-made exclusions from patentable subject matter, and if it seemed to the court that granting a patent would provide a state-granted business monopoly rather than encouraging and rewarding an undertaking of technological risk, the court could invalidate the patent on subject-matter grounds. With the Federal Circuit’s current standard—that a software-related invention or business method need only produce a “useful, concrete and tangible result,” broadly construed, to be patentable subject matter—the lower courts, at least, no longer have that option, and the Federal Circuit seems disinclined to exercise it. Thus, quite apart from the fact that the Federal Circuit’s new standard confuses patentable subject matter with the separate requirement for utility, it removes the discretion that courts once had to make

216. See id. at 1161-62 (“[E]ach issue of the Patent Office Gazette seems to include another patented business method . . . . Recently issued Patent Office Guidelines further suggest that other business, artificial intelligence and mathematical processing applications are firmly within the grasp of the patent system.”) (citations omitted); see also supra note 49.

217. This point also did not go unnoticed by the dissenters in Alappat: [L]ike the discovery of a law of nature, abstract idea, or principle, the discovery of mathematical functions, relationships, operations, or algorithms does not entitle a person to a patent therefor. It does not matter how “original,” “inventive,” or “useful” the mathematics might be in the ordinary sense of those words.

Alappat, 33 F.3d at 1554-55 (Archer, C.J., dissenting in part) (citations omitted); see also supra note 144; infra note 218.
patent law economically rational.

To a lesser extent, the same is true of the Federal Circuit's "suggestion" test for obviousness. Now that invalidation of a patent for obviousness requires a "suggestion" in prior-art references to combine them, the test for obviousness is little more than a gap-filler, allowing multiple references to be combined to invalidate a patent despite the doctrine of complete anticipation. The notion that the requirement for nonobviousness is supposed to do "something more," i.e., to require an invention that in some undefined way is "important," as well as new, has been discarded. Thus languishes Thomas Jefferson's fond hope that the courts would keep the public from the "embarrassment" of bad patents.

This in itself would not be so bad had the Federal Circuit not relied on the requirements for novelty and nonobviousness as justifying its emasculation of the subject-matter requirement. But with the subject-matter exclusion reduced (insofar as software-related and business-method inventions are concerned) to the phrase "abstract ideas" construed narrowly and literally, with the presence of patentable subject matter confused with the separate requirement for utility, and with the nonobviousness requirement reduced to little more than relaxation of the doc-

218. Although short quotations do not illustrate the point completely, it is hard to read the State Street panel's opinion as a whole without coming to the conclusion that it confused the constitutional and statutory requirement for patentable subject matter with the separate statutory requirement that an invention be "useful." 35 U.S.C. § 101 (2000). See generally Brenner v. Manson, 383 U.S. 519, 521-22 (1966) (interpreting and applying utility requirement); 1 DRATLER, supra note 21, § 1.05[1]

References to the invention's usefulness recur throughout the State Street opinion like a mantra, and the panel's chief reason for rejecting the "idea or law of nature" exception appears to have been that the invention did something useful. The following quotations, while representative and persuasive, do not entirely capture the sense of the opinion as a whole. See State Street Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368, 1373 (Fed. Cir. 1998) ("Unpatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not 'useful.' From a practical standpoint, this means that to be patentable an algorithm must be applied in a 'useful' way."); id. ("[W]e hold that the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces 'a useful, concrete and tangible result.'") (quoting Alappat, 33 F.3d at 1544 (en banc majority opinion)); id. at 1375 ("The question of whether a claim encompasses statutory subject matter should not focus on which of the four categories of subject matter a claim is directed to—process, machine, manufacture, or composition of matter—but rather on the essential characteristics of the subject matter, in particular, its practical utility.") (citation omitted).
trine of complete anticipation—i.e., to novelty as a nonlawyer would construe it—no safety valves are left open for sound judgment to protect the patent system from the natural human pressure toward the safety of monopoly. As a result, we see patents upheld for inventions that involve little or no technological risk but effectively cover new business models (for example, a type of investment partnership, or a new way of selling products on the world wide web).219

Were Lord Darcy to come back from the grave, he would find his state-granted monopoly on playing cards much better received in twenty-first century America than it was in seventeenth century England. All he would have to do is find some clever business wrinkle unique to the playing-card business—perhaps a way of configuring small packages of decks of playing cards to fit in unused niche spaces in the trucks and airplanes of Federal Express and UPS, thereby lowering shipping costs. Next he would write a computer program, using standard, off-the-shelf, general-purposes digital computers and pedestrian programming languages and techniques, to implement his new business scheme. Finally, having invented nothing (not the computer, not the programming language, and certainly not the planes that carry the decks of cards) he would patent his computer program as a “system and method for shipping playing cards,” broadly claiming any equivalent method for lower shipping costs. The Federal Circuit, citing State Street and its progeny in all their glory, would likely uphold his broad claims (in the absence of any combination of references suggesting the same thing), giving Darcy effectively the exclusive right to an insuperable shipping-cost advantage,220 and therefore a state-

219. See supra note 37; supra the text accompanying notes 149-157.
220. By hypothesis, the method of stacking decks of cards in otherwise unused space in transport vehicles would permit shipment at lower cost, and presumably lower prices, than would be available to competitors. The point here is not the precise business idea that produces a competitive advantage. Admittedly the example in text is academic and artificial from the business perspective. The point is that the same analysis applies to any novel idea for improving a business, as long as it is capable of being implemented with computers, as most today are. The idea could be a better method of organizing the business, a better method of counting the cards once produced (to be sure each deck contains a full complement of cards), or something else.

Whatever the novel business idea, State Street provides a simple three-step plan for an end run around antitrust law. First, write a computer program to implement the business idea—an operation which in most cases entails zero technological risk. See State Street, 149 F.3d at 1371-72. Second, apply for a patent claiming
granted monopoly in his business comparable to the one that the English common-law courts and Parliament sought to outlaw nearly four centuries ago.

The Supreme Court has yet to speak on this trend. Recently, however, it gave clear notice that there are values more important than certainty, which the patent system must respect. In its controversial decision in *Festo*, the Federal Circuit had decreed that any amendment to a patent claim, for any reason relating to a statutory requirement for patent protection, creates a "complete bar" to applying the doctrine of equivalents in infringement litigation involving the amended claim, thus narrowing the effective scope of that claim. The court left no

the business improvement so implemented. See id. Claim it broadly as a "machine" (the programmed computer), a "system," a "process" or all three, without any reference to the details of how the computer is actually programmed, so that the patent, in essence, controls the novel business idea itself (as long as computers are used to implement it). *Alappat* and *State Street* allowed such patents, and the Federal Circuit's "open door" approach to subject matter and nonobviousness will validate them as long as the idea or the program are novel in the sense of not being suggested in prior patents or publications. See generally *In re Alappat*, 33 F.3d 1526, 1541-45 (Fed. Cir. 1994); *State Street Bank & Trust Co. v. Signature Fin. Group, Inc.*, 149 F.3d 1368, 1372-75 (Fed. Cir. 1998). Finally, use the patent to threaten and sue any competitor who implements the same business idea with computers; on winning the lawsuit, ask for injunctive relief. See supra note 82. As long as the novel business idea is best or most efficiently implemented with computers—as many today are—the patent will provide an effective economic monopoly over the business idea for twenty years from the application filing date. Checkmate Darcy.


222. See id. at 563 ("[A]n amendment that narrows the scope of a claim for any reason related to the statutory requirements for a patent will give rise to prosecution history estoppel with respect to the amended claim element."); id. at 569 ("When a claim amendment creates prosecution history estoppel with regard to a claim element, there is no range of equivalents available for the amended claim element. Application of the doctrine of equivalents to the claim element is completely barred (a 'complete bar').").

223. Although the courts are reluctant to speak of the doctrine of equivalents as "expanding" the scope of a patent's claim, that is, in effect, what it does, by allowing the patentee to condemn as infringing devices that do not meet the literal limitations of the claim. See generally 1 DRATLER, supra note 21, § 2.05[3][b][i] (discussing doctrine of equivalents and its application in infringement litigation). In contrast, the doctrine of prosecution history estoppel, in effect, narrows the scope of a claim that a patentee is able to assert in infringement litigation—both literally and under the doctrine of equivalents—by holding the patentee to narrowing statements, admissions, and claim amendments made during patent prosecution. See id. §§ 2.05[3][a] (literal infringement), 2.05[3][b][i] (infringement under the doctrine of equivalents), 2.06[2] (prosecution history estoppel generally). By expanding the scope of prosecution history estoppel to include any claim amendment made for any reason related to patentability, and to preclude any range of equivalents for claims so amended, the Federal Circuit in *Festo* purported severely to restrict the
doubt of its reason for this decision, which appeared to overturn voluminous precedent:224 to infuse more certainty into the traditionally uncertain task of applying the doctrine of equivalents.225

The Supreme Court, however, flatly rejected this gambit.226 It required the Federal Circuit and district courts to assess the extent of equivalents remaining after amendments of patent claims on a case-by-case basis, in light of the specific reasons for each amendment and the difficulty of drafting claims for new technology in light of unknown future contingencies.227 In so


The [Federal Circuit] acknowledged that its own prior case law did not go so far [as to create a complete bar] . . . . In four separate opinions, the dissenters argued that the majority’s decision to overrule precedent was contrary to Warner-Jenkinson and would unsettle the expectations of many existing patentees. Judge Michel, in his dissent, described in detail how the complete bar required the Court of Appeals to disregard 8 older decisions of this Court, as well as more than 50 of its own cases.

Id. (referring to Warner-Jenkinson Co. v. Hilton Davis Chemical Co., 520 U.S. 17 (1997)).

225. See Festo Corp. v. Shoketsu Kinzoku Kagyo Kabushiki Co., 234 F.3d at 575 (“In [recent] years, the notice function of patent claims has become paramount, and the need for certainty as to the scope of patent protection has been emphasized.”).

The en banc majority of the Federal Circuit had abandoned precedent because it viewed the “flexible bar” to equivalents accepted in precedent as “unworkable.” Id. at 575 (“We believe that the current state of the law regarding the scope of equivalents that is available when prosecution history estoppel applies is ‘unworkable.’”) (quoting United States v. IBM Corp., 517 U.S. 843, 856 (1996) (noting that Supreme Court itself has overruled precedent that is “unworkable” or “badly reasoned”)).

226. See Festo, 535 U.S. at 737 (“[W]e disagree with the decision to adopt the complete bar.”).

227. See id. at 737-38:

Though prosecution history estoppel can bar challenges to a wide range of equivalents, its reach requires an examination of the subject matter surrendered by the narrowing amendment. The complete bar avoids this inquiry by establishing a per se rule; but that approach is inconsistent with the purpose of applying the estoppel in the first place—to hold the inventor to the representations made during the application process and to the inferences that may reasonably be drawn from the amendment. By amending the application, the inventor is deemed to concede that the patent does not extend as far as the original claim. It does not follow, however, that the amended claim becomes so perfect in its description that no one could devise an equivalent. After amendment, as before, language remains an imperfect fit for invention. The narrowing amendment may demonstrate what the claim is not; but it may still fail to capture precisely what the claim is. There is no reason why a narrowing amendment should be deemed to relinquish equivalents unforeseeable at the time
doing, the Supreme Court noted that it had thrice—in decisions spanning a century and a half—preferred robust patent protection to certainty.\textsuperscript{228} It therefore ruled the doctrine of equivalents sufficiently well established that only Congress can change it.\textsuperscript{229} Perhaps the Court will also rule that the long list of decisions rejecting patents as improper subject matter—\textsuperscript{230} in part on economic ground—\textsuperscript{231} is no more easily swept aside in the name of certainty.

\textbf{V. Conclusion}

No one ever said that our (or any) patent system is eco-


\textsuperscript{229}. See \textit{Festo}, 535 U.S. at 733 ("[I]n \textit{Warner-Jenkinson}, the Court reaffirmed that equivalents remain a firmly entrenched part of the settled rights protected by the patent. A unanimous opinion concluded that if the doctrine is to be discarded, it is Congress and not the Court that should do so.") (citing \textit{Warner-Jenkinson}, 520 U.S. at 28); \textit{id.} at 739 ("In that case [\textit{Warner-Jenkinson}] we made it clear that the doctrine of equivalents and the rule of prosecution history estoppel are settled law. The responsibility for changing them rests with Congress.") (citing \textit{Warner-Jenkinson}, 520 U.S. at 28).

\textsuperscript{230}. See Parker v. Flook, 437 U.S. 584, 588-90 (1978) (rejecting patent on software-related invention as improper subject matter); Gottschalk v. Benson, 409 U.S. 63, 67, 71-72 (1972) (also rejecting patent on software-related invention); Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948) (invalidating patent on combination of strains of bacteria as attempt to monopolize product of nature); O'Reilly v. Morse, 56 U.S. (15 How.) 62, 112-21 (1853) (rejecting broad claim covering every use of electromagnetism for telecommunication); see also Diamond v. Diehr, 455 U.S. 175, 185 (1981) (recognizing in dicta that "This Court has undoubtedly recognized limits to [subject matter under] § 101 and every discovery is not embraced within the statutory terms. Excluded from such patent protection are laws of nature, natural phenomena, and abstract ideas."); Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980) (noting in dicta that "Einstein could not patent his celebrated law that $E=mc^2$; nor could Newton have patented the law of gravity.").

\textsuperscript{231}. For detailed discussion of the economic basis for these decisions, see 1 \textit{DRATLER}, supra note 21, § 2.02[2].
nomically optimal. The duration of patent protection is still largely based upon the length of an apprenticeship in the trade guilds before the dawn of the Industrial Revolution. The very notion that a single patent duration term fits all types of inventions in all industries is awfully hard to support when, for example, computer products become obsolete in months or years, while penicillin is still useful more than seventy years after its discovery.

The doctrine of equivalents, which gave up certainty in patent infringement litigation in the pursuit of elusive justice, has horribly complicated patent litigation and raised transaction costs; yet the Supreme Court has ruled that strengthening patents against nonliteral piracy is worth the cost of this uncertainty.

The distinction between prohibited business monopolies and permitted, temporary patent grants for inventions involving technological risk is just as fundamental. State-granted monopolies of business have been prohibited since 1623. An exception for temporary patent protection is justified only for legitimate inventions whose creation needs and can benefit from the incentive of temporary monopoly.

Not only is this distinction fundamental to patent law; it is fundamental to the operation of all economic law that governs free markets. It is not just a matter of patent law, but of the efficient functioning of our entire economy. To the extent the "exception" for patent law allows businesses to circumvent the...
prohibition on state-granted monopolies that has kept competition vibrant and ensured the pre-eminence of Anglo-American economies for four centuries, it strikes at the heart of our free-market system. It is therefore vital for Congress or the Supreme Court to set the balance right.

Even if not corrected, the Federal Circuit's shutting patent law's "safety valves" for improper subject-matter and obvious "inventions" may have no immediate effect. The corrosive effect of state-granted monopolies for minor "innovations" without technological risk may take decades or centuries to emerge. But eventually a doctrine that permits businesses, by whatever subterfuge, to garner state-granted monopolies not justified by technological risk will have a deleterious economic effect, as the English Parliament understood four centuries ago.

One has only to look at Russia and China to confirm this proposition in real life. After more than twenty years of economic liberalization, China is still in the process of recovering from its disastrous flirtation with economic monopoly as a principle of industrial organization—despite the extraordinary entrepreneurial ability of its people, as demonstrated in the Chinese diaspora worldwide. Russia's recovery from a longer flirtation with monopoly is only now beginning and may take decades.

These are not hypothetical cases or bare theoretical speculations; nor are they the self-interested arguments of patent counsel and their clients. They are practical demonstrations of the evils of monopoly on a colossal scale—the closest thing to decisive "experimental" results that the "dismal science" of economics may ever see. Russia's and China's woeful experiments with state monopoly as a principle of industrial organization have produced untold human misery. That misery continues today, even though the experiments have largely been abandoned. It ill behooves the United States to repeat those experiments—even on a small scale—under the guise of expanding intellectual

235. Unfortunately, neither the patent bar nor its clients are likely to clamor to restore balance and discriminating judgment to the patent system by narrowing the scope of patentable subject matter. The patent bar has a strong economic self-interest in anything that increases the opportunity for patent prosecution and patent litigation. Similarly, its clients have a strong interest in anything that broadens their chances for escaping from the ceaseless struggle that is competition and enjoying the quiet life of monopoly. It therefore appears that the courts, insulated as they are from special interests, are the institution in our government best situated to restore the necessary balance.
property protection.

Re-opening the safety valves of the subject-matter exception and a more robust test for obviousness may require discriminating judgment and increase somewhat the uncertainty of patent litigation. But the game is well worth the candle.

In this regard it is useful to recall the lesson of Baker v. Selden,236 perhaps the single most important decision in the history of American intellectual property. Faced with a novel question in 1880—a claim to a state-granted monopoly on a system of bookkeeping under the guise of copyright—the court rightly rejected it.237 The statute said nothing on point; the Constitution gave little guidance; and the issue was one of first impression.238 Yet the Court, relying on its common sense and good judgment, did what courts are supposed to do: it judged.239 In the process, it not only rationalized the intellectual property system and protected the integrity of patents;240 it avoided a collision between copyright and the First Amendment as well.241

236. 101 U.S. 99 (1880).
237. See id. at 104-05.
238. The Court cited no specific statutory authority and did not mention the Constitution, except in summarizing a precedent that mentioned the Patent and Copyright Clause. See id. at 105-06.
239. With reason, common sense, and judgment, the Baker v. Selden Court assessed the differences between patent and copyright law and the consequences of a rule that copyright could monopolize a system or “art,” thereby circumventing the shorter term and stronger requirements for patent protection. See id. at 101-05.
240. The Baker v. Selden Court preserved the integrity of patents by preventing inventors of “systems” that ought to be patented from circumventing the stringent requirements (and relatively shorter term) for patent protection by writing a book about the system, copyrighting the book, and claiming that copyright in the book prevented others from practicing the system, in addition to copying the book. See id. See generally 1 Dratler, supra note 21, § 5.01[2][b] (discussing policies underlying decision).
241. The rule of Baker v. Selden is now codified in § 102(b) of title 17, United States Code. See 17 U.S.C. § 102(b) (2000) (“In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work.”). This rule, also called the idea/expression dichotomy, prevents copyrights from controlling not only ideas, techniques, processes, but also facts and factual speculation. See Hoehling v. Universal City Studios, Inc., 618 F.2d 972, 978-79 (2d Cir. 1980) (holding that copyright did not protect historical facts or speculation regarding circumstances of destruction of “Hindenburg” dirigible). By precluding copyright protection of ideas, facts, and factual assertions, the rule prevents copyright owners from suppressing them and thereby suppressing free speech. See, e.g., Eldred v. Ashcroft, 123 S. Ct. 769, 774 (2003) (“17 U.S.C. § 102(b), which makes only expression, not ideas, eligible for copyright protection, strikes a definitional balance between the First Amendment and copyright law by permitting free communication of facts
The Baker v. Selden Court could hardly claim to have advanced the cause of certainty and simplification. The idea/expression dichotomy that it introduced, while simple to state, is notoriously difficult to apply, particularly to modern objects of copyright such as computer programs. Moreover, it arises in many, if not most, copyright cases and therefore significantly increases the complexity of copyright litigation. Yet the decision upheld values more fundamental than certainty. By limiting copyright to expression, not ideas, it honored our nation's "prime directive" of free speech. By preventing a copyright "end run" around the stiff requirements for and shorter terms of patents, it protected the integrity of the patent system. Even after more than 120 years, it is difficult to imagine a solution that better serves these same values while creating less uncertainty.

while still protecting an author's expression.)(citing Harper & Row, Publishers, Inc. v. Nation Enters., 471 U.S. 539, 556 (1985); Iowa State Univ. Research Found., Inc. v. Am. Broad. Cos., Inc., 621 F.2d 57, 61 (2d Cir. 1980) ("The public interest in the free flow of information is assured by the law's refusal to recognize a valid copyright in facts."); quoted with approval in Harper & Row, 471 U.S. at 558; see also Harper & Row, 471 U.S. at 560: In view of the First Amendment protections already embodied in the Copyright Act's distinction between copyrightable expression and uncopyrightable facts and ideas, and the latitude for scholarship and comment traditionally afforded by fair use, we see no warrant for expanding the doctrine of fair use to create what amounts to a public figure exception to copyright. Id. 242. A simple review of just three federal appeals court cases in chronological order suffice to make this point. See Whelan Assocs., Inc. v. Jaslow Dental Lab., Inc., 797 F.2d 1222, 1236, n.1, 1234 (3d Cir. 1986) (finding nonliteral "structure, sequence and organization" of computer program in source code form protected, and proposing rule that, for a computer program, the idea is the program's function, and all else is expression); Computer Assocs. Int'l, Inc. v. Altai, Inc., 982 F.2d 693, 705-11 (2d Cir. 1992) (rejecting Whelan approach and developing complex three-step procedure, involving "abstraction, filtration [of ideas], and comparison," to judge substantial similarity of expression only); Lotus Dev. Corp. v. Borland Int'l, Inc., 49 F.3d 807, 814-15, 818-19 (1st Cir. 1995) (rejecting the test in Altai as inapplicable to circumstances and cutting the Gordian knot by declaring aspects of computer program at issue—menu command hierarchy—a "method of operation" that is unprotectable under § 102(b)), aff'd without opinion 516 U.S. 233 (1996). Interestingly, the Whelan court, whose approach has been almost universally rejected, recognized the difficulty of the problem of distinguishing idea from expression in any copyrighted work, let alone computer programs. See Whelan, 797 F.2d at 1225 ("No less an authority than Learned Hand, after a career that included writing some of the leading copyright opinions, concluded that the distinction will 'inevitably be ad hoc.'") (quoting Peter Pan Fabrics, Inc. v. Martin Weiner Corp., 274 F.2d 487, 489 (2d Cir. 1960)).
As Baker v. Selden so well illustrates, there are more important values than certainty. Patent and copyright law are a part of economic law, and for four centuries the most central principle of Anglo-American economic law—and one that has made our nation a superpower—has been free competition. Bringing back sound and discriminating judgment with respect to subject matter and obviousness in patent cases may increase uncertainty in patent litigation somewhat, but it will better serve this fundamental principle. It will do so by allowing courts to throw out state-granted monopolies on purported "inventions" that are not, and to do so without the delay, trouble and expense of full-blown patent litigation. It may even decrease the volume of litigation by eliminating spurious patents with less exhaustive analysis of prior art. But whether or not it decreases uncertainty, discriminating judgment on these or constitutional grounds\(^2\) is required. A reduction in transaction costs from putative "bright line" rules will be no bargain if achieved at the price of making patent law an unwitting instrument in weakening our superbly competitive economy.

243. Thomas Jefferson may not have realized his goal of including a prohibition on monopolies in the Bill of Rights, but a general prohibition on business monopolies granted by the state is implicit in the Patent and Copyright Clause. See supra notes 16-17, 24, 27. Therefore the distinction between state-granted business monopolies (which are prohibited) and patents on inventions that require temporary monopolies for their encouragement (which are permitted but not required) is indisputably of constitutional dignity. See Ochoa & Rose, supra note 27, at 691:

The stipulation that patent and copyright protection be granted only "for limited Times," only to "authors" and "inventors," and only "[t]o promote the Progress of Science and useful Arts," appears to have been aimed at preventing the kinds of abuses that had prompted the Statute of Monopolies 150 years earlier. It is clear that many of the Framers were concerned with restraining monopolies of all kinds.

Id.; see also id. at 695 (concluding, after review of Constitutional Convention and ratification debates, that "the Clause appears to have been designed not so much to limit the means by which Congress could promote the progress of science and useful arts, but rather to limit the duration and purposes for which exclusive rights could be granted").