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Efficient Uncertainty in Patent Interpretation

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Abstract

Research suggests that widespread uncertainty over the scopes of issued patents creates significant costs for third-party firms and may decrease innovation. This Article addresses the scope uncertainty issue from a theoretical perspective by creating a model of patent claim scope uncertainty.

It is often difficult for third parties to determine the legal coverage of issued patents. Scope underdetermination exists when the words of a patent claim are capable of a broad range of plausible scopes ex ante *in light of the procedures for interpreting patents. Underdetermination creates uncertainty about claim coverage because a lay interpreter cannot know which interpretation will ultimately be elected and employed by a judge or jury in a patent infringement proceeding. This Article models this uncertainty problem by the set of interpretations that are plausible for a patent-claim element in light of constraints that restrict meaning, internal and external to the patent document. The model suggests generalizable properties against which we can critically evaluate patent interpretive rules and procedures. On this basis, the Article develops an approach to improving the* ex ante *scope precision of any given patent claim. The general approach is to reduce the set of interpretative scopes that patent claim words can plausibly obtain. By increasing explicit, scope-defining information in the public patent record, it is possible to improve scope*

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precision by ex ante *clarifying scope coverage and exclusion in foreseeable scope uncertainty scenarios.*

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I. Introduction

The Patent and Trademark Office routinely issues patents of uncertain scope.[1] Patents give legal rights over inventions, and patent holders can exclude others from making, selling, or using products[2] encompassed by a patent's claims.[3] A patent claim has an uncertain scope if it is difficult to determine which products infringe that claim with any degree of legal certainty. Scope uncertainty is problematic because it can reduce net innovation in particular fields of endeavor.[4]

Ambiguous patent claims often provide private benefits to the holder but impose external costs upon others.[5] Uncertainly scoped patent claims can increase transaction costs for third-party firms that compete in the patent's space.[6] When firms cannot easily determine claim boundaries they

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1. It is difficult to quantify the number of patent claims whose scope would be considered highly *ex ante* uncertain. However, the overall level of *ex ante* legal uncertainty in patent scope is suggested by the difficulty in obtaining patent infringement insurance. *See* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 51 (2008) ("[U]ncertainty about [a patent's] scope and validity undermine the market for patent enforcement insurance."); *see also* Michael Fitzpatrick, *Battles of the Tech Intellects*, RISK & INS. (Sept. 15, 2010), http://www.riskandinsurance.com/story.jsp?storyId=531905766 (last visited Nov. 18, 2011) ("Because of the severe monetary risks and uncertainty associated with patent infringement, the insurance market for this risk has been slow to develop.") (on file with the Washington and Lee Law Review).

2. To avoid verbosity, I will primarily refer to patent "product" claims rather than the more cumbersome "products or process claims." Patents can and often do claim "processes" or "methods" which are "an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing." Gottschalk v. Benson, 409 U.S. 63, 70 (1972). The principles developed herein for product claims apply to process claims as well.

3. Patent law also allows holders to exclude others from "offering for sale or selling" those products covered by a claim. 35 U.S.C. § 154(a)(1) (2006).

4. *See* BESSEN & MEURER, *supra* note 1, at 146 ("[O]ur evidence implies that patents place a drag on innovation.").

5. A patent claim drafted with scope uncertainty makes it more likely that invalid patent claims—or claims with a range of scopes, some of which are invalid—will issue. During prosecution, patent examiners search for prior art to determine if the patent meets the requirements of non-obviousness and novelty. Variability in the scope of claim words complicates the finding invalidating prior art. Examiners operate in a world of limited time and search resources. Multiple, plausible interpretations mean a wider range of potentially applicable prior art. If there are multiple interpretations, examiners are instructed to employ "the broadest reasonable interpretation." *See* U.S. PATENT & TRADEMARK OFFICE, MPEP § 2111 (8th ed. Rev. 1, July 2010) [hereinafter MPEP].

6. The tendency is to think about the costs that patents impose on third party

may be unable to mitigate legal risk by altering their behavior or "inventing around" known claims to avoid infringement.[7] More generally, simply operating in contexts of endemic patent uncertainty can depress innovation and can raise the risks and costs of patent infringement.[8] When these third-party effects are taken into account, it appears that uncertain patent claims generate substantial costs from a society-wide perspective. These costs are often exacerbated when patent holders opportunistically exploit uncertainty in actual, or threatened, litigation.[9] Accordingly, the reduction of some patent scope uncertainty would likely lead to greater overall efficiency.

The conventional view from the academic literature is that many problems of patent scope uncertainty are simply inherent and unavoidable.[10] For example, patents often issue in rapidly changing technological contexts. Precise claim scope delineation may be difficult when technological progression is unpredictable and unforeseeable technologies arise. Similarly, patent law requires applicants to employ written language to

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competitors—firms in the same field as the patent holder—which make and sell competing products or processes. But patent rights also cover the end users of potentially infringing products. The cost to this class of third-party users (e.g., consumers or purchasing firms) is often overlooked. This is explored in Part II.

7. The outcome of patent litigation is often unpredictable. That can result in expenses of $5 million or more per side. DAN L. BURK & MARK A. LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT 18 (2009).

8. Carl Shapiro, *Patent System Reform: Economic Analysis and Critique*, 19 BERKELEY TECH. L.J. 1017, 1018 (2004) ("Although these companies rely on patents to protect their inventions, they feel strongly that defects in the patent system are raising costs, [and] imposing uncertainty . . . Ultimately, the companies claim these defects hinder their ability to compete, to innovate, and to contribute to economic growth.").

9. Some patent holders opportunistically exploit the *ex ante* uncertainty of claim language by suing (or threatening to sue) through the entire range of a given claim's scope. Once issued, patent claims receive a legal presumption of validity. It is often quite expensive to invalidate an issued patent claim. Some strategically take advantage of the high cost of invalidation by invoking overly broad, but potentially invalid, interpretations. For pioneering work on the "notice externalities" of uncertain patent claims, see Peter Menell and Michael Meurer, Notice Externalities (unpublished research) (on file with the Washington and Lee Law Review); *see also* BESSEN & MEURER, *supra* note 1, at 5 (discussing the E-Data patent infringement case).

10. *See, e.g.*, ROBIN FELDMAN, RETHINKING PATENT LAW 1–10 (forthcoming 2012); William R. Hubbard, *Efficient Definition and Communication of Patent Rights: The Importance of* Ex Post *Delineation*, 25 SANTA CLARA COMPUTER & HIGH TECH. L.J. 327, 330–31 (2009) (arguing that increased certainty in the patent application process can lead to inefficiency).

delimit their legal rights within patent claims.[11] Words have well-known limitations in capturing intangible concepts, and inventive ideas are often quintessentially abstract. Language can be imprecise, ambiguous, open-ended, or inadequate in describing relevant future conduct.[12]

Even acknowledging these limitations, this Article argues that it is possible to broadly reduce patent scope uncertainty. This is because many uncertainty issues do not arise for the intractable reasons just described. Rather, numerous problems of patent claim uncertainty result from scope *underdetermination*. Underdetermination refers to scenarios where a patentee could have supplied information (e.g., in the patent document) that would have clarified the patent's scope for a significant portion of relevant contexts but did not do so.[13] Although there has been some recognition of an underdetermination problem in patent law, without a meaningful theoretical framework, the issue has been difficult to address. To that end, this Article offers a model of uncertainty in patent scope. This model suggests classes of efficient, well-targeted types of information that can reduce the external costs of patent scope uncertainty.[14]

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11. Strictly speaking, the legal scope of a patent emanates from the words of a patent claim, and not the supporting drawings or enabling descriptions that accompany claims. *See* 35 U.S.C. § 112 (2006) ("The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention."); *see also* Giles S. Rich, *Extent of Protection and Interpretation of Claims—American Perspectives,* 21 INT'L REV. INDUS. PROP. & COPYRIGHT L. 497, 499 (1990) ("To coin a phrase, *the name of the game is the claim*."). Interpretive doctrine, however, allows for the usage of the non-claims portion of the patent document as evidence of meaning. *See, e.g.*, Phillips v. AWH Corp., 415 F.3d 1303, 1312–19 (Fed. Cir. 2008) (en banc) (discussing evidence outside the language of a claim that courts use when construing a claim).

12. *See* Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 731 (2002) ("Unfortunately, the nature of language makes it impossible to capture the essence of a thing in a patent application."); Dan L. Burk & Mark A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction*, 157 U. PA. L. REV. 1743, 1744 (2009) ("Literally every [patent] case involves a fight over the meaning of multiple terms, and not just the complex technical ones."); H.L.A. Hart, *Positivism and the Separation of Law and Morals*, 71 HARV. L. REV. 593, 607 (1958) ("Human invention and natural processes continually throw up . . . variants on the familiar . . . .").

13. For an excellent description of the concept of "underdetermination," see Lawrence B. Solum, *On the Indeterminacy Crisis: Critiquing Critical Dogma*, 54 U. CHI. L. REV. 462, 473–75 (1987) (describing underdetermination as a decision, the results of which are a subset of all results that were imaginable at the time of the decision).

14. For a good high-level approach to improving patent certainty by requiring more information during patent prosecution, see Lee Petherbridge, *Positive Examination*, 46 IDEA 173, 174 (2006).

In Part II of this Article, I examine the evidence that widespread legal uncertainty in the existing patent system creates significant economic and social costs. Scholars usually evaluate the patent system using a utilitarian framework—comparing the net social benefits from exclusive patent rights against their net social costs. Uncertainly scoped patents appear to disproportionately tilt this calculus, increasing net cost. Some researchers have argued that the external costs to third parties of operating in environments of uncertainly scoped patents may be leading to broad reductions in net innovation.[15] If correct, this would appear to undermine a primary purpose of patent law, which is to promote net inventive activity.[16]

Part III explores the theory of patent scope uncertainty more rigorously as a foundation for developing mitigation strategies. In particular, I frame the issue of patent scope underdetermination as a special case of "legal uncertainty" generally by drawing from the jurisprudence literature. This approach frames legal uncertainty in terms of *ex ante*[17] constraints on "legal officials" (e.g., judges, juries, etc.).[18] Uncertainty results when such *ex ante* constraints do not meaningfully limit (and hence render unpredictable) the range of *ex post* decisional outcomes available to an official.[19]

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15. *See* BESSEN & MEURER, *supra* note 1, at 5–10 (discussing the inherent difficulties of equating patents to property, one of which is the inability to define the boundaries of patent rights).

16. *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 480 (1974) ("The [purpose of the] patent laws [is to] promote . . . progress by offering a right of exclusion for a limited period as an incentive to inventors to risk the often enormous costs in terms of time, research, and development."). "The productive effort thereby fostered will have a positive effect on society through the introduction of new products and processes of manufacture into the economy . . . ." *Id.* Scholars have noted other important purposes of patent law, including incentivizing disclosure and commercialization of technology.

17. The "*ex ante*" period that I refer to throughout this Article is the period consisting of any time up until a judge (or other legal official) makes an authoritative legal determination as to the meaning of a claim word during a patent infringement lawsuit. Thus, because most patents are not litigated, and even fewer reach the claim construction phase of the lawsuit, the vast majority of patents will remain in the *ex ante* stage, never to have their claim words authoritatively determined. *See, e.g.*, John R. Allison, Mark A. Lemley & Joshua Walker, *Extreme Value or Trolls on Top? The Characteristics of the Most-Litigated Patents*, 158 U. PA. L. REV. 1, 4 (2009) (noting that only 1.5% of patents are litigated).

18. I use the term "legal official" broadly, referring not just to judges, but to any legal position that has the capacity to authoritatively resolve an issue of law or fact. This term encompasses juries and administrative officials, in addition to trial and appellate judges.

19. *See* Duncan Kennedy, *A Semiotics of Critique*, 22 CARDOZO L. REV. 1147, 1158 (2001) (stating that choices made by social actors are often underdetermined by "available principles" and influenced by "strategic behaviors"); *see also* H.L.A. HART, THE CONCEPT OF

This view maps well onto patent scope uncertainty scenarios. Third parties cannot easily determine the boundaries of a patent claim when it has a high degree of *ex ante* interpretive variability.[20] A claim scope is variable if it has a wide range of plausible interpretations even after applying the internal and external constraints to the patent document that limit coverage. For example, consider a claim with the word "encryption," which can be reasonably interpreted broadly as "a cipher"[21] or narrowly as "computerized encoding" read in context of the patent document.[22] Such interpretive variability leads to scope uncertainty because a third party cannot know with any degree of legal certainty, *ex ante*, which of the plausible scopes will be adopted by a judge *ex post* (during an infringement lawsuit).[23] If the application of one plausible interpretation over another would produce a diametrically opposite outcome such that a party would be liable for

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LAW 132 (2d ed. 1994) (noting the considerable discretion allowed courts in making determinations); Frederick Schauer, *Exceptions*, 58 U. CHI. L. REV. 871, 873 (1991) (finding that the power to create "exceptions" to defined rules "turns out to be the power both to change the rules and to avoid their constraints"); Joseph William Singer, *The Player and the Cards: Nihilism and Legal Theory*, 94 YALE L.J. 1, 11–13 (1984) (characterizing the indeterminacy of legal doctrine as desirable and inevitable to an extent).

20. A patent claim that has a high range of *ex ante* interpretive variability can more easily straddle the issues infringement of patent validity. *Ex ante* variation in scope range permits a wide range of sometimes shifting meanings during litigation. For some examples of shifting meanings of claim terms during infringement proceedings, see Highmark, Inc. v. Allcare Health Mgmt. Sys., Inc., 732 F. Supp. 2d 653, 664 (N.D. Tex. 2010). ("The Court also cited Allcare's shifting claim construction as a basis for sanctioning Hill. . . . Hill now explains that it is 'not unusual' in patent litigation for a party to adjust its claim construction during the course of litigation.").

21. *See Cipher*, OXFORD WORLD DICTIONARY ONLINE (2011) ("A disguised way of writing; a code."). Cipher codes predate computers and do not require computer technology to implement.

22. For a similar case, see L & P Prop. v. JTM, LLC, 578 F. Supp. 2d 318, 326 (D. Mass. 2008) ("Defendants take issue with L & P's definition of 'encryption' by citing numerous definitions from technical dictionaries.").

23. A patent claim drafted with a fair amount of scope uncertainty probably makes it more likely that invalid patent claims—or patent claims with a range of scopes, some of which are invalid—will issue. During prosecution, patent examiners search for prior art to determine if the patent meets the statutory requirements of non-obviousness and novelty. Variability in the scope of patent claim words complicates the process of finding invalidating prior art. Patent examiners operate in a world of limited time and search resources. Multiple plausible interpretations means a wider range of potentially applicable prior art. If there are multiple plausible interpretations, patent examiners are instructed to employ "the broadest reasonable interpretation." *See* MPEP, *supra* note 5, § 2111.

infringement under interpretation "A" but not under interpretation "B," the claim will be uncertainly scoped relative to that product.[24]

Part IV develops a formal model of claim scope uncertainty that builds upon the earlier model. This formal model's goal is to provide a more rigorous structure for understanding the problem of scope underdetermination in order to develop mitigation strategies. This Part frames the salient features of scope uncertainty using the mathematical frameworks of set theory and constraint satisfaction.[25]

This model highlights a marginal approach to reducing scope uncertainty. We can view scope uncertainty as a relational inquiry from the perspective of a third party seeking to avoid infringement. One can measure the adequacy of claim scope definition by contrasting the claim against a relevant set of products. This set consists of all products that third parties would like to determine, *ex ante*, whether they do or do not infringe a particular claim. Given that a claim's scope is underdetermined, the marginal approach queries: What *additional* information is likely to increase the certainty of such infringement analyses? Requiring patentees to provide clarifying, scope-defining information *ex ante* can reduce scope uncertainty. The way to increase scope certainty is to create more precise claim boundaries. To make the boundaries of a claim element more precise *ex ante*, one must prospectively exclude *ex post* scope coverage.

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24. For example, imagine an accused product that employed non-computerized encryption in the product. If "encryption" is interpreted broadly by a judge during claim construction, it may literally cover a non-computerized version of encryption. By contrast, if the term is endowed with a narrower meaning restricted to computers, the accused product may not literally infringe. The interpretation and hence scope may be hard to predict *ex ante*.

25. This constraint-satisfaction model serves as a useful analogy to the way in which patent claim interpretation operates. The patent document serves to establish the boundaries of the patent holder's exclusive rights. *See* 35 U.S.C. § 154(a)(1) (2006) (granting patentees various rights to use, and restrict the use of, the patented invention or process). In interpreting patent claims, judges look to hone in on the meaning of the claim words by consulting evidence from multiple sources. *See* Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996) (noting that the court may utilize a number of sources). These indicia of likely meaning come from within the patent document itself (intrinsic evidence), as well as evidence of meaning external to the patent document such as dictionaries (extrinsic evidence). *Id.* at 1582–83 (discussing the proper weighing of intrinsic and extrinsic evidence). Judges typically use these indications to restrict the possible meanings of claim words to their most reasonable interpretation in light of the sources of evidence. *Id.* at 1582 (describing clear and unambiguous language as highly relevant).

In Part V, guided by the formal model, I suggest policy changes to improve overall claim scope certainty.[26] The model largely supports the Federal Circuit's current patent interpretive framework but proffers important modifications. For example, the model reveals that aspects of the doctrine, such as reliance on an "ordinary meaning in the art" default interpretive standard, often provide illusory constraints on claim scope.[27] A more theoretically justified approach requires patentees to provide classes of low-cost but targeted scope-defining information in the patent record.

Mindful of efficiency, this Part focuses upon disclosures that are limited yet likely to yield improvements. For example, scope uncertainty problems often arise when different "embodiments"[28] included in a patent share common physical design attributes. A common issue of scope ambiguity concerns whether these shared characteristics should be read as *implicit* limitations on the scope of a given claim during an infringement proceeding.[29] The model suggests that the patent system can efficiently reduce this and other predictable uncertainty issues by requiring patentees to explicitly disambiguate foreseeably problematic boundary lines *ex ante* on the public patent record.[30]

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26. Timothy R. Holbrook, *Substantive Versus Process-Based Formalism in Claim Construction*, 9 LEWIS & CLARK L. REV 123, 127–33 (2005) (discussing different standards of "formalism" used by courts in their efforts to give patent law more certainty); Kelly Casey Mullally, *Patent Hermeneutics: Form and Substance in Claim Construction*, 59 FLA. L. REV. 333, 365–66 (2007) (describing problems with formal patent rules in not incorporating relevant contextual information).

27. *See* Bell Atl. Network Servs., Inc. v. Covad Commc'ns Grp., Inc., 262 F.3d 1258, 1267 (Fed. Cir. 2001) ("As a starting point, we give claim terms their ordinary and accustomed meaning as understood by one of ordinary skill in the art.").

28. An "embodiment" is "a specific, disclosed example of how an inventive concept, that is more generally stated elsewhere in the disclosure, can be put into practice." WORLD INTELLECTUAL PROP. ORG., INT'L PATENT CLASSIFICATION GUIDE 33 (2009).

29 Consider a patent claim with the word "motor," which only discloses internal combustion motors in the specification, but which is being extended to electric motors. There is a fundamental tension in patent law between the embodiments (or exemplars of technology) that are included in a patent document and the claim scope. The scope of a patent claim is not supposed to be limited simply to the included embodiments. Rather, it is supposed to be expansive beyond whatever particular physical form is disclosed as an example. On the other hand, common features among included embodiments often suggest genuine limitations on the intended scope of a patent claim.

30. The public patent record generally includes the patent document itself as well as the prosecution history—the record of the patent prosecution. Such a targeted approach can be efficient and complementary to other *ex post* approaches to handling problematic patent claims. *See, e.g.*, BURK & LEMLEY, *supra* note 7, at 45; Hubbard, *supra* note 10, at 331.

II. The Problem of Uncertainty in Patent Scope

Many patents granted by the Patent and Trademark Office have claims of ambiguous legal scope.[31] The aggregation of so many uncertain patents creates an environment of ambiguity as to legal coverage, leading to significant social costs. Before presenting a model of scope uncertainty, it is helpful to have an understanding of why uncertainly scoped patents may partially undercut patent law's economic justification. In this subpart I will survey some costs of uncertainly scoped patent claims.

A. The U.S. Patent System Is Justified if It Produces Net Social Benefits

The classic justification for the U.S. patent system is utilitarian.[32] Under this view, the net benefits of a system of exclusive patent rights must outweigh the net costs from a society-wide perspective.[33] Primarily, we grant private patent rights to induce technological inventions that would not otherwise be produced absent such incentives.[34]

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31. *See* Mark A. Lemley, *The Changing Meaning of Patent Claim Terms*, 104 MICH. L. REV. 101, 102 (2005) ("Claim construction occurs in every patent case during a 'Markman hearing.'"). For various reasons, it is difficult to quantify the percentage of indeterminate claims. One admittedly imperfect metric is the claim construction rate during litigation. Nearly every patent infringement lawsuit requires a judge to choose between different, but reasonably plausible, interpretations of patent claims. *Id.* Because claim construction occurs in every or nearly every case, one reasonable interpretation is that, for that subset of claims litigated, they are of *ex ante* uncertain scope. Of course, this is only a rough metric of systemic uncertainty. One would presume that there is selection bias because those claims that are litigated, rather than settled, are probably those that are more uncertain.

32. *See* U.S. CONST. art. I, § 8, cl. 8 (granting Congress the power "[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").

33. *See* Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc., 548 U.S. 124, 126–27 (2006) (Breyer, J., dissenting, joined by Stevens and Souter, JJ.) ("[T]he reason for the exclusion is that sometimes *too much* patent protection can impede rather than 'promote the Progress of Science and useful Arts,' the constitutional objective of patent and copyright protection." (citing U.S. CONST. art. I, § 8, cl. 8)).

34. Beyond the *development* of inventions, patent rights are also thought to be important in incentivizing the commercialization of inventions, and the disclosure and dissemination of new technological information to the public. *See generally* WILLIAM LANDES & RICHARD POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 294, 308 (2003).

According to the standard economic account, patent rights are designed to overcome the "public goods" problem that leads to the underproduction of inventions.[35] We can think of an invention as "information" because the value of an innovation consists largely in the underlying knowledge about how to make and use the underlying technology. Because an invention is information, it has the economic characteristics of a "public good" (i.e., non-rivalry and non-excludability). In the marketplace for physical goods, excludability and rivalry are the properties that allow creators to sell copies of their product to each purchaser willing and able to pay. Ideas, as intangibles, lack these properties. It is thus difficult for inventors to use the traditional market to capture the value of their inventive contributions. Inventors have no practical way of selling their inventive ideas to only those who pay for them while excluding others who do not.

Because traditional market mechanisms are inadequate for intangible ideas, the belief is that, absent exclusive patent rights, inventions will be underproduced relative to a socially desirable level.[36] Inventive ideas are often expensive for an inventor to develop, but once created, often inexpensive for competitors to copy.[37] An inventor must recoup the

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35. Patent laws as formulated exist to rectify the "public goods" problem of inventions. This problem is best understood by contrasting physical, tangible goods, and the "informational" nature of inventions. Physical goods are, by their physical nature, rivalrous and excludable. The ability to exclude those who do not pay for physical goods from using those goods allows sellers of those goods the ability to appropriate the value of those physical goods in the marketplace. This ability to sell and profit from goods in the marketplace establishes a sufficient incentive to encourage producers of physical goods to invest in the means of producing those goods, as they have a mechanism to recoup their investment. Inventions are, at their base, non-tangible ideas, and are thus non-rivalrous and non-excludable. Thus, absent some intervention, inventors will not be able to appropriate the full value of their inventions. Without the ability to appropriate the full value of their inventions, inventors will not invest in research and development to create new inventions.

36. The notion of underproduction of inventions refers to two distinct ideas: the ultimate creation of inventions and the pace of inventive activity. The first refers to the idea that some inventions may never be produced at all absent adequate incentives. The second refers to the idea that some inventions may still ultimately be produced absent patent incentives, but that the speed of innovation will be diminished and such technologies will arrive at a socially undesirable slower pace. *See* LANDES & POSNER, *supra* note 34, at 302–07 (discussing rules that reduce the social cost of patent protection).

37. *See* BURK & LEMLEY, *supra* note 7, at 80–81 (stating that the ratio of inventor cost to imitator cost is large, for example, in the pharmaceutical industry). Although inventions are often costly to develop because they are essentially information, they are easy to copy by competitors who did not incur the same development costs as the inventor. *Id.* Competitors will be therefore be able to price the product lower than the inventor because the inventor

research costs of developing the invention, but copying competitors will be able to "free ride" off an inventor's investment without having borne the development costs.[38] The concern is that putative inventors will not invest in developing inventions in the first instance if they believe they will not later be able to recoup their investment due to underpricing by copying competitors.

Patent rights are a government intervention designed to overcome the problem of underproduction of inventions in the normal competitive marketplace. The legal system artificially endows inventive ideas with legal analogs to the excludability and rivalry properties that naturally allow the value of physical goods to be appropriable in the market. Time-limited, exclusive patent rights are thus designed to incentivize private inventors to invest in, develop, and commercialize technologies. Exclusive patent rights permit supra-competitive marketplace profits for a limited period to permit inventors to recoup research and development costs and appropriate the value of their inventive contribution.[39]

From a utilitarian perspective, one weighs the net social benefits of exclusive patent rights against their net social costs. All intellectual property regimes have costs, including dead-weight economic losses from monopoly pricing, administrative costs, third-party transaction costs, and increased downstream-development costs.[40] Exclusive patent rights are

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has to price the product at a higher level to recoup its development costs; whereas competitors did not incur such development costs and can afford to charge a lower price. *Id.* Under conditions of perfect competition, competitors will drive the price of inventions down to their marginal cost. RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 38–40 (4th ed. 1992). Inventors will therefore be at a disadvantage because they incur the fixed costs of development in addition to the marginal cost of producing each product; whereas copiers do not incur the fixed development costs. *See id.* (discussing the economics of intellectual property law).

38. *See* LANDES & POSNER, *supra* note 34, at 294–95 (discussing the tension between the costs of keeping trade secrets and the patent disclosure rules).

39. *See In re* Ciprofloxacin Hydrochloride Antitrust Litig., 363 F. Supp. 2d 514, 540 (E.D.N.Y. 2005) (agreeing that the "exclusion of competitors and charging of supracompetitive prices are at the core of the patentee's rights, and are legitimate rewards of the patent monopoly." (quoting United States v. Studiengesellschaft Kohle, m.b.H., 670 F.2d 1122, 1128 (D.C. Cir. 1981))).

40. *See* LANDES & POSNER, *supra* note 34, at 16–21 (discussing the costs of granting intellectual property rights). For a good discussion of downstream costs imposed by early patents, see Charles W. Adams, *Allocating Patent Rights Between Earlier and Later Inventions*, 54 ST. LOUIS U. L.J. 55, 56–60 (2009) (explaining the problems that arise when allocating intellectual property rights to an initial inventor and a later improver).

primarily justified to the extent they incentivize the introduction of technologies that would not have otherwise been produced. The additional public welfare contributed by these incentivized technologies largely provides the benefits that justify any costs of the system.

Recent empirical research suggests that the existing patent system's costs might outweigh its benefits.[41] According to evidence from James Bessen and Michael Meurer, a significant source of these costs stems from the relative indeterminacy of patent coverage.[42] If true, the net external costs imposed by uncertain patents may undermine the utilitarian justification for patent law. Since patents of uncertain scope appear to disproportionately shift the cost/benefit calculus, it is worth particularly focusing on the certainty of patent scope as a problem within patent law.

B. The Social Costs of Systemic Uncertainty in Patent Scope

In this subpart I will explore some of the external costs of patent scope uncertainty. Before doing so, it is helpful to have an intuitive view of what it typically means for a patent claim to be *ex ante* uncertain in scope.

1. Patent Claim Scope Uncertainty: An Intuitive View

A patent gives the holder a time-limited right to exclude all others from making, selling, or using products or processes that fall under the scope of the patent's claims. The claims, found at the end of a patent document, define the legal scope and boundaries of "the subject matter that

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41. *See* BESSEN & MEURER, *supra* note 1, at 120–44 (finding that, for most industries in the late 1990s, patents likely provided a net disincentive to innovate due to the costs of patent litigation). Bessen and Meurer provide evidence that for the average firm outside of the pharmaceutical and chemical industries, the private costs of the patent system outweigh the private benefits. *Id.* This, of course, is a different measure than net social welfare—how the patent system benefits society as a whole. Net social welfare is difficult, if not impossible, to measure empirically. True, their results are not conclusive about net social welfare. Nonetheless, their research provides some strong indirect evidence that the costs of the patent system probably outweigh its benefits. If, as Bessen and Meurer argue, for the average firm, the incentives provided by the patent system are negative, it seems unlikely that the patent system will induce overall increased innovation, thereby increasing net social welfare.

42. *See id.* at 147–48 (concluding that notice failure and inadvertent infringement are major factors contributing to the surge in patent litigation).

the applicant regards as his invention."[43] Patent claims are composed of language—by law, a single sentence that describes the technology or invention that forms the basis of the right to exclude.[44]

Many instances of scope uncertainty involve claims with a high degree of *ex ante* interpretive variability. The process of patent infringement largely involves comparing the words of the patent claim to the product or process that is accused of infringing that claim.[45] The scope of a patent claim—which technologies it covers—will often turn on the interpretation of claim terms.[46] A well-scoped claim will have, *ex ante*, a well-defined, bounded, and definite range of meanings.

In an uncertainly scoped patent claim, the range of plausible scopes is often variable.[47] In other words, the legally authoritative meanings of most of the words of the claim are not definitively knowable *ex ante*, but rather, exist in a probabilistic range of possible scopes. Patent claims with a wide range of interpretive variability often create scope uncertainty because it is difficult to know objectively, and *ex ante*, which is the legally determinative scope. The scope of such a claim may be an uncertain, probabilistic assessment, because during a patent infringement lawsuit, a judge (or jury) might elect any one of the plausible interpretations.

Ex ante, third parties cannot tell what is, and what is not, covered by such patent claims with any degree of legal certainty. With one interpretation, a competitor's product could be held to infringe and with another interpretation, not. Precision of scope therefore refers to the degree

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43. 35 U.S.C. § 112 (2006).

44. *Id.*; *see also* MPEP, *supra* note 5, § 608.01(m) ("Each claim begins with a capital letter and ends with a period. Periods may not be used elsewhere in the claims except for abbreviations.").

45. There are two steps to the infringement analysis—literal infringement, and infringement under the doctrine of equivalents. 4 R. CARL MOY, MOY'S WALKER ON PATENTS § 13:1 (4th ed. 2010). For the moment, I focus on the former, and equate the prima facie scope of a patent with literal infringement of the claim.

46. *See In re* Van Geuns, 988 F.2d 1181, 1184 (Fed. Cir. 1993) (stating that "it is axiomatic that claims define the invention which an applicant believes is patentable").

47. Thus, when we talk about an uncertainly scoped patent we are not concerned with a broadly but well-defined scope (e.g., clearly "All motor vehicles"). Rather, we are concerned with scenarios where the scope of the patent may be broad, narrow, or somewhere in between—we are just unable to determine which (e.g., unclear if "All motor vehicles," "electric-motor vehicles," "plug-in hybrid cars"). For reasons explained later, this Article is not concerned with broadly scoped patents but uncertainly scoped patents, whether broad or narrow.

to which the patent adequately conveys to third parties which technologies are, and which are not, covered by a given patent claim.[48]

2. External Costs to Third Parties of Uncertainly Scoped Patents

The primary problem with uncertainly scoped patents is that they can impose significant costs on third parties. Any issued U.S. patent is potentially valid against all parties within the jurisdiction of the United States.[49] In any field of endeavor, a firm must take into account the total risk of patent infringement based upon their activities or products. This risk and associated expenses represent costs that firms internalize into their investment and production decisions. All patents impose some cost on third parties, but uncertainly scoped patents impose disproportionately greater costs.

When a patent claim is uncertain because of a wide range of interpretive variability, a third party cannot easily determine its boundaries.[50] This increases the information transaction costs for a firm of estimating and assessing infringement liability risk.[51] It also raises the cost of proactively reducing risk by reorienting production activities, or attempting to "invent around" a particular claim by creating products that do not infringe. Such legal risk reduction strategies are more difficult because, in many cases, a firm cannot know with any level of certainty what the *ex post* boundaries of a given claim will be held to be. In many cases where a patent claim exhibits a wide scope variance, it might be impossible or costly to restructure a product outside of its scope.

Whether or not firms routinely clear patent rights prospectively, they do often become aware of patents in their field and must make investment and planning decisions accordingly.[52] For example, inventing companies

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48. Mullally, *supra* note 26, at 333 ("The claims inform us of the boundaries delineating the subject matter over which the inventor holds an exclusive right.").

49. *See* 35 U.S.C. § 271 (2006) (discussing patent infringement).

50. *See* BESSEN & MEURER, *supra* note 1, at 147 ("[T]he boundaries created by patents are hidden, unclear, or too costly to determine.").

51. *See id.* at 147–50 (suggesting that patent scope uncertainty increases patent litigation risk, which acts as a disincentive to innovation).

52. *See* Mark A. Lemley, *Ignoring Patents*, 2008 MICH. ST. L. REV. 19, 21–22 (explaining how inventors in patent law commonly adopt a wait and see approach for patent infringement rather than conducting research into the patent rights landscape prior to invention).

routinely receive "cease and desist" letters that alert them to particular patents, or are actually sued for infringing particular patent claims.[53] When the claims at issue are uncertain, risk-mitigation strategies will be reduced because of the inability to fully determine conduct firmly outside of that claim's scope. Such claims likely also increase the costs of patent litigation. The inability to unambiguously determine coverage contributes to the typical costs of patent-infringement litigation, ranging from $2–$5 million per side.[54] Legal uncertainty typically makes settlement less likely and pre- and post-litigation costs higher. These higher litigation costs will cause a firm to redirect money that could have been directed to more socially productive uses.[55]

Uncertainly scoped patents also increase firms' costs of confronting potentially invalid patent claims.[56] For a patent to issue, it must meet the statutory validity requirements of the patent act, including novelty, non-obviousness, and enablement. A patent claim that has a high range of *ex ante* interpretive variability can more easily straddle the issue of patent validity. Some plausible interpretations may meet the statutory validity requirements while others may not. Not only does this variable scope complicate the job of the patent examiner in discovering invalidating prior art during prosecution (likely leading to more claims with only probabilistic validity), it requires third-party firms to contend with more such claims that simultaneously have both valid and invalid prima facie interpretive scopes.

These external costs become significant from a society-wide perspective when we consider the number of firms potentially affected and the number of patents potentially at issue. Given the size of the United

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53. Also, company researchers sometimes come across or passively gain knowledge of existing patents. Finally, in a minority of technological areas, such as in pharmaceuticals, there are well-known patents that are widely known by industry participants, and inventing entities frequently do actually attempt to do prospective searches of patent rights. *Id.* at 29. Lemley notes that in the pharmaceutical industry, companies are required to list all of the patents covering each FDA approved drug. This allows third parties to survey the patent coverage much more succinctly in that domain.

54. *See* AMERICAN INTELLECTUAL PROP. LAW ASS'N, 2009 REPORT OF THE ECONOMIC SURVEY (2009) (showing that the cost of patent-infringement litigation ranges from $1 million to $25 million depending on the size of the firm and the stage of the case).

55. *Id.*

56. *See* BESSEN & MEURER, *supra* note 1, at 6 (discussing the E-Data patent infringement case). The original invention covered by the E-data patent was a kiosk that produced digital audio tapes in the retail settings. It was later asserted in patent litigation to cover broad swathes of e-commerce activities.

States patent system, even a small amount of systemic patent scope uncertainty can result in dramatic costs. There are approximately two million patents in force at any given time.[57] Each patent, in turn, contains approximately ten claims, with each claim bestowing its own separate legal right to exclude technologies.[58] Thus, nearly every organization or individual has to incorporate into their planning the probability of infringing roughly twenty million active patent claims. Even if we exclude active but unrelated patents, the number of claims that should be theoretically included in the expected cost valuation numbers is in the still unmanageable tens of thousands in many industries.[59] Only a small percentage of issued patents are economically viable and ever litigated or licensed.[60] However, even issued patents that have not yet been litigated may increase a firm's internal expected costs if there is a non-trivial possibility of litigation. Moreover, even if a small percentage of the viable claims are uncertainly scoped, given the large numbers of patents generally, the net costs can be quite significant.

In theory at least, a third-party firm making investment decisions factors in the expected cost of patent infringement for some percentage of these patent claims.[61] The Supreme Court has noted that even a small

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57. *See* WORLD INTELLECTUAL PROP. ORG., WORLD PATENT REPORT: A STATISTICAL REVIEW 23 (2008) (estimating the number of patents in force as of 2006 at 1.8 million).

58. *See* Dennis Crouch, *Dropping: Average Number of Claims per Patent*, PATENTLY-O BLOG, http://www.patentlyo.com/patent/2010/01/dropping-average-number-of-claims-per-patent.html (last visited Nov. 18, 2011) (providing a rough estimate of the number of claims per patent) (on file with the Washington and Lee Law Review). According to Crouch's random sample of 22,000 patents, the average number of claims per patent has increased over the last twenty years, dropping slightly from its peak. *Id.* The number of claims per patent increased from roughly ten claims per patent in 1980 to over fifteen claims per patent by 2009. *Id.*

59. BESSEN & MEURER, *supra* note 1, at 8–9. The authors estimate that for a firm selling products on the Internet, the firm would have to take into consideration over 4,000 potentially applicable patents. *Id.* With an average of ten claims per patent, that translates into over 40,000 claims whose expected infringement cost might be incorporated by a firm. Firms may be able to filter out the vast majority of active patent claims as they are likely to be outside of any particular field of endeavor.

60. Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1507 (2001) ("As we have seen, only about 1.5% of patents are litigated at all. The total number of patents licensed for royalties without even a complaint being filed is likely somewhat higher, but I suspect the total number of patents litigated or licensed for a royalty (as opposed to a cross-license) is on the order of five percent of issued patents.").

61. *See* Richard A. Posner, *Efficient Responses to Catastrophic Risk*, 6 CHI. J. INT'L L., 511, 523 (2006) (presenting the use of a cost-benefit in situations of extreme uncertainty).

amount of systemic legal uncertainty in an inventive area can depress development. As the Court said, "'[T]he limits of a patent must be known' . . . otherwise, a zone of uncertainty which enterprise and experimentation may enter only at the risk of infringement claims would discourage invention only a little less than unequivocal foreclosure of the field."[62] In other words, even without knowledge of particular uncertain patent claims, simply operating in an environment of suspected endemic patent uncertainty can encumber innovation.[63]

C. Relationship Between Clear Legal Boundaries and Growth

While patent uncertainty seems to dampen investment, by contrast, economic research suggests a general relationship between clear legal boundaries and increased economic growth.[64] Scholars have suggested that research to this effect from the real property realm can be helpful as a (limited) analogy to the scope uncertainty issues in the intellectual property realm. It is generally thought that in property-rights systems, extensive uncertainty as to scope of legal rights leads to increased transaction costs and decreased investment.[65]

In the real property domain, much has been written about the importance of public, certain, and easily accessible titles and deeds in facilitating economic development.[66] With respect to land, the boundaries of real property are precisely described by the "metes and bounds" of the

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62. Markman v. Westview Instruments, Inc., 517 U.S. 370, 390 (1996) (quoting Gen. Elec. Co. v. Wabash Appliance Corp., 304 U.S. 364, 369 (1938) and United Carbon Co. v. Binney & Smith Co., 317 U.S. 228, 236 (1942)).

63. *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698, 698–99 (1998) (discussing the effect patent monopolies have on increasing prices to investors in hopes of encouraging invention).

64. *See* Tamar Frankel, *The Legal Infrastructure of Markets: The Role of Contract and Property Law*, 73 B.U. L. REV. 389, 395 (1993) ("The policies of both contract and property law aim at reducing peoples' planning costs and transaction costs. Planning is facilitated by rules that remove, as much as possible, ambiguities and legal risks in the relationships.").

65. *Id.* at 395–97.

66. *See, e.g.*, Arthur R. Gaudio, *Electronic Real Estate Records: A Model for Action*, 24 W. NEW ENG. L. REV. 271, 289 (2002) (stating that recording promotes efficiency and economic development).

land as delineated in the deed. In modern day deeds, it is possible to precisely fix the outer boundaries of properties using global positioning coordinates.[67] Even if third parties do not actually inspect real property deeds before investing, they can have confidence that the boundary demarcation mechanisms used are precise. Such knowledge of precision of boundary rights results, in turn, in general confidence that transaction costs in determining boundaries should be low if a dispute does arise.

Empirical research has linked precision and certainty of boundaries in the real property realm to improved economic development.[68] By contrast, countries with inadequate institutions and rules for promoting public notice as to boundaries in real property tend to exhibit stunted investment, development, and planning.[69] The increased legal uncertainty translates into increased transaction costs and ultimately serves to inhibit net investment.[70]

Although the analogy to real property law has its limits, there are reasons to believe that there are similar dynamics in patent law. All things being equal, we would expect decreased investment, planning, research, and development in new technologies when inadequate certainty exists about the scope of existing patent rights. Conversely, when third-party firms have more certainty about their potential patent infringement liability, there will likely be increased investment. For example, the Supreme Court has said, "If competitors cannot be certain about a patent's extent, they may be deterred from engaging in legitimate manufactures outside its limits, or they may invest by mistake in competing products that the patent secures."[71]

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67. *See* Peter H. Dana, *Global Positioning System Overview*, UNIV. OF COLO. (May 1, 2000) http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html (last visited Sept. 13, 2011) (stating that differential carrier phase GPS tracking can achieve surveying accuracy from 1 mm to 1 cm) (on file with the Washington and Lee Law Review).

68. *See* BESSEN & MEURER, *supra* note 1, at 77 (linking Britain's Industrial Revolution to the establishment of clear private property rights, more predictable courts and police, and limitations on confiscatory taxation).

69. *See id.* at 81 (citing a study finding that the quality of a nation's property rights institutions has a strong, positive correlation to economic growth).

70. *See id.* at 39–45 (discussing that the regulation of property law minimizes costs by decreasing the information burden). A properly functioning property system will encourage investment and trade, but, if the system is not implemented well, then disputes arise and cause increased costs. *Id.* at 45; *see also* HERNANDO DE SOTO, THE MYSTERY OF CAPITAL (2000).

71. *See* Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 732–33 (2002) (addressing the issues stemming from the uncertainty of a patent claim's extent).

Patent boundaries cannot be as precise as deeds in lands.[72] Nonetheless, the analogy is useful because, even absent precise claim scope certainty, *relatively more* certain patent claim boundaries would yield more overall investment in socially productive usages such as research and development and relatively fewer outlays toward legal transaction costs. As Bessen and Meurer have argued, overall uncertainty about patent rights likely imposes significant costs on third-party development, and those costs would be more productively redirected in environments of patent scope certainty.[73] The legal uncertainty of an ambiguously scoped patent can act like an industry-wide tax on the cost of invention, which all firms bear. This sum of these external costs may outweigh any social benefit brought by the patented invention.

D. Opportunistic Behavior from Patentees

Uncertainly scoped claims also incentivize opportunistic behavior on the part of patent holders. Such uncertainty can produce problematic externalities: private benefits for the patent holder but costs that are borne externally by other firms and the public. Recall that some uncertainly scoped patents exist *ex ante* in a probabilistic range of interpretive scopes. Some patent holders strategically exploit the *ex ante* uncertainty of claim language by suing (or threatening to sue) through the entire range of a claim's prima facie scope, irrespective of actual validity or coverage.[74] Once issued, patent claims receive a legal presumption of validity, and it is often quite expensive to invalidate an issued patent claim.

Some patentees deliberately take advantage of the high cost of invalidation by invoking overly broad, but potentially invalid,

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72. The analogy is limited because, unlike in real property, the boundaries of patents are not precisely fixed using global positioning coordinates. Rather, patent rights are described by the vagaries of words. To continue with our real property analogy, let us imagine that even if deeds were publically available, they designated property boundaries using impermanent, movable landmarks, or that the level of precision was in miles, rather than the needed feet or inches. We would imagine knowledge among real property developers of such endemic imprecision would have a depressive effect on property development. Thus, although the real property analogy is instructive as a theoretical goal, such precise boundary definition may be elusive in patent law.

73. BESSEN & MEURER, *supra* note 1, at 67.

74. *Id.* at 6 (discussing the E-Data patent infringement case).

interpretations. This allows patentees, for example, to threaten suit over technologies that the patentee never actually invented, but which fall under some subset of plausible interpretations given the literal language of the claims. Some commentators have found this particularly common in patent infringement suits by non-practicing entities. Even without such opportunism, run-of-the-mill patentees often benefit from the flexibility permitted by *ex ante* scope uncertainty to selectively adjust their asserted scope to navigate invalidity and infringement obstacles before and during litigation.[75]

E. Some Social Benefits of Scope Uncertainty

Having focused on the costs of patent scope uncertainty, it is also important to note some benefits. First, it is often difficult and costly for patentees to precisely define the boundaries of their claims *ex ante*. Leaving some claims imperfectly defined can be seen as an efficient use of a patent applicant's limited resources.[76] Second, patents drawn with rigidly defined boundaries may undercompensate patentees in future infringement proceedings.[77] The patent system aims, as a general goal, to reward patent holders proportionately to their inventive contribution to society. However, undercompensation may occur if rigidly defined patent boundaries do not cover competitors' future products employing the patentee's inventive concept.

Overall, it would be undesirable to have a patent system that is perceived by inventors to systematically undercompensate them relative to their inventive contribution. Most clearly, the "doctrine of equivalents" is a process aimed at addressing the underinclusion problem inherent in rigidly defined categories. However, we can consider patent scope *uncertainty* as another, albeit more informal, means to approach the same problem. Uncertainty in the scope of a claim often has the functional benefit of allowing judges the *ex post* flexibility to adjust their interpretive decisions to proportionally match the underlying inventive contribution.

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75. Rambus Inc. v. Hynix Semiconductor Inc., 569 F. Supp. 2d 946, 980 (N.D. Cal. 2008) (noting that parties shift in claim construction positions during litigation caused a "clear inequity").

76. *See* Hubbard, *supra* note 10, at 341–43.

77. *Id.* (noting the difficulties inherent in writing patents to extend future technology).

In this way, scope uncertainty can have an indirect public value. Nonetheless, I believe this benefit is far outweighed by the total costs such uncertainty engenders. This Article suggests that there are more straightforward, efficient, and narrowly tailored approaches to achieving a similar *ex post* flexibility for the occasional case of severe undercompensation due to underinclusive patent scope.

F. A Theoretical Model Can Improve Scope Certainty

The scope of a patent claim, and public notice as to that claim's boundaries, are linked to claim interpretation. This subpart provides a brief overview of such procedures as a link to the next Part, which more deeply probes the problem of patent scope uncertainty.

During a typical patent infringement lawsuit, a patent-holder (usually the plaintiff) alleges that a patent claim covers a tangible product manufactured, used, or sold by the defendant.[78] The product that is being compared to the patent claim is called the "accused device." Because we are comparing the element *words*[79] of a particular patent claim to a real-world product or process during much of the infringement analysis, the interpretation of the claim language is crucial. *Claim construction* is the phase of litigation in which the presiding judge interprets and establishes the official meaning of patent claim words for the purposes of the lawsuit.[80] These interpretations become important because the finder of fact (usually the jury) is required to employ these meanings in its infringement determination.

Words are capable of multiple meanings and may possess broader or narrower scopes of meaning. Because multiple interpretations are possible, it

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78. *See* Eifion Phillips, Phillips v. AWH Corp.*: Reemphasizing Context in Patent Claim Construction*, 31 DEL. J. CORP. L. 957, 958 (2006) (defining claim construction as the act of "determining the meaning and scope of the claims of a patent").

79. A patent claim is a single sentence. It is divided into distinct parts termed "limitations" or "elements." An element may consist of a single word or a group of words. For simplicity, I will use "claim words" and "claim terms" interchangeably with elements in the body of the text. As I discuss later, the division of a claim into elements is itself a nuanced process.

80. Note that claim construction interpretations for the same claim are not typically binding from one infringement case to another involving that same claim. However, previous interpretations, if in context, can be highly influential. *See* Peter Menell, Matthew Powers & Steven Carlson, *Patent Claim Construction: A Modern Synthesis and Structured Framework*, 25 BERKELEY TECH. L.J. 711, 775–80 (2010).

is often *ex ante* legally uncertain whether the words of a patent claim cover a particular accused device or process. For example, consider a word in a patent claim with two equally plausible dictionary meanings. Under one potential interpretation, a claim may clearly cover the accused device at issue in an infringement case, and under the other, the accused device may clearly fall outside the claim. To use a well-known example: Imagine a patent claim whose words describe a technology involving a "board."[81] Imagine that the accused device being sold by the defendant involves a synthetic, rather than a wooden, board. Depending upon the chosen definition, the term "board" is variously capable of covering only wooden, or both wooden and synthetic, boards.

In many cases, the selection of one interpretation over others will be dispositive on the ultimate issue of patent infringement. If the judge selects an interpretation that clearly puts the accused device outside of the patent claim, no literal infringement can be found.[82] A significant number of patent infringement cases will therefore be disposed of shortly after claim construction by motions for summary judgment, eliminating the need for an infringement trial.[83] For this reason, the claim construction process has become one of the most important, if not the most important, phase of the patent infringement lawsuit.[84]

The ability of third parties to alter behavior *ex ante* to avoid infringement is partly contingent on their ability to accurately predict the scope of coverage of claim words in a future infringement proceeding. As I will argue in the sections that follow, the prediction's certainty is partially dependent upon the quality of the information being interpreted—such as the scope-defining information in the patent document—and partially on the rules and procedures followed by district court judges in claim construction proceedings.[85]

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81. *See* Nystrom v. TREX Co., 374 F.3d 1105, 1111–12 (Fed. Cir. 2004) (construing the meaning of the claim term "board").

82. Literal infringement of a claim occurs when every limitation or element in the patent claim at issue is found in the accused device. *See* Amgen Inc. v. F. Hoffmann-La Roche, Ltd., 580 F.3d 1340, 1374 (Fed. Cir. 2009) ("If any claim limitation is absent from the accused device, there is no literal infringement as a matter of law.").

83. EDWARD MANZO, PATENT CLAIM CONSTRUCTION AT THE FEDERAL CIRCUIT § 6:1 (2009).

84. Not all claim words are necessarily construed by the presiding judge—some lay terms may be directly interpreted and applied by the ultimate finder of fact, usually the jury, during the infringement determination. *See* Menell et al., *supra* note 80, at 730–33.

85. *See* Markman v. Westview Instruments, Inc., 52 F.3d 967, 979 (Fed. Cir. 1995),

In sum, firms can incur substantial direct or indirect costs due to patent claims of uncertain scope. Some research has hinted that these external costs, when multiplied across numerous third-party firms and multiple active claims, might outweigh any benefits induced by these patent claims. With this calculus in mind, the next Part will begin a theoretical model of the scope uncertainty problem. The goal will ultimately be to develop strategies for changing patent procedures likely to produce patent claims of generally more certain scope.

III. Patent Scope and Legal Uncertainty

A. Claim Scope Uncertainty: A More Rigorous View

As indicated, current patent procedures permit claims whose scopes range from the well-defined to the relatively poorly defined. This Part clarifies patent scope issues through the lens of broader concepts of legal uncertainty. It develops a theoretical (and idealized) metric representing a patent claim of perfect scope certainty. A claim will meet this theoretical standard if a lay interpreter of the claim is able to, on the basis of the interpretive information provided, classify the "universe" of potentially accused products as either infringing or non-infringing with legal certainty. This theoretical ideal serves as a useful reference for articulating the various sources of patent scope uncertainty. On this metric, "patent scope uncertainty" decomposes into the different ways in which actual patent claims fall short of this scope-certainty ideal.

This Part uses this framing to identify sources of claim-scope uncertainty that are potentially more foreseeable, and hence more preventable than others.[86] The premise is that many[87] common claim-scope issues are not

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aff'd, 517 U.S. 370 (1996) ("[C]ompetitors should be able to rest assured, if infringement litigation occurs, that a judge . . . will similarly analyze the text of the patent and its associated public record and apply the established rules of construction, and . . . arrive at the true and consistent scope of the patent owner's rights . . . .").

86. Notably, this Part seeks neither to eliminate nor to frame it as achievable or efficient the reduction of all uncertainty in claim scope. Rather, it focuses upon a set of uncertain scenarios common under our current procedures that might be efficiently reduced by increasing particular types of information.

87. It is an empirical question what percentage of scope uncertainty issues can be attributed to ordinary underdetermination. As far as I am aware, there have not yet been studies classifying patent claims in terms of relative scope certainty and the reasons they

of the intractable sort but rather the result of routine "underdetermination."[88] Underdetermination refers to scenarios where a patentee could have supplied scope-defining information that would have mitigated the scope issues in a class of relevant cases, but did not. Particularly problematic are claim scope interpretive decisions made upon *implicit*, rather than *explicit*, information (e.g., limits on claim scope inferred contextually from the specification).

1. Literal Scope Versus Non-Literal Scope of Patent Claims

Before addressing the more complex issue of claim scope uncertainty, it is helpful to first consider the more basic concept of patent claim *scope*. The scope of a patent claim is a reference to the extent, and implicitly the bounds, of a claim's legal rights. A patent holder has the right to employ legal remedies to exclude others, for example, from selling products covered by a given claim. Thus, questions of patent scope, as references to legal rights, should be framed analytically through the lens of a hypothetical patent infringement lawsuit. The scope—the coverage of a claim—will be what the claim is held to encompass in a putative patent infringement proceeding involving the claim at issue.

One can separate patent scope into two conceptually distinct aspects—literal and non-literal scope—guided by the doctrinal structure of patent infringement. Substantive infringement analysis is divided into two distinct phases: literal infringement and infringement under the doctrine of equivalents.[89] During the process of literal infringement the

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might be considered uncertain in any given infringement suit. This is a useful area for future empirical exploration. Informally and non-scientifically, one can readily find underdetermination issues in reported district and Federal Circuit claim construction decisions. Such examples are not statistically valid due to selection bias and other lack of comprehensiveness issues, but at a minimum they suggest that the issue is reasonably prevalent. For some recent reported examples, see *Fujitsu Ltd. v. Netgear Inc.*, 620 F.3d 1321 (Fed. Cir. 2010), and *United Coin Machine Co. v. Ardent Progressive Systems & Games, LLC*, No. 3:08-CV-0466-LRH-RAM, 2010 WL 3257858 (D. Nev. Aug. 16, 2010).

88. *See* Lawrence B. Solum, *On the Indeterminacy Crisis: Critiquing Critical Dogma*, 54 U. CHI. L. REV. 462, 473 (1987) ("The law is *underdeterminate* with respect to a given case if and only if the set of results in the case that can be squared with the legal materials is a nonidentical subset of the set of all imaginable results.").

89. *See* Cross Med. Prods., Inc. v. Medtronic Sofamor Danek USA, Inc., 424 F.3d 1293, 1310 (Fed. Cir. 2005) (en banc) ("To prove direct infringement, the plaintiff must establish by a preponderance of the evidence that one or more claims of the patent read on the accused device literally or under the doctrine of equivalents." (citing Advanced

jury[90] compares the meaning of the patent claim term elements to the particular "accused product"[91] that is the subject of infringement.[92] Literal (or prima facie) patent scope is thus a function of the outcome of this literal infringement analysis. If the finder of fact finds no literal infringement, it is asked to consider the claim and accused product under a distinct analysis—the doctrine of equivalents (DOE)—which considers accused products outside the literal meaning of the claim terms but sharing substantial functional similarity.[93] Infringement under the DOE would constitute a claim's "non-literal" scope.

This Article is primarily focused on the *literal* scope inquiry because of its *ex ante* orientation.[94] In this usage, *ex ante* refers to the time period after a patent is issued but before any actual patent infringement proceeding. The defining feature of the *ex ante* period, as contrasted with the *ex post* period, is that legal uncertainty about claim scope, meaning, or infringement has yet to be authoritatively resolved. *Ex post* thus refers to the period after which a legal official[95] has authoritatively interpreted and

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Cardiovascular Sys., Inc. v. Scimed Life Sys., Inc., 261 F.3d 1329, 1336 (Fed. Cir. 2001))). A literal infringement occurs when an accused product possess all elements set forth in a claim. *Id.* (citing Franks Casing Crew & Rental Tools, Inc. v. Weatherford Int'l, Inc., 389 F.3d 1370, 1378 (Fed. Cir. 2004)). In contrast, "[t]he doctrine of equivalents allows the patentee to claim those insubstantial alterations that were not captured in drafting the original patent claim but which could be created through trivial changes." Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 733 (2002).

90. By default, literal infringement is a question of fact to be decided by the jury. Of course, parties can agree to a bench trial where the finder of fact is the judge.

91. The points are most clearly illustrated by reference to physical objects. Thus, for simplicity, I will focus my analysis on patent "product," rather than process, claims. The principles apply to process claims as well. Utility patents are often classified into two major categories: product patents and process patents. As the name suggests, a product patent claims actual physical objects such as machines or molecules. In contrast, a process patent claims methods or steps for accomplishing some task. Process patents normally require a description at a higher level of abstraction. Section 101 provides a list of statutory patentable subject matter. *See* 35 U.S.C. § 101 (2006).

92. The words of the patent claim have been sectioned in logically distinct "elements," and have usually been given an authoritative meaning by the presiding judge during claim construction.

93. The doctrine of equivalents queries whether the accused device employs "insubstantial alterations" that were not captured in the original claim.

94. Going forward my references to patent claim scope should be therefore read to refer to literal scope unless otherwise indicated.

95. Note that I use the term "legal official" rather broadly not just to refer to judges but to any legal role with the official capacity to resolve some legal uncertainty including juries,

determined the scope of the patent claim during the course of a patent infringement lawsuit. Unlike literal infringement, infringement under the DOE has a decidedly *ex post* orientation because DOE analysis deliberately invites *ex post* discretionary consideration by juries. This Article focuses on literal scope because increasing certainty about claim scope and coverage requires an *ex ante* (pre-litigation) orientation.

If our concern is legal notice, then the analytical posture should reflect the perspective of a lay interpreter—a non-official. This is important to clarify because there are several classes of interpreters of patent claims—lay (third) parties (e.g., competing firms), legal officials (e.g., judges, juries, and examiners), and patent applicants themselves. The lay view considers patent scope from the standpoint of an objective third party attempting to determine the boundaries of an issued claim. Scope uncertainty will be related to the potential divergence between the predictions of scope by such lay observers and any eventual, authoritative determination of scope by a legal official during a proceeding. Because patent scope issues are little different from scope-of-law issues arising elsewhere in law, it is helpful to look to the broader scholarship on legal scope for conceptual grounding.

2. Scope Is About Boundaries and Function

One can understand scope-of-law issues through at least two distinct analytical frameworks: one oriented upon boundaries and the other upon function. In one sense, the scope of any legal right, including a patent claim, concerns the demarcation of legal boundaries. Within law the term "legal scope" refers to both the coverage and non-coverage of a given law.[96] The concept of scope suggests that application of a given legal rule will be, in some sense, limited. To reference a law's scope is to imply that a law will not apply to *all* future entities, objects, and behaviors, but to some limited subset.[97] From that perspective, legal scope is related to the substantive criteria by which we differentiate, *ex ante*, the subset of legal actors, objects, behaviors, and states that will be subject to a law's

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trial or appellate judges, ALJs, and others.

96. Russell L. Weaver, *Retroactive Regulatory Interpretations: An Analysis of Judicial Responses*, 61 NOTRE DAME L. REV. 167 (1986).

97. For a highly readable introduction to such a framework for thinking about laws and regulation, see PATRICK MCFADDEN, A STUDENT'S GUIDE TO LEGAL ANALYSIS: THINKING LIKE A LAWYER 2–5 (2001).

differential treatment or legal consequences.[98] A scope boundary is the "line" distinguishing that which is covered by a law from that which is not. In this sense, critiques of legal scope generally tend to focus upon demarcation of legal boundaries via the legal criteria chosen *ex ante*.

Within the patent claim context, questions of literal scope are, in many respects, similarly concerned with boundary-defining criteria. A primary emphasis is on the claim words and interpretive information upon which a lay observer must rely to distinguish infringing products from non-infringing products.[99]

Legal scope can also be understood through a related but distinct functional definition. In this orientation, we are not so concerned with legal boundaries for their own sake; rather we ask how well those boundaries perform their functional role of distinguishing specific identifiable entities or behaviors that violate a given law and are accordingly subject to its differential legal consequences. This approach to scope directs us to decompose our abstract legal categories into particular legal entities and to make specific determinations as to whether they do or do not "violate" the criteria of the law. Under this functional conception, one can characterize formal notice about patent scope by the extent to which the words of the patent claim establish boundaries that distinguish real-world objects covered by a patent claim from those that are not.

This functional framing of patent claim scope highlights a key point—claim scope is a relative formulation. It is not sufficient to simply focus on the inadequacy of the claim-word boundaries in the abstract. Rather, we must evaluate the scope of a patent claim by its ability to effectively classify the relevant universe of potentially accused products and to do so in a way that is not over- or underbroad. Any inquiry into the sufficiency of the delineation of the patent claim's scope should be considered relative to the class of accused devices potentially inside or outside its scope. If we aim to critique a claim for having an uncertain scope, we should do so in

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98. Pierre Schlag observes that a typical law employs "legal distinctions"—*ex ante* descriptive legal categories, statuses, or criteria—to abstractly delineate the subset of entities and behaviors that will be governed by the law and subject to its differential consequences. *See* Pierre Schlag, *Cannibal Moves: An Essay on the Metamorphoses of the Legal Distinction*, 40 STAN. L. REV. 929, 948 (1988).

99. *See* Mullally, *supra* note 26, at 349 ("[T]he claims of the patent define a patentee's property right, delineating what the patentee believes she has invented and is entitled to exclude all others from doing.").

relation to the class of products that may or may not potentially infringe. The heart of the scope inquiry is functional—to delineate and distinguish those products that literally infringe from those that do not. The import of this functional and relational component of patent scope will be apparent later when exploring strategies for improving *ex ante* scope certainty.

In sum, issues of patent claim scope are concerned with the set of technologies that are subject to the patent holder's exclusive legal rights. As such, the analysis is best seen through the lens of a hypothetical patent infringement proceeding. The literal scope of a claim is the outcome of the literal infringement analysis as ultimately interpreted by a judge and applied by a jury. In this regard, we can express literal scope in two ways. One perspective is focused on the claim terms and boundary-defining concepts. Another considers claim scope functionally, relative to the "universe" of accused products. Together, one can understand *ex ante* literal scope more effectively by considering: (1) how well-defined and objective patent claim legal boundaries are, and (2) how certainly, *ex ante*, these boundaries distinguish those products that literally infringe from those that do not.

B. Defining Claim Scope Uncertainty

Having described the concept of literal claim scope, we are now in a position to define claim scope *uncertainty*. The goal of this exercise will ultimately enable us to identify the distinct ways by which patent claims are considered "uncertainly scoped." I will suggest that we can approximately group these different sources of scope uncertainty into those that are difficult to avoid and those that can be improved.

1. A Theoretical Metric: Perfect Scope Certainty

The idea of claim scope uncertainty is usefully expressed by contrast to a hypothetical, theoretical ideal: a patent claim whose scope we would consider *perfectly certain*. What would it mean to have an idealized patent claim of perfect scope certainty? One answer comes from our functional definition of patent scope. Recall the functional definition, which queries how effectively a claim distinguishes the class of infringing products from the class of not infringing products. Recall further that, for notice purposes, we are concerned with an *ex ante*, rather than an *ex post*, view of patent scope. Therefore, an ideal patent claim of perfect scope would be one in

which every real-world product is, *ex ante*, unambiguously and objectively classified as infringing or not infringing that claim.

A perfectly literally scoped patent claim would be one in which the objective interpretations of the claim elements are sufficiently precise so as to classify all potential accused devices *ex ante* as literally infringing or not. A claim of perfect literal scope would give rise to a set of objective, legally certain classification rules that would unambiguously resolve the issue of literal infringement *ex ante* when applied to any accused product. Such a perfectly scoped claim is, of course, merely theoretical and unattainable in practice for reasons discussed shortly. Nonetheless, the ideal will be helpful as a guide for the goal of improving claim scope certainty.

2. Characterizing Literal Claim Scope Uncertainty

We can express the concept of patent scope uncertainty as a departure from our theoretical metric of perfect scope certainty. An uncertainly scoped patent claim is one that falls short of the ideal. Such a claim fails to fully differentiate the set of potential accused products as literally infringing or not. A rough proxy of the degree of uncertainty is given by the size of the class of products that cannot be unambiguously classified in this way. As I will suggest later, of particular interest would be the group of products that are variants of included embodiments in the patents or foreseeable third-party products that seek to "invent around" the literal scope. We can consider a claim literally uncertainly scoped if there is a significant percentage of relevant products that cannot be classified as literally infringing or not, given the patent scope.

C. Legal Uncertainty Through the Lens of a Legal Official

We now have a working characterization of the literal scope uncertainty of a patent claim. A claim will have a legally uncertain literal scope if the boundary-defining information provided in the public patent record fails to distinguish those products that literally infringe from those that do not, *ex ante*. As this is a theoretical standard, all claims will likely suffer from uncertainty to some degree. Of concern are those claims that are of highly uncertain scope relative to the relevant set of products.

As a legal determination, the resolution of patent claim scope presents uncertainty issues of the type that routinely occur elsewhere in law. Thus,

to illuminate the sources of patent scope uncertainty, it will be helpful to have a broader model of legal uncertainty importing existing views on the topic. In this section I will present one characterization of legal uncertainty that I will subsequently apply to issues of patent scope uncertainty.[100]

1. One View of Legal Uncertainty

As Oliver Wendell Holmes and others have argued, we should ultimately conceive of legal rights through the lens of the predicted conclusions of legal officials because officials are those who are officially empowered to authoritatively resolve legal uncertainties.[101] Drawing upon different strands from the works of H.L.A. Hart,[102] Duncan Kennedy,[103] and Frederick Schauer,[104] we can paint a characterization of "legal uncertainty" in terms of the choices and constraints on the part of legal officials in the range of outcomes in a given legal determination.

In one sense, *ex ante* legal uncertainty is a function of the *ex post* options available to legal officials in light of constraints on these outcomes.

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100. Perhaps ironically, the concept of legal uncertainty is itself uncertain. There is no unitary, agreed-upon definition of the notion of legal uncertainty. It shares a great degree of similarity, or is perhaps considered identical, to the Critical Legal Studies concept of "legal indeterminacy" or H.L.A. Hart's concept of "open texture." For a discussion of legal indeterminacy, see generally Anthony D'Amato, *Can Any Legal Theory Constrain Any Judicial Decision?*, 43 U. MIAMI L. REV. 513 (1989) (exploring various legal theories and why no theory is inherently capable of constraining judicial decisions). For a discussion of open texture, see H.L.A. HART, THE CONCEPT OF LAW 121–31 (1961) (defining "open texture" as the point at which general rules communicating standards of behavior become indeterminate). The family resemblance shared by all of these concepts is that there is no clear, definitive answer that is likely to be widely agreed upon, either by the disputants or an authoritative decision maker *ex ante*.

101. *See* Oliver Wendell Holmes, *Supreme Judicial Court of Massachusetts: The Path of the Law* (Jan. 8, 1897), *reprinted in* 78 B.U. L. REV. 699, 700 (1998) (explaining that the job of lawyers is to predict how the law will apply to their clients; thus it is essential to understand how courts arrive at their judgments).

102. *See generally* Hart, *supra* note 12.

103. *See* Kennedy, *supra* note 19, at 1147 (studying legal arguments and classifying their reoccurring patterns). Implicit in this idea of correlative legal arguments and the availability of multiple legal arguments is this characterization of legal uncertainty.

104. *See* Frederick Schauer, *Formalism*, 97 YALE L.J. 509, 518–21 (1988) (discussing how judges often have choices among rules to apply to given situations, even when they appear constrained by a formal rule, and how judges can often escape the seemingly mandated formal conclusion of a rule by justifying the application or creation of an alternative, plausibly acceptable rule).

Consider the common scenario in which a legal official, such as a judge, is presented with some *ex ante* legally uncertain and contested point of law, fact, or outcome to resolve. In such a case, there are typically formal constraints (like the text of an applicable statute) that might partially constrain the outer range of possible outcomes. Under this mode, to state that there is legal uncertainty is simply to imply that there are multiple, plausible legal arguments surrounding that point of law or fact, even given any formal constraints.[105] There is legal uncertainty from the perspective of the lay observer because, *ex post*, a legal official may reasonably elect from any one of the plausible options or arguments presented.[106]

By contrast, "legal certainty" is often used in the sense of "legal determinacy" and describes situations where there is only one plausible argument (or option), and therefore only one reasonable conclusion, that could be reached by a legal decision maker.[107] Legal uncertainty is partially linked to the degree to which the legal decision makers are or are not constrained in their range of choices in applying laws and arriving at legal outcomes.

There are two clarifying points to be made. First, even when there are constraints, such as statutes, that are on point and restricting the outer bounds of a legal official's options, there may still be a high degree of *ex ante* uncertainty as to any particular legal outcome due to a large range of *ex post* options still available within those bounds.[108] Explicit, on-point legal rules can still have open-texture legal categories at a high level of abstraction or discretion (e.g., "reasonable"). Such criteria still leave such a large range of *ex post* discretion so as to engender considerable *ex ante* uncertainty. Moreover, as Kennedy, Schauer, and Pierre Schlag have noted, legal officials often have the ability to avoid undesired outcomes,

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105. This is consistent with a common, colloquial usage of legal uncertainty in the law. *See, e.g.*, Rubin v. United States, 525 U.S. 990, 995 (1998) (Breyer, J., dissenting from denial of certiorari) ("The matter is, as the Court of Appeals conceded, 'fairly disputed.'. . . It is legally uncertain. . . . And only this Court can provide an authoritative answer.").

106. For illustrative purposes, let us assume for the moment that all of the outcomes are "equally plausible." We can relax this assumption later, as clearly some legal arguments are at times more likely than others.

107. *See, e.g.*, Brian H. Bix, *Can Theories of Meaning and Reference Solve the Problem of Legal Determinacy?*, 16 RATIO JURIS 281, 281 (2003) ("A persistent topic in modern legal philosophy is that of legal (in)determinacy: the question of whether there are . . . *unique* right answers—to legal questions . . . .").

108. Pierre J. Schlag, *Rules and Standards*, 33 UCLA L. REV. 379, 410–16 (1985).

despite formal constraints that superficially appear determinative.[109] A judge might, for example, be empowered to craft exceptions to an otherwise constraining statute, find a different but plausible applicable statute, avoid a decision, or craft an outcome on different doctrinal or statutory grounds. Thus, in some legal contexts, officials are not necessarily as constrained in their outcomes by formal constraints as it might appear on the surface.

Such limits notwithstanding, this model of uncertainty in terms of official options in light of constraints has significant resonance in legal logic and practice. The familiar concept of a "legal point" being "at issue" captures this characterization. If, under the circumstances, there really is only one legal argument that can be plausibly advanced around a legal or factual issue, then it is common to say that the point of law or fact is not "at issue" under typical modes of objective legal analysis. This notion of uncertainty as "choice among arguments" is also deeply embedded in law school curriculum. A typical pedagogical goal is to imbue within law students the judgmental capacity to assess which potential points of law or fact are "at issue" or are plausibly arguable within a factual context.[110]

This idea is also reflected in the logic of current legal practice. Under the doctrine of "judgment as a matter of law," a judge is justified in deciding a particular issue normally reserved for the jury when "the evidence . . . leaves open to the rational fact-finder only one conclusion on the issue."[111] Similarly, litigants rarely expend effort arguing points of law or fact for which there are no good arguments (or options for legal officials)

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109. *See, e.g.*, Duncan Kennedy, *Strategizing Strategic Behavior in Legal Interpretation*, 1996 UTAH L. REV. 785, 787–90 (1996) (describing the various opportunities available for judges to act strategically in ruling on an issue and the range of attitudes judges and their clerks take toward these opportunities).

110. *See, e.g.*, RICHARD FISCHL & JEREMY PAUL, GETTING TO MAYBE: HOW TO EXCEL ON LAW SCHOOL EXAMS 117–28, 143–46 (1999) (offering guidance on how to spot issues and how to wisely budget limited time in an exam setting, disposing of less contentious issues quickly and saving time for issues requiring more in-depth analysis). This is the heart of "legal issue spotting," the standby format for law school exams. *Id.* Perhaps the biggest mistake committed by first-year law students on a typical issue-spotter exam is to spend time analyzing potential points of fact or law that are not "at issue"—or reasonably legally uncertain—under the fact pattern presented. *Id.*

111. Laferriere v. Paradis, 293 A.2d 526, 528 (Me. 1972); *see also* Volvo Cars of N. Am., LLC v. United States, 571 F.3d 373, 381 (4th Cir. 2009) ("[J]udgment as a matter of law is proper only when 'there can be but one reasonable conclusion as to the proper judgment.'" (quoting United States *ex rel.* DRC, Inc. v. Custer Battles, LLC, 562 F.3d 295, 305 (4th Cir. 2009))).

on either side.[112] Finally, we see that the notion of a "dispositive" legal argument contains this same basic logic. A legal argument is dispositive when its presence essentially eliminates all other contending arguments with respect to an issue of law or fact.[113] The essential idea of relative legal certainty is that the legal official is informally or formally constrained in his ultimate determination, and thus outcomes are relatively more predictable from the perspective of a lay observer *ex ante*.

This characterization of *ex ante* legal uncertainty is necessarily stylized but nonetheless captures some intuitive aspects of legal uncertainty. In some sense, the magnitude of legal uncertainty can be aptly characterized by the number of equally reasonable outcomes or options that might be pursued by a legal official *ex post*. For the moment, let us put aside concerns with defining the precise contours of "plausibility" or with the idea that not all legal arguments and options have equal strength or probability.[114] While there is force to these objections, our simplified, informal model of legal uncertainty is sufficient to usefully illuminate analogous problems in the patent scope context.[115]

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112. Litigants will sometimes argue points of law or fact for which there are not strong arguments on both sides for various strategic and appeal-related reasons.

113. *See* BLACK'S LAW DICTIONARY 540 (9th ed. 2009) (defining "dispositive" as "being a deciding factor; (of a fact or factor) bringing about a final determination"); *see also* State v. Oliver, 30 S.W.3d 363, 364 (Tenn. Crim. App. 2000) ("An issue is dispositive when this court must either affirm the judgment or reverse and dismiss." (citing State v. Wilkes, 684 S.W.2d 663, 667 (Tenn. Crim. App. 1984))).

114. Under the classical model of probability, all outcomes of an event are assumed to have an equal chance of occurring. The paradigmatic example of a phenomenon accurately described by the classic model is the roll of a die, in which there is an equal probability of any side landing face up. More sophisticated views of probability complicate the classical model and take into account that differing probabilistic events have different chances of occurring. However, for many purposes, especially pedagogical, the classical model is sufficient.

115. *See* MATTHIAS KLATT, MAKING THE LAW EXPLICIT: THE NORMATIVITY OF LEGAL ARGUMENTATION 41–42 (2008) (discussing Karl Larenz's application of this notion to the interpretation of words). In particular, Klatt notes that, "[a]ccording to Larenz, drawing precise limits remains impossible, yet 'in the overwhelming majority of all cases' it can be clearly shown whether a statement lies outside the meaning of a term." *Id.* at 42.

D. Sources of Patent Scope Uncertainty

It is helpful to apply the model of legal uncertainty in terms of "constraint and choice" to the problem of patent claim scope uncertainty. A claim with an uncertain scope *ex ante* is one in which legal officials will have multiple options about the scope *ex post*. In the patent context, legal officials are often not seeking flexibility in outcomes but rather are looking for objective indicia and guidance to objectively direct their claim interpretation and application decisions.[116]

However, in a significant number of cases, the existing constraints on claim scope simply do not sufficiently narrow the outcomes to the level of precision needed to meaningfully direct the issue of literal infringement. *Ex ante* variation in interpretive range often makes claim scope more uncertain *ex ante* than it theoretically needs to be. A lay interpreter (such as a third-party firm) cannot classify *ex ante* the universe of accused products as infringing or not if that observer cannot know *ex ante* how the claim will be authoritatively interpreted *ex post* by a legal official. This is the problem of *underdetermination*—imprecision leads to multiple interpretive scopes and creates uncertainty about ultimate legal scope. This subpart will consider the various ways in which actual patent claims tend to fall short of the theoretical ideal of perfect claim scope certainty, with a particular view of scope uncertainty as a function of *ex post* claim interpretation choices.

1. A Patent Claim Is a Classification Rule

One can articulate the contours of claim scope uncertainty by reference to our theoretical metric of perfect scope certainty. Patent claims can be considered uncertain for the various reasons by which they fall short of this theoretical metric. Recall that such a perfectly scoped claim would permit an objective interpreter to classify *ex ante* all potentially accused products as literally infringing or not. It is therefore analytically helpful to consider a patent claim as representing a "classification rule."

A patent claim is a classification rule in the sense that a jury will ultimately be asked to make a classification based upon the claim's interpreted meaning as to whether a specific accused device infringes. In

116. *See* Phillips v. AWH Corp., 415 F.3d 1303, 1311–15 (Fed. Cir. 2005) (en banc) (emphasizing the importance of considering the patent claim and language in context rather than in a vacuum).

this way, we can use the phrases "claim meaning" and "claim classification rule" interchangeably, with this usage meant to highlight the functional role that will ultimately be played by a claim's meaning. The *ex ante* range of a patent claim's literal scope will be based upon whatever classification rules can plausibly be derived from that claim based upon the patent and interpretive doctrine.

To understand this "classification rule" approach to scope uncertainty, it is helpful to detail the doctrinal structure of literal patent infringement. Recall that under the literal infringement analysis, the jury compares a patent claim to one or more of the defendant's accused products. Before this occurs, there are typically some threshold issues. Although a patent claim is written as one (often long) sentence, the doctrine first requires the judge to divide the patent claim into distinct subparts known as "elements" or "limitations."[117] In the typical case, the judge also provides definitive interpretations for claim words to be used by the jury in the infringement decision.[118]

According to the literal infringement doctrine, the jury then proceeds through the claim element by element. For each element in the claim, the finder of fact must look to the accused device to determine whether there is a physical "part," "feature," or property of the accused device that literally corresponds to the meaning of a given element.[119] Literal infringement can only be found when there is complete correspondence between the claim elements and "features" of the accused device. If, for every element in the claim, there is a physical part or "feature" in the accused device that parallels that element, then there is literal infringement.[120] If even one

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117. *See* MPEP, *supra* note 5, § 608.01(n)(B)(4) ("[T]he limitations or elements of each claim . . . must be considered separately.").

118. Such a definitive interpretation often proves dispositive on the issue of literal infringement. For example, the judge may elect an interpretation that clearly excludes the defendant's accused device from the literal scope.

119. *See* ROBERT C. FABER, FABER ON MECHANICS OF PATENT CLAIM DRAFTING § 3:3, at 3-7 (6th ed. 2010) ("The 'elements' of an apparatus claim are the main structural parts that together make up the combination claimed.").

120. *See* Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 29, 40 (1997), *rev'd on other grounds*, 520 U.S. 17 (1997) (stating that the "essential inquiry" is whether "the accused product or process contain[s] elements identical or equivalent to each claimed element of the patented invention").

element in the claim cannot be found in the accused device, then there is no literal infringement.[121]

This detail is important because it is helpful to consider claim scope at the element level rather than at the level of the claim as a whole.[122] Each individual element represents its own classification rule. In the literal infringement analysis, the jury is effectively applying "element-level" subrules in determining whether the accused product has a corresponding feature. A perfectly scoped element would differentiate those accused products that have that element's feature from those that do not. The scope of the claim as a whole can be thought of as the combination of all of its constituent element-level subrules. Thus, literal scope certainty will turn upon how well defined the individual elements are. Any analysis aimed at improving *ex ante* notice will focus to a large degree upon whether the claim elements are defined with enough information to provide meaningful distinctions *ex post* relative to actual, accused objects.

2. Underdetermination and Scope Certainty

What causes actual patent claims to fall short of delineating *ex ante* scope with perfect legal certainty? There are many reasons, but one common pattern involves claim scope underdetermination. As indicated earlier, underdetermination concerns scenarios where, *ex ante*, an objectively interpreted patent claim has a number of plausible interpretive scopes. There is uncertainty about the outcome because a lay interpreter cannot know which, among many possible scopes, a judge will ultimately choose and a jury will ultimately apply.

Although the range of possible interpretive scopes that a legal official may adopt can be wide, it is usually not unlimited. Let us consider ways in which claim words tend to be bounded at their "outermost" edges. Even if a claim element has a poorly defined scope ("attached to," for example), it is not necessarily *un*-scoped—we still may know some things that are clearly

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121. To give an overly simple example, the inventor of a windmill might characterize his invention in the following single-sentence claim: "A windmill comprising a blade and a shaft." If the composite elements are deemed by the judge to be "blade" and "shaft," the jury will look to the accused product—a physical windmill—to determine if that product has parts or characteristics that are (or are not) literally encompassed by the meanings of both elements—"blade" and "shaft."

122. *See* MPEP, *supra* note 5, § 608.01(n)(B)(4) ("[T]he limitations or elements of each claim . . . must be considered separately.").

outside the plausible range of the literal scope.[123] The underdetermination problem is that such outer-edge bounding may not be sufficiently precise to provide the legal certainty that third-party firms frequently need to make *ex ante* literal infringement assessments.

Let us consider the "outer most" scope of most claim terms through the lens of the patent interpretation doctrine. We can think of a word's scope as being successively narrowed by different limiting rules. Absent a specific, contrary meaning,[124] all words in legal decisions are implicitly bounded by the word's possible, ordinary understandings. If we have "encryption" as a claim term, we may not know what it means precisely, but we know that it does not mean "mountain." Because there is no such plausible connotation, we can know with some certainty that a judge or jury will not employ such a meaning in an infringement proceeding.

Patent doctrinal rules narrow the scope of a word further by the restriction that claim words be interpreted in accordance with how "a person of ordinary skill in the art" would have interpreted the word at the time of the invention.[125] While this may further restrain possible scope, such a bound typically leaves a relatively wide range of plausible interpretive scopes *ex ante*. Finally, at a high level, interpretive rules instruct to narrow claim word scope by the implicit and explicit restrictions arising when one reads the claim "in the context of the entire patent."[126]

The underdetermination point is that even though these successive levels of restriction may narrow the outer interpretive scope to some degree, there are typically still relatively large ranges of plausible interpretations. Read together, these successive levels of constraints may narrow the interpretive range of given claim words like "encryption" or "board" quite significantly when compared to relatively unbounded and subjective terms such as "reasonable" or "aesthetically pleasing" that would be considered

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123. *See* KLATT, *supra* note 115, at 41–42 (discussing Karl Larenz applying this notion to interpretation of words and noting that, "according to Larenz, drawing precise limits remains impossible, yet in the 'overwhelming majority of cases' it can be clearly shown whether a statement lies outside the meaning of a term").

124. Patentees, for example, can assign unusual or idiosyncratic meanings to claim words that differ from ordinary, colloquial usage. *See* Phillips v. AWH Corp., 415 F.3d 1303, 1314 (Fed. Cir. 2005) (en banc) (noting that, while claim language can sometimes be understood by reference to its ordinary meaning, "patentees frequently use terms idiosyncratically").

125. *Id.* at 1313.

126. *Id.*

too indefinite under 35 U.S.C. § 112.[127] However, scope underdetermination occurs when there are enough different interpretive scopes for a claim element, in light of the external and internal constraints, so as to create uncertainty as to the boundaries of a given claim. In a patent claim covering a "board," the classification rule that emerges once applying the interpretive rules may not distinguish whether coverage is limited to "wooden boards" or covers "synthetic boards." For this reason, relying on a superficially bounding default interpretive standard such as "plain and ordinary meaning in the art" may actually provide only illusory scope constraint relative to the needed precision, as multiple, plausible alternatives will often likely still remain.

It is important to emphasize that such scope uncertainty is a *relative* concept. How inadequate we believe the scope to be will be relative to the products that one needs to classify, *ex ante*, as infringing or not.[128] To use a simple example, consider a claim with the element "motor vehicle" and imagine applying the typical scope narrowing constraints, such as "plain and ordinary meaning." Such a minimally narrowed scope could still exhibit considerable *ex ante* uncertainty. For example, imagine one interpretation suggesting that "motor" encompasses *all* motor vehicle motive technology. Another objective, plausible reading might suggest restriction to *only* internal combustion motors (e.g., based upon internal combustion embodiments). While there may not be scope uncertainty to the maker of an internal combustion engine, there may be uncertainty to the seller of a vehicle with an electric motor. Such a lay interpreter may not be able to determine the claim's literal scope *ex ante* because there are a range of plausible scopes that can be elected *ex post* by a judge. If a product would infringe under one scope interpretation but not another, there will be scope uncertainty relative to that product.

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127. *See, e.g.*, Datamize, LLC v. Plumtree Software, Inc., 417 F.3d 1342, 1356 (Fed. Cir. 2005) (concluding that "aesthetically pleasing" was indefinite because it failed to "particularly point[] out and distinctly claim[] the subject matter which the patentee regards as his invention").

128. To illustrate this point using a fanciful example, consider an underdetermined (and indefinite) claim covering "beautiful, purple widgets." Imagine further that it was only possible to produce white widgets and not purple widgets. Even though we might consider such a subjective claim underdetermined in the abstract because "beautiful purple widgets" could give rise to a wide range of potential scope interpretations *ex ante*, it is sufficiently well-scoped in relation to the relevant set of products—white widgets.

a. Underdetermination: Multiple-Word Definitions or Scopes

There are a few common scope underdetermination scenarios to highlight. The first might be termed the "multiple meanings" pattern. This occurs when a claim word can be plausibly interpreted in any of several distinct ways. Such a scenario can arise where a claim term has several reasonably distinct dictionary definitions or usages in the art. For example, the claim element "secured to" may have two distinct definitions: one that defines it as "firmly in place" and another that defines it as "directly attached to."[129] The theoretical metric of perfect claim scope seems to require one, and only one meaning or classification rule per element. If, *ex ante*, there are multiple equally plausible classification rules that are arguable, it will be difficult to predict which definition will ultimately prevail during infringement litigation. This unpredictability will increase *ex ante* scope uncertainty.

b. Underdetermination: Implicit Constraints on Scope

Implicit scope constraints create a related problem. A patentee's legal rights arise from claims—the single-sentence, numbered paragraphs located at the end of the patent document. However, the scope of these claims is often delineated by reference to other parts of the patent document, particularly the specification.[130] This incongruity—defining the scope of patent claims by reference to differently purposed sections—can lead to scope ambiguities. The problem is that the specification is often performing a functionally different role in patent law apart from claim scope delineation. In the specification, the patentee is required to describe

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129. For a case raising similar issues, see *Donaldson Co., Inc. v. Baldwin Filters, Inc.*, No. 09-CV-1049, 2011 WL 2183179 (D. Minn. June 6, 2011).

130. Technically, the "claims" are part of the specification, but most common colloquial usage separates the claims into their own distinct section and considers the specification to consist primarily of the written-description and enablement portions of the specification. *See* 35 U.S.C. § 112 (2006)

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

the claimed invention so as to identify it and enable others in the art to make and use it. In many cases, the specification is only secondarily used for the purpose of narrowing the scope of a given claim element, and even then, this scope delineation is usually done only implicitly if at all.[131]

Implicit constraints on claim scope—those inferred contextually in the specification—can lead to uncertainty issues. First, it is difficult to know objectively the content and scope of implied constraints because the restrictions of such constraints are contextually inferred. Implicit constraints, by definition, are not reified, explicit, and fixed. Second, there is often a threshold issue of uncertainty as to whether such a constraint was intended to, and should be interpreted to, limit the literal scope of a claim term. Continuing with the motor vehicle patent example, imagine that the specification summarizes the state of the art of internal combustion engines and how the claimed invention improves upon the state of the art.[132] One might plausibly argue that the scope of the claim word "motor" is implicitly narrowed to combustion motors based upon repeated use in the specification. However, it is not clear whether the usage in the specification should actually be read to modify the scope of the claim term because one can only infer such a restriction indirectly.

Thus, even if one could plausibly assert that this implicit usage in the specification should be read as scope-defining restriction, since it is defined contextually through usage (and not reified as an explicit scope limitation), one cannot make an *ex ante* determination of the precise substance of the criteria that a jury will employ in a literal infringement decision. Rather, the scope will be subject to a range of plausible interpretations suggested by the implicit usage. For example, if we infer a constraint of "only internal combustion motors" based upon three included embodiments, all of which display internal combustion motors, we still do not know the precise scope of such an implicit constraint. Should it be read to cover all versions of internal combustion motors or just the particular designs included? Since such a constraint is implicit, similar scope issues will nearly always arise for implicit constraints unless explicitly clarified *ex ante*. Nearly any time evidence is implicit rather than explicit there is the problem of a significant range of plausible arguments about the "true" objective *ex ante* meaning.

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131. The specification can perform an *explicit* claim word scope-defining role when the patentee includes its own definitions. I will discuss this possibility in Part IV.

132. 35 U.S.C. § 112 typically is read to require a "Background of the Invention" section that summarizes the state of the art and how the claimed invention relates to that art.

Additionally, a word used in the process of describing the use of an invention may have a different or more limited goal than if the word had been used explicitly for the sole purpose of intentionally defining the word's scope. For example, the usage in the specification might refer to "internal combustion engines" because its primary purpose in that part of the document was to describe the existing state of the art, rather than to delineate a scope limitation. Inferring constraints based upon usages other than scope-definition may lead to ambiguities concerning this use/scope-delineation disparity. Since many issues of legal uncertainty about scope arise from implicit constraints, explicitly disambiguating inferred constraints is a promising strategy.

c. Underdetermination: Normalization of Implied Definitions

Implicit constraints also tend to suffer from normalization problems. Ideally, if a patentee is defining the scope of a claim word in the specification there should be a clear and explicit link between the claim term and any constraint that is intended to delimit that claim word's meaning. A normalized claim definition would have an unambiguous link between scope limitation and claim word. When constraints are implicit, there may not be such an explicit linkage, creating some ambiguity.

To illustrate this point, consider that patents typically have multiple claims within a single patent document. It is common for applicants to use the same words across multiple independent and dependent claims, as they are often describing different variants of the same invention. Imagine there are five such claims, each employing the term "motor." Further imagine that the word "motor" is potentially implicitly defined contextually in the specification as limited to "internal combustion motor." There is a fundamental ambiguity here. Even if we grant that the word "motor" is implicitly being limited in the specification, does this scope limitation apply to all of the distinct claims that use the word "motor" or simply to some subset of them? Each separate claim bestows its own legal right to exclude, and it is consistent to employ different scopes for the same word across different patent claims in the document. This lack of normalization—explicit link between claim word and implied or explicit definition—creates another source of scope uncertainty.

E. Underdetermination: Precision Inadequacy

Another underdetermination scenario might be termed the context of "inadequate scope *precision*." Generally speaking, "precision" refers to the appropriate capacity to make distinctions at the level of detail required by the task at hand.[133] This scenario is characterized by an element whose scope is not adequately demarcated, *ex ante*, for the types of infringement distinctions likely to be made. Thus, even if one has "one" classification rule that can be derived from an element, the criteria provided by the rule might not be enough to resolve scope issues *ex ante*.

A claim word can be imprecisely scoped if it inherently has a relatively high level of abstraction (e.g., "physical").[134] More commonly, we simply consider a claim imprecisely scoped, if the scope-defining information provided in the patent document does not adequately allow one to definitively distinguish literal infringement among the relevant universe of potentially accused devices (e.g., "water-tight" for competitive products that can be either water-proof or water-resistant).[135] Theoretically, these two scenarios are conceptually the same. The imprecision issue occurs when the claim words, in the context of the patent document, still do not provide criteria that are adequately fine-grained to make *ex ante* literal infringement distinctions certain relative to the set of accused products. Rather, the words permit a wide range of scope interpretations, rendering infringement decisions uncertain from the perspective of a lay interpreter.

F. Underdetermination: Element Divisions

Dan Burk and Mark Lemley have highlighted another underdetermination issue concerning the division of claims into "elements" during infringement.[136] An element can be a distinct word or a group of

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133. *See* OXFORD ENGLISH DICTIONARY ONLINE (3d ed. 2011), *available at* http://www.oed.com/viewdictionaryentry/Entry/149667 ("The degree of refinement in a measurement, calculation, or specification. . . .").

134. Internet Machs. LLC v. Alienware Corp., No. 6:10-cv-023, 2011 WL 2551295 (E.D. Tex. June 24, 2011) (considering whether the scope of "interface" was limited to "physical interfaces" or included logical and non-physical interfaces).

135. Zip Dee, Inc. v. Dometic Corp, 63 F. Supp. 2d 868, 870 (N.D. Ill. 1998) (construing "water-tight" to mean that no liquid would be admitted).

136. *See* Dan L. Burk & Mark A. Lemley, *Quantum Patent Mechanics*, 9 LEWIS & CLARK L. REV. 29, 51 (2005) (noting the seeming disconnect between the rhetorical

words, and there is no definitive way to tell ahead of time what words or group of words will constitute distinct elements. Because the authoritative division of a claim into elements is only done *ex post* during litigation by the judge,[137] *ex ante* third parties can only make educated guesses about the likelihood that individual words will constitute separate elements. Differences in grouping or separation of elements can lead to differences in scope and hence increase *ex ante* uncertainty about true scope.[138]

G. Scope Uncertainty Issues Difficult to Avoid

The previous subparts indicated problems of underdetermination some of which may be mitigated by policies that explicitly disambiguate foreseeable sources of scope uncertainty. Here I will briefly highlight sources of scope uncertainty that may be fundamentally difficult to avoid *ex ante*. These sources are not the focus of this Article, as most deal with unforeseeable future scenarios or limitations inherent in language.

The scope of a claim may become uncertain due to changes in technology. There is a temporal problem in patent law. We require patentees to define their legal boundaries at one point in time, yet patents persist over a twenty-year period. During this period, technology may change or emerge in ways that were unpredictable at the time of drafting. Scope uncertainty may arise when one is asked to compare a given claim against after-arising, unforeseeable technologies. The scope-defining

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objectivity of patent claim elements and the reality of subjectivity). District court judges are ultimately the ones who must determine which word or words in the claim constitute distinct "elements." *Id.* They critique the disparity that there is no definite means of determining, *ex ante*, what word or combinations of words in the patent claim constitutes a distinct and separate element for the purposes of infringement analysis. *Id.*

137. A given claim is sometimes divided into logical parts, separated by commas, giving a semi-structure. But this structure is implicit, and need not be followed by the presiding judge.

138. An analogous and perhaps unavoidable problem occurs relative to any accused product. In the infringement analysis, the finder of fact compares the "elements" of the claim to the "features" of the accused device. What is the proper division of the "features" of the accused device? It may not be possible to divide the various parts and features of an accused product *ex ante* with any degree of certainty. Take, for example, a patent with a claim elements "attached windmill blades." Imagine that our accused product is a windmill which has been made out of a unibody fiberglass structure. How should the finder of fact divide up the parts of the accused device for comparison to the element? Should the "unibody" blades be considered a separate element from the shaft?

boundaries fixed in the patent document may not provide adequate guidance for an unforeseeable product. In significant cases, it may be desirable for legal officials to employ *ex post* discretion to avoid inadequate coverage for a given claim. Similarly, pioneering patents often arise in emerging fields with underdeveloped vocabularies. Such terminology may develop or change significantly in subsequent years. Uncertainty may arise in applying a claim drafted in an era when a field's expressive capacity was limited. Scope problems of this nature may be difficult to avoid *ex ante*.

There are also well-known "line-drawing" problems involving formal rules that are difficult to avoid on the margin. Formal rules and categories tend to be both over and underinclusive relative to their underlying intent. This is well illustrated by H.L.A. Hart's classic example of a law prohibiting vehicles in a public park.[139] When lawmakers are required to reduce their intentions into formal categories such as "vehicles" to indicate a law's scope, there are often unstated but implied limitations or expansions of the category's plain scope. For example, although this law superficially excludes all vehicles, it is likely that emergency vehicles, such as ambulances, form an unstated scope exception. The category "vehicle," on its face, is thus overinclusive relative to the underlying intent for some marginal, non-paradigmatic types of vehicles.

Similar inclusiveness issues can arise in patent claiming. Patent rules require patentees to declare their patent claims, using categories to describe features or elements. Requiring the decomposition of an invention into rigid categories can often mask the true complexity of the invention. There might arise an accused device that does not fall within the scope of a claim's categorical element, but which exhibits the technological features of the invention nonetheless.[140] Similarly, products that are hybrids and that straddle category boundaries tend to create issues of legal uncertainty.[141]

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139. *See* H.L.A. Hart, *Positivism and the Separation of Law and Morals*, 71 HARV. L. REV. 593, 607 (1958).

140. Such underinclusion is the primary justification for infringement under the doctrine of equivalents. There is also the rarely employed "reverse" doctrine of equivalents which excludes overinclusion.

141. That legal categories present problems at the margin is well known to law professors and law students. A common pedagogical approach in law school is to use hypotheticals that straddle the boundaries of legal categories. For example, negligence law typically treats defendants differently if an accident that they caused was due to a physical disability (e.g., blindness) rather than a mental disability (e.g., schizophrenia). *Compare* RESTATEMENT (SECOND) OF TORTS § 283C (1965) (declaring that defendants with physical disabilities should be compared with a reasonable person having the same disability), *with*

Additionally, inventions are abstractions. There are well-known limitations to expressing the contours of abstract concepts using language and drawings. Uncertainty arises when legal officials seek to avoid the undesirable literal outcome of a rigid claim word. Such an *ex post* divergence in outcome from expected literal coverage may lead to scope unpredictability from the perspective of a third party.

Another source of unavoidable patent scope uncertainty arises from the aspects of patent infringement that are deliberately discretionary, and hence *ex post* in nature. Infringement under the doctrine of equivalents, for example, requires juries to determine if the accused device is "substantially the same" in various ways to the patent holder's claimed invention.[142] Such judgment-oriented legal criteria can make *ex ante* prediction of claim scope under the doctrine of equivalents somewhat more uncertain than literal scope. Similarly, judges predisposed to employing "holistic" approaches to claim construction—interpretations that routinely avoid literal constraints in favor of contextual judgments—likely increase *ex ante* scope uncertainty.[143]

Unpredictability, changing technology, marginal exceptions to rules, hybrid products, intentional *ex post* discretion, and the limitations of language—these are all issues of uncertainty that one cannot easily reduce. However, the argument is that many patent uncertainty problems are not of this intractable nature. Rather, they involve more mundane issues of underdetermination that may be avoided through the provision of increased *ex ante* information. To the extent we can construct patent definition and interpretation policies that produce claims with relatively fewer possible *ex ante* meanings, this would seem to translate into increased systemic scope certainty for patents generated under such procedures. This is not to

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id. § 283B (declaring that defendants with mental disabilities should be compared to a reasonable person in the same circumstances). A law professor might illustrate this common pattern of legal uncertainty at the margin of a legal category by presenting a hypothetical involving a disability that could be characterized as either physical or mental depending upon the framing.

142. If no literal infringement is found by the jury, the jury is asked to determine infringement under the doctrine of equivalents. The standard is whether the accused device "performs substantially the same function in substantially the same way to achieve the same result." Hilton Davis Chem. Co. v. Warner-Jenkinson Co., 62 F.3d 1512, 1517 (Fed. Cir. 1995), *rev'd on other grounds*, 520 U.S. 17 (1997).

143. For a description of this holistic approach, see Timothy R. Holbrook, *Substantive Versus Process-Based Formalism in Claim Construction*, 9 LEWIS & CLARK L. REV 123, 146–48 (2005).

suggest that uncertainty can be eliminated. There will always be marginal line-drawing problems. Rather, uncertainty can be reduced in common scenarios. The Part that follows will pursue a more formal treatment of this intuition.

IV. Legal Uncertainty and Scope—A More Formal Approach

A. Set Theory as a Model of Legal Scope and Uncertainty

In this Part, I will model the problem of patent-scope uncertainty more formally using the mathematical frameworks of set theory and constraint satisfaction.[144] The model represents claim scope uncertainty by the set of plausible interpretations that a claim word can have in light of constraints that bound the meaning. The larger the set of relevant interpretations, the more uncertainty about scope boundaries there will generally be. One strategy for reducing uncertainty is to increase, in the public patent record, explicit constraints on meaning focused upon eliminating or disambiguating plausible interpretations employed *ex post* in infringement proceedings.

The formal model highlights heuristics[145] for mitigating scope uncertainty issues. This framing allows us to identify general properties that are characteristic of constraints that limit claim scope *ex ante*. These properties provide a standard against which we can compare existing patent interpretive rules and procedures in terms of their potential to constrain meaning. For example, the metric will illustrate that the "plain and ordinary meaning in the art" interpretive standard is predisposed to inadequately restricting scope *ex ante*. This model also enables us to consider marginal modifications to the patent definitional system likely to produce scope certainty benefits.

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144. I will describe these formal models primarily using "mathematical English" rather than formal equations. The reason is to make the underlying logic of the model accessible to a largely non-technical audience. *Cf.* ROBERT L. CAUSEY, LOGIC, SETS, AND RECURSION 2 (2006) ("[Mathematical English] refers to the rigorous but somewhat informal style of presentation found in mathematics books and articles.").

145. Note that I am not arguing that the formal, theoretical maximum of certainty as described under set theory is either achievable or desirable in our actual patent system. Rather, the purpose of this model is to provide a theoretical standard to guide our thinking in considering changes to patent definitional and interpretational rules in a way that will tend to increase the systemic certainty of patent scope.

1. Set Theory Overview

Set theory provides a convenient structure for modeling legal uncertainty and patent scope. Set theory is the branch of mathematics concerned with "sets," which are collections of distinct "objects" or "elements."[146] An "element" of a set is the word used to indicate anything that is a member of or belongs to a particular set.[147] To use a simple example, imagine a fruit bowl on one's dining room table that contains one apple, one orange, and one banana. The relevant set is "the set of fruit in the bowl on one's dining room table" and the set members (or elements or objects) are "the apple, the orange, and the banana" that are in the bowl. The essential idea underlying the theory is that one can refer to entire collections of individual objects by referencing a single entity—the set.[148]

Neither sets, nor set elements, need refer to physical, real-world objects. A set can represent collections of abstractions or intangible concepts or ideas.[149] Although a set can represent a collection of particular physical objects (the set containing one apple, one orange, and one banana in a fruit bowl on one's dining room table), or general collections of physical objects (the set of all fruit; the set of all red fruit), it can also represent collections of abstractions (the set of all real numbers). A set is just a convenient, mathematically formal way of representing distinct collections of objects. "Set elements" (henceforth just "elements") should not be confused with the same terminology used in patent law to refer to the subparts of a patent claim—"patent-claim elements."[150]

Because a set can contain abstractions, a particular set might represent a collection of numbers (e.g., the set containing the numbers 1, 2, 3, 4, and

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146. CAUSEY, *supra* note 144, at 2. I shall here be working with a basic version of set theory. There are several variants of set theory, but the complexities and nuances are beyond the scope of this Article. Set theory was originally developed by the German mathematician George Cantor in the nineteenth century. ROBER ROTH STOLL, SET THEORY AND LOGIC 1 (1979).

147. CAUSEY, *supra* note 144, at 2.

148. STOLL, *supra* note 146, at 2.

149. *Id.* at 3.

150. It is unfortunate and perhaps confusing terminology that both set theory and patent law claims use the same term "element." In patent law, a patent claim element is usually used as a synonym with a patent claim "limitation." BLACK'S LAW DICTIONARY 597 (9th ed. 2009). By contrast, in set theory, an element is an abstract concept used to refer to any member of a set. CAUSEY, *supra* note 144, at 115.

5) or a collection of phrases (e.g., the set containing the two phrases "Four score and seven years ago" and "We hold these truths to be self-evident"). We can also conceive of abstract sets relating specifically to law. There can be a set of different legal arguments (e.g., the set containing "there is a cause of action in negligence under these facts" and "there is a cause of action in breach of contract under these facts") or a set of objects that are regulated by a given law. For example, we can have a set of all the objects covered and regulated by a vehicular speeding statute. "Automobiles" will be a member of that set whereas "dogs" will not be. It is the latter two abstract sets—the sets containing plausible legal arguments and objects governed by laws—upon which I will shortly build my thesis. Before I use set theory to model patent scope and legal uncertainty, let me first briefly justify its use in characterizing legal concepts.

2. Justifying the Use of Set Theory to Characterize Legal Concepts

There are several reasons why set theory is a useful analytical tool for revealing insights about law. For one, set theory has a fundamentally dichotomous framework, and this corresponds nicely to our general conceptions about legal scope and notice. To understand why, we must first probe more deeply into the framework of set theory.

The fundamental "concept of set theory is the membership relation."[151] Roughly speaking, the membership relation requires that for every object and every set, it has to be the case that the object either is a member of the set, or it is not a member of the set.[152] In other words, there is no "in between" with respect to set membership. This dichotomous requirement is known as the *principle of bivalence* or is sometimes discussed through a related principle—the law of the excluded middle.[153] Under the principle of bivalence, whether a given object is a member of a set is either unambiguously true or unambiguously false.

Bivalence provides us with a conceptual tool for dividing up the world. Given a particular set, we can cleanly separate and conceptualize "the

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151. CAUSEY, *supra* note 144, at 115.

152. *See id.* at 116–17 (discussing predicates and explaining that a given predicate must be true or false and that a certain object is, or is not, a member of the set).

153. *See* JENNIFER FISHER, ON THE PHILOSOPHY OF LOGIC 56–57, 91 (2007) (stating the law of the excluded middle means that every sentence, or its negation, is true, and the principle of bivalence means that every sentence must be either true or false).

world" as consisting of two groups: The group of "objects" in the world that are members of the set we are considering, and the rest of the group of objects that are not (e.g., everything else in the world that is not part of the set). The usefulness of the ability to conceptualize the world as sharply divided into two groups along some set of criteria will become apparent shortly as I apply it to characterize the scope of laws.

3. Legal Bivalence and Legal Scope

Legal scope has this same quality of bivalence, and it is this bivalent character that makes set theory a useful tool in its analysis of patent scope problems. To understand this, it is helpful to recall our earlier characterization of legal scope as concerning an *ex ante* limit or boundary in the coverage of a given law. A typical structure for a law's boundary is a generic characterization of a class of actors and behaviors to be regulated, along with some criteria for distinguishing regulated from unregulated behavior and the consequences once those criteria are implicated.[154] As a simple example, let us use a speed limit statute that makes it a violation of the vehicular code to travel in a motor vehicle on a highway at a speed greater than sixty-five miles per hour.[155] This law lays out a generic description of objects (vehicles), actors (drivers), and particular future behaviors (traveling at a speed greater than sixty-five miles per hour).

Superficially, *ex ante* legal uncertainty appears to be in tension with the principle of legal bivalence. If applied to law, the principle of bivalence would seem to suggest that for any given factual situation, it would be either unambiguously true or unambiguously false whether that situation violates the law *ex ante*. This seems at odds with common experience. After all, even seemingly unambiguous legal "rules"—such as the speed limit—can generate exceptions and genuine legal uncertainty *ex ante*.[156]

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154. This characterization is true whether the law is an explicit statute or the holding of a case. In the latter, the holding is often an implicit "rule," the content of which is capable of being characterized at multiple levels of abstraction and generality. Because an implicit holding can be plausibly characterized in different ways, there may not be unitary agreement about the "rule" of a case.

155. *See, e.g.*, CAL. VEH. CODE § 22349 (2009) ("Except as provided in Section 22356, no person may drive a vehicle upon a highway at a speed greater than 65 miles per hour.").

156. One common example might include a husband driver speeding to be by his wife's side during birth. There might be genuine uncertainty whether this fact pattern will be held

Moreover, many legal doctrines employ considerably less predictable legal "standards"—for example the "compelling government interest" standard in First Amendment jurisprudence. Nonetheless, I argue that it is not the objective legal reality, but the mechanism for resolving legal uncertainty, that creates the dichotomous, bivalent structure to which I refer.

The law is bivalent *ex post* because legal officials ultimately have the institutional capacity to resolve any legal uncertainty. Law is ultimately a societal construct and as such can be rendered dichotomous in a legally certain way *ex post*. A particular set of facts either *does* or *does not* violate a particular law—as determined by a legal official. An authoritative legal official can render a final, binding pronouncement that renders previously legally uncertain issues legally certain. This is true even in fundamentally *ex post* policy-oriented areas such as First Amendment law, which involve deliberately flexible legal criteria. Even with a complex and highly uncertain set of facts, a court has the authority to conclusively[157] decide whether a fact pattern does, or does not, violate the First Amendment—in a bivalent manner.[158] It is useful to recognize this connection explicitly, because it will be the divergence in *ex ante* and *ex post* bivalence in patent scope that will form the approach for characterizing scope uncertainty.

B. Formally Defining and Patent Scope

1. Formally Defining Patent Scope and Certainty

Issues of patent scope are similarly concerned with legal bivalence. Our earlier assumption states that every law implicitly divides up the world into two groups: Group 1 includes the future behaviors that are the subject of the law. Group 2 includes the future behaviors that are not. The principle of legal bivalence implies that (despite *ex ante* uncertainty) a legal official ultimately has the capacity to classify a given example of real world behavior into one of two categories: Either the behavior "violated a given law" or "did not violate a given law." This notion helps us to more formally

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to violate the law.

157. Of course, there are different levels of hierarchy in law. In some cases, the "conclusive" determinations of lower courts can be overruled by higher courts. Nonetheless, there is always a court "of last resort" that can conclusively resolve a legal uncertainty.

158. Legal officials, in principle, have the ability to officially resolve legal uncertainty in this dichotomous and bivalent way through their final, binding authoritative judgments.

define the concept of legal scope using set theory. We can functionally define the legal scope of a law in terms of two sets: the set of actors, objects, behaviors, and states that violate the law and the set of those that do not.[159]

We can characterize the scope of a patent claim in precisely this same way. Patents are legal rights, and like a statute, a patent claim's coverage is specified through the use of generalization to capture a class of expected real-world exemplars. In the case of a product patent, the applicant aims to abstractly delineate coverage over some group of future devices that fall under the patent claims.[160] We can think of the potential domain of the claim as all real-world objects and devices. The essential question of literal patent scope is which real-world objects and behaviors are unambiguously covered by a patent claim, and which are not. In a world of maximal precision—a perfectly scoped patent claim—the scope of a patent claim would delineate the hypothetical set of all real-world objects that unambiguously infringe the patent claim. Every other device would form the set of objects outside the scope of the patent claim.

Defining the scope of a patent claim through set theory is helpful because it directs our attention squarely on the scope membership criteria. We must focus on the available criteria for separating objects into the set of objects covered by the claim from the set that is not covered by the claim. This in turn focuses on how effectively existing constraints on claim scope effectuate bivalence relative to the types of objects, devices, or technology the criteria will classify as infringing. Specifically, if we are to improve the precision of patent scope, there must be sufficient, objective criteria framed at the level of detail necessary to classify the set of relevant objects. If we do not have criteria specified at that level, then the *ex ante* scope or coverage of the patent will be uncertain. In other words, the criteria will provide neither lay interpreters nor legal officials with unambiguous guidance for classifying as covered or not covered, a large set of real-world objects. The first benefit of the set theory model is highlighting bivalence as a theoretical goal in terms of scope certainty.

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159. Set A = {Set of all entities and their future behaviors that violate the law}; Set B = {Set of all entities and their future behaviors that do not violate the law}.

160. In the case of a process patent, the coverage is toward all future behaviors that might fall under the purview of the process.

2. Patent Scope Uncertainty Using Set Theory

For similar reasons, set theory serves as a useful framework for modeling patent uncertainty due to scope underdetermination. I will briefly summarize that argument. Patent scope underdetermination often arises due to *ex ante* interpretive variability in claim terms. Variability means that, in interpreting a patent, the claim words are capable of multiple, plausible interpretations or scope coverage, *ex ante.* Such variability is often present even after applying the interpretive rules of claim construction in light of scope-limiting information available in the patent document. Such variability can lead to uncertainty about claim scope and boundaries. There is uncertainty because, in an infringement proceeding, a judge might elect any one of the interpretations plausible in light of constraints. An objective lay interpreter will be unable to determine scope boundaries *ex ante* because they will be unable to know which of the possible interpretations will be authoritatively chosen by a legal-official *ex post*. If there are many such plausible interpretive scopes available, there will be considerable legal uncertainty about the scope of a given claim.

We can represent literal scope underdetermination within the descriptive syntax of set theory. Uncertainty due to underdetermination is represented by the set of plausible interpretations for a patent claim word (or element).[161] If the set of interpretations that can plausibly be advanced around a claim term is greater than one, there may be some legal uncertainty surrounding the meaning that the claim term can take on during litigation. If the set of plausible meanings includes one interpretation which, if applied, will mean that an accused product will be found to infringe, and another which, if applied, will absolve a defendant of liability, then there is scope uncertainty for that claim relative to that product. The set of plausible interpretations is one measure of scope uncertainty.

Set theory also provides us with a functional model of claim scope uncertainty. Recall that an ideal, perfectly scoped patent claim would objectively classify, with legal certainty, the set of all products into two subsets: (1) those products that literally infringe the patent and (2) those that do not. For most claims, the interpretive information does not permit such unambiguous classification. Rather there will be a third subset—those products for which it is legally uncertain whether they do or do not literally infringe. One can

161. Within law generally, "legal uncertainty" can be characterized by the set of plausible legal arguments surrounding an issue of law or fact.

approximate relative imprecision of patent scope by the size of this third set of underdetermined objects.

This third set of underdetermined objects is crucially important. First, this underdetermined set is clearly going to be the set of objects that will most likely be the subject of litigation. Second, it provides a target for refining the scope of any claim: Given the likely pool of products in which a patent will apply, has the patentee given enough definitional information such that we could unambiguously distinguish an object that is covered by the patent claim from an object that is not? If the answer is no, then we likely need more information from the patent applicant. Reducing scope uncertainty will be tantamount to reducing the size of this third set.

C. Formalizing Scope Restrictions

1. Constraint Satisfaction and Boundary Delimitation

Because issues of patent scope are concerned with claim boundaries, it is important to also formalize the concept of scope limitation. In this regard, I employ a framework from computer science known as "constraint satisfaction."[162] This framework will model the process by which the scope of a patent term becomes successively more restricted through the interpretive process. To reemphasize, in such a model, constraint satisfaction serves mostly as an analogy to help us approach uncertainty issues. Having such a formal conceptual model will aid in understanding why some patent interpretive rules will tend to improve legal certainty and some will not.

Constraint satisfaction is a mathematical construct used for modeling certain types of problems encountered in the computer science domain.[163] From an intuitive standpoint, constraint satisfaction can be thought of as formalizing the idea of "filtering" or successively narrowing possibilities

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162. A formal mathematical treatment of the framework is beyond the scope of this Article. For completeness purposes, however, I provide a formal definition. Formally, a constraint satisfaction problem is composed of three components: a set of variables, *X*; a set of domains, *D*; and a set of constraints, *C*. A variable is a symbol that can take on one or more values. The set of domains *D* describes the "domain," or the set of unconstrained possible values for each variable *X*. Finally, the constraints *C* represent the constrained subset of possible values that a variable *X* can take on. *See* STUART RUSSELL & PETER NORVIG, ARTIFICIAL INTELLIGENCE: A MODERN APPROACH 202–04 (3d ed. 2010).

163. *Id.* at 202.

from a larger set of possibilities.[164] Constraint satisfaction is built upon set theory. A "constraint" as the name suggests, is simply a rule that narrows the valid members of a set.[165] It can be thought of as a filtering rule that eliminates those members of the set that do not satisfy the substantive content of the constraint. Thus, if we start with the set containing the numbers 1, 2, 3, 4, and 5, and we apply the constraint rule "odd numbers are not permitted," we are left with the subset of numbers 2 and 4. The members 1, 3, and 5 have been "filtered out" of the constrained set because they do not meet its criteria.

Importantly, constraints can be *additive.* Multiple constraints can apply and work in conjunction to further narrow a given set. If we add the constraint "numbers over 3 are not permitted" to the existing constraint "odd numbers are not permitted," and apply both constraints to the set 1, 2, 3, 4, and 5, we are left with a subset containing a single member—the number 2. Or, if we start with the set of two apples, two oranges, and two bananas in a particular fruit bowl, and apply the constraint "only yellow fruit are permitted," we are left with a subset containing only the bananas. Similarly, we can conceive of a set of plausible legal arguments that are present in a particular legal context and constraints as external authoritative filters that eliminate previously plausible arguments.

The constraint satisfaction framework is thus about determining which possibilities are left in the "constrained set" after applying a series of constraining rules that tend to narrow and eliminate various possibilities. Generically, we can call the original, non-narrowed set the "search space." We can term the set that has been narrowed, after the constraints have filtered the search space, the "solution space." Thus, in the above example, the "search space" consists of the set of "two apples, two oranges, and two bananas." And the narrowed "solution space," applying the constraint "only yellow fruit are permitted," is the subset containing "two bananas."

2. Origins of Constraint Satisfaction as a Framework

To understand the relevance of constraint satisfaction in the patent scope context, it is helpful to understand its origins. Constraint satisfaction emerged in computer science as a technique for mathematically modeling

164. *Id.* at 202–04.

165. *Id.* at 202.

certain real-world problems involving very large combinations of possibilities that might solve a particular problem.[166] In theory, a computer might methodically assess every possibility to find one or more solutions to such a problem. However, some mathematical problems have so many potential solutions that the number attempted would be staggeringly large. For example, one famous chess problem has over 100 trillion possible combinations, with only a very few of those combinations as actual solutions.[167] Working methodically through 100 trillion combinations and analyzing each one as a potential solution is infeasible even for a modern computer.[168]

The constraint satisfaction technique was developed to dramatically restrict the number of possible combinations a computer would have to analyze by filtering or constraining the possibilities ahead of time. The set of every possible combination was known as the "search space," and the "solution set" was the small subset of the search space which was a solution to the problem.[169] Constraint satisfaction allowed one to dramatically decrease the search space by applying multiple constraints or "filtering rules" that eliminated vast swathes of solutions in the search space.[170] Accordingly, if the size of the set of remaining solutions was radically reduced, the remaining set of potential solutions could actually be feasibly tested one by one by a computer.[171] This framework thus allows the modeling of sets and using rules to filter out possibilities from that set.

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166. *Id.* at 202–04.

167. *See id.* at 71–72 (demonstrating that there are 1.8 x 1014 possibilities in the famous 8 Queens Problem).

168. If a computer, even today's fastest one, was to methodically start at the beginning and try every combination to see if it worked, it would not be computationally possible to find a working solution in a reasonable amount of time. *Id.* at 72.

169. *Id.* at 202.

170. *Id.*

171. For example, by applying a series of constraint rules which eliminate vast swathes of potential solutions from contention, computer scientists were able to reduce the number of possible solutions to be tested from 100 trillion to about 2,000—well within the abilities of modern computers. *See id.* at 72 (reducing 1.8 x 1014 possibilities to 2,057).

3. Constraints on Meaning in Patent Law

As an analogy, the constraint satisfaction framework is helpful for modeling the reduction of claim scope through interpretation. As indicated, one way of abstractly conceiving of the interpretation of words in a patent claim is as a selection process among the multiple plausible interpretations, meaning, and scope that a word could have. We can think of all of the potential distinct scopes as consisting of the "search space" of potential interpretations for the word. A claim word has a set of possible scopes on its face—its unconstrained scope. The plausible coverage is successively narrowed when we apply the interpretive rules that additively restrict its possible meanings. For example, interpretation according to ordinary meaning to one skilled in the art might narrow the interpretive scope of a word further compared to its colloquial, every day usage.

Ex ante, the plausible interpretive scopes of a patent claim word will be those that are left after such scope constraints have "filtered out" the other possibilities. Thus, to use a simple example, if we have the claim word "encryption," the unconstrained scope might be a set of two meanings: "a cipher whether computerized or not" or narrowly as "computerized encoding." We could imagine a scope restriction in the specification requiring encryption to be restricted to a computer context, considerably narrowing the scope to the second interpretation.

Scope uncertainty due to underdetermination may occur when the constrained set of plausible interpretations permits multiple scopes. Roughly speaking, the more constrained the set of possibilities is, the fewer members there will be in the set of possible interpretations. Conversely, the larger the set of plausible interpretations—the less constrained the set of possible interpretations there are—the larger the room for argument about the scope and interpretations, and consequently, the more legal uncertainty there will be. Thus, the ability of constraints on meaning to narrow *ex ante* the search space is directly linked to the function of improving public notice and certainty of patent scope coverage.

a. Constraints on Meaning in Interpreting Patent Claims

This constraint satisfaction conceptualization is helpful as a rough metric for evaluating patent rules to the extent that such rules promote the policy of certainty in the scope of coverage of patents. To the extent that we have increased relative certainty about the boundaries, we will have

increased certainty as to coverage. Lack of certainty about scope and boundaries will result in the lack of public notice as to the coverage of patents.[172] To make the thesis more tangible, it is helpful to think about what acts as a constraint on claim meaning in the existing patent system. For the moment, let me just list the most obvious category constraints on claim meaning before evaluating them normatively in terms of their effectiveness.

Drawing from the caselaw and statute, the major constraints on the meaning of a claim term, from the point of view of an interpreting judge are:

- the patentee's own included definitions for claim terms,[173]
- the "ordinary and customary" meaning of claim terms as understood by a person having ordinary skill in the art (PHOSITA) at the time of the invention,[174]
- the context of and use of words in the same or surrounding claims,[175]
- the contextual use of claim terms in the specification,[176]

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172. Note that I am not arguing for interpretive rules that result in the general narrowing of the scope of patent claim terms. The distinction between appropriate scope and clear boundaries is one that is occasionally confused, and it is worth distinguishing. Rather, I am arguing for procedures which result in more *ex ante* legal certainty about the scope and boundaries of legal terms, and hence increase public notice. It is entirely possible—and consistent with the thesis of this paper—to have valid patent terms of very broad scope, but whose scope and boundaries are simply well defined and delineated. *See* BESSEN & MEURER, *supra* note 1, at 46 (advancing the theory that due to a lack of clear notice "innovators find it increasingly difficult to determine whether a technology will infringe upon anyone's patents").

173. *See* Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996) ("Although words in a claim are generally given their ordinary and customary meaning, a patentee may . . . use terms in a manner other than their ordinary meaning, as long as the special definition of the term is clearly stated in the patent specification or file history." (citations omitted)).

174. *See* Phillips v. AWH Corp. 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc).

175. *See id.* ("'[W]e must look at the ordinary meaning in the context of the written description and the prosecution history.'" (quoting Medrad, Inc. v. MRI Devices Corp. 401 F.3d 1313, 1319 (Fed. Cir. 2005))).

176. *See Vitronics*, 90 F.3d at 1582 ("[I]t is always necessary to review the specification to determine whether the inventor has used any terms in a manner inconsistent with their ordinary meaning. The specification acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication." (citations omitted)).

- the use of claim terms or explicit disclaimers about meaning found in the prosecution history,[177]
- the meaning of the term found in contemporary technical dictionaries,[178]
- the meaning of claim terms as provided by experts who testify at trial,[179] and finally,
- the canons of construction.[180]

Less obvious, but in the background, are more subtle constraints on claim meaning, including the ordinary meaning of words as construed by society generally in ordinary English. Such constraints make it implausible to interpret words completely subjectively (absent a patentee-supplied definition) as meaning something fully outside their normal range of meaning.[181] Also, there are legal technical meanings of words, such as transitions like "comprising of," defined by caselaw and convention.

D. Patent Scope Uncertainty and Marginal Analysis

Before analyzing the effectiveness of these constraints, it is helpful to formally model the reduction of claim scope uncertainty. The set-theoretic model is useful because it highlights a patent scope uncertainty-reduction strategy based upon marginal analysis of constraint information. By "marginal analysis" I refer to the general process of inquiry that is focused upon changes in terms of increments—a procedure frequently associated with microeconomics.[182]

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177. *See id.* at 1583 ("'The prosecution history limits the interpretation of claim terms so as to exclude any interpretation that was disclaimed during prosecution.'" (citations omitted)).

178. *See Phillips*, 415 F.3d at 1318 ("We have especially noted the help that technical dictionaries may provide to a court 'to better understand the underlying technology' and the way in which one of skill in the art might use the claim terms." (citations omitted)).

179. *See id.* ("We have also held that extrinsic evidence in the form of expert testimony can be useful to a court . . . to establish that a particular term in the patent or the prior art has a particular meaning in the pertinent field." (citations omitted)).

180. *See* All Dental Prodx, LLC v. Advantage Dental Prods., Inc., 309 F.3d 774, 780 (Fed. Cir. 2002) (stating that patents can be interpreted "according to the familiar canons of claim construction" which includes "the claim language itself, . . . patent specification and prosecution history" (citations omitted)).

181. I argue that "plausibility" acts as a general constraint filtering out arguable but wildly unlikely potential definitions.

182. *See, e.g.*, PHILIP H. WICKSTEED, THE COMMON SENSE OF POLITICAL ECONOMY 40

Let me briefly summarize the marginal approach generally before applying it to the set-theoretical model of patent scope uncertainty. Marginal reasoning is associated with three general features: (1) the ability to identify one or more referent or "baseline" levels upon which to initiate analysis, (2) the capability of identifying incremental increases or decreases relative to the selected reference point, and (3) a focus on the margin—emphasizing the effects as a result of incremental changes.[183]

For those unfamiliar with marginal reasoning, an example will help illustrate its usage. This marginal approach is both best illustrated by, and most associated with economics. In microeconomics, elementary problems often focus on the level of output of factories. In such questions, the "marginal approach" to cost of production refers to a certain baseline level of production by a factory and explores the incremental cost of one additional unit over the selected baseline level of production.[184] For our purposes, it is enough to note the marginal approach to cost is focused on the effects of an incremental unit or additional unit over the baseline.[185]

The set-theoretic model helps us similarly analyze the problems of scope uncertainty at the margin. What would it mean to take a marginal approach to legal uncertainty? Similar to the economic conception, we would first need a means of characterizing a "baseline" or referent level of legal uncertainty. Then we would need to focus our analysis upon incremental changes in terms of increased or decreased legal uncertainty from that baseline. The marginal approach ultimately will enable an inquiry into incremental types of scope-defining information likely to increase the legal certainty of the scopes of patent claims.

(Lionel Robbins ed., 1933) ("Marginal considerations are considerations which concern a slight increase or diminution of the stock of anything which we possess or are considering.").

183. For a good introduction to marginal reasoning, see N. GREGORY MANKIW, PRINCIPLES OF ECONOMICS 6 (5th ed. 2009).

184. *See id.* ("Economists use the term marginal changes to describe small incremental adjustments to an existing plan of action.").

185. Another example of the marginal method comes from within economic analysis of negligence law. A foundation of negligence is that one may sometimes employ precautions to reduce the risk of some activity (e.g., using snow tires to reduce risks of accidents while driving in the snow). A marginal analysis of the benefits of adopting a precaution would not look at that precaution out of context. Rather, the analysis would focus upon the incremental benefits conferred by the precaution over some existing level of precaution already being taken (e.g., a car that already employs four-wheel drive). *See, e.g.*, RICHARD POSNER, ECONOMIC ANALYSIS OF LAW 167–68 (6th ed. 2002).

1. Principle of Comparative Legal Uncertainty

Recall that patent scope uncertainty is simply a special instance of legal uncertainty. There is *ex ante* uncertainty, from the perspective of a lay observer, about the *ex post* outcome on the part of a legal official. Conceptualizing legal uncertainty using set theory provides some analytical advantages in terms of marginal reasoning. If we think about legal uncertainty as consisting of sets or *collections* of potential legal outcomes then we are able to think more rigorously about the notion of comparing the amount of legal uncertainty between similar legal contexts on the basis of the set of plausible legal arguments under each context. The contention that it is possible to compare the amount of legal uncertainty between two factual contexts is what I call the "principle of relative legal uncertainty." I will explore this principle through a simple example from law generally and then apply it specifically to the patent scope context.

Let us take a particular factual situation that is governed by particular legal rules, and call this a "factual context." Imagine a factual scenario—a business transaction—in which either a tort rule or a contract rule may or may not apply. Let us assume that one source of legal uncertainty surrounds the question of which of the two laws apply (and ultimately will be used to govern the outcome). As an initial matter, there is going to be a body of potential legal arguments that are "self-evidentially" excluded from consideration.[186] For example, unless there are specific reasons to believe otherwise, we can imagine that the typical business transaction does not involve the body of rules from the "law of space." As Larry Solum has noted, in any given factual scenario, only a small subset of the total number of enacted laws and regulations can reasonably be said to apply.[187]

In our example, the facts are such that it is simply uncertain, *ex ante*, whether the contract rule does or does not apply. Definitively resolving the uncertainty as to the applicability of the law will ultimately fall to an authorized legal official. To illustrate the point of comparative legal certainty, let us use the same factual scenario, but with one additional constraint. In our modified scenario, we are adding the existence of an

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186. *See* Lawrence B. Solum, *On the Indeterminacy Crisis: Critiquing Critical Dogma*, 54 U. CHI. L. REV. 462, 470–73 (1987) (discussing what the author terms the "strong" indeterminacy thesis).

187. *See id.* at 471–72 (discussing and using examples where it is clear a given act does not break any legal rule to show the strong indeterminacy thesis cannot be true because it denies the possibility that such cases exist).

additional, explicit statute that clearly indicates that the contract rule does not apply under these facts. Imagine further that there is no reasonable argument as to why this new statute does not settle the issue, and the legal official is not seeking to avoid this outcome. It would be fair to say that the overall legal uncertainty in the second scenario is comparatively less than the first. In the second, there is now only legal uncertainty concerning whether the tort rule applies and not uncertainty about whether both the tort rule and the contract rule apply.

Let us consider this second modified scenario in terms of set theory. Holding everything else equal, there will be one fewer argument in the set of plausible legal arguments surrounding our modified factual situation. From the perspective of the legal official, there will be one fewer facially plausible option in terms of outcome. The set of plausible legal arguments will no longer contain the following member: "the contract rule might apply." The principle of relative legal uncertainty thus contends that it is possible to compare the legal uncertainty between the former and the latter factual situations based upon the number of plausible legal arguments in each set. According to this principle, the latter factual context containing the additional rule is incrementally and marginally less legally uncertain than the former. One legal argument, which had contributed to the overall legal uncertainty surrounding the factual context, has been eliminated by the additional constraint. Intuitively, we can think of net "legal uncertainty" in a given context as marginally decreasing when there is a change in which a previously plausible legal argument has been eliminated. Similarly, we can think of net legal uncertainty as marginally increased when a previously implausible legal argument has somehow been made plausible.

2. Marginal Reduction of Legal Uncertainty

This marginal methodology maps well onto strategies for reducing claim scope uncertainty due to underdetermination. Patent law already requires some baseline level of scope delineation through detailed rules requiring claim specificity and contextual information in the specification. What types of additional classes of scope-defining information are likely to result in reduction in scope uncertainty? We have framed an underdetermined scope by the “set" of interpretations that are plausible for a patent claim word in light of existing constraints. A patent scope is uncertain, relative to an accused product, if a third party cannot determine,

ex ante with legal certainty whether that product does or does not infringe given the range of plausible scopes. Thus, to improve scope certainty, the goal should focus on additional constraints that are likely to narrow or filter the set of plausible interpretations *ex ante* to the needed level of precision.

In other words, for any claim, there are already a series of constraints that are narrowing the plausible scope of the claim to some degree. The underdetermination problem occurs because these constraints are not precise enough *ex ante*, to filter some subset of plausible interpretations from *ex post* consideration by a legal official. Increased scope certainty will be achieved when an additional constraint filters, *ex ante*, particular *ex post* interpretive options from consideration. As in our earlier example involving the claim word "encryption," the addition of an explicit, on-point, scope-limiting definition in the specification, restricting the word to encryption on computers, marginally improved the literal scope certainty of that term. For the set of accused products involving encryption not involving computers (e.g., by hand), the certainty of scope has been incrementally improved. With an explicit, on-point constraint literally restricting scope, it has become costly[188] for a legal official, *ex post*, to elect an interpretive option that runs counter to this restriction. By contrast, an ostensible constraint that does not marginally reduce the set of plausible interpretations with certainty will prove to be mostly an illusory constraint.

By reflecting on incremental improvements in uncertainty, the marginal model allows us to sidestep a point of contention in legal scholarship—skepticism about the existence of "legal determinacy" or absolute legal certainty concerning legal conclusions.[189] It is possible to talk about setting the conditions for marginal progress that improves the likelihood of increased scope certainty, rather than absolute notions of

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188. Again, following the lead of Critical Legal Studies scholars such as Duncan Kennedy, it is not impossible for legal officials—judge or jury—in the patent context to avoid the legal consequences of on-point, explicit constraints. *See* Kennedy, *supra* note 109, at 788 (discussing the potential for judges to adopt strategic attitudes and to try to make legal materials "mean something other than what they at first appear to mean"). Rather, we think that such on-point constraints make deviation more costly. Overall, the prevalence of such on-point constraints should lead to a relative predictability. Comparatively speaking, patent law interpretation might be considered a more "formal" context in which formal boundaries tend to be respected as compared to other, more explicitly discretionary areas.

189. *See* Harry Surden, *The Variable Determinacy Thesis*, 12 COLUM. SCI. & TECH. L. REV. 1, 2–5 (2011), *available at* http://www.stlr.org/cite.cgi?volume=12&article=1 (discussing historical development of the view of legal determinacy in American legal scholarship in the context of proposing ways of using computer automation in determining legal outcomes).

certainty or uncertainty. From a rule consequentialist perspective we can examine properties of patent procedures in light of their general propensity to marginally increase or decrease legal uncertainty in particular situations.

3. Metrics for Notice-Enhancing Constraints

The set theory/constraint satisfaction model is thus useful because it allows us to identify general theoretical properties for constraints in terms of their ability to improve patent scope certainty. On the basis of these properties, we can then evaluate specific patent interpretive procedures. If improving public notice is about narrowing the search space of potential meanings *ex post*, there are three general theoretical properties that will be desirable in constraints: (1) A constraint must be "set narrowing"; (2) the content of the constraint rule must be *ex ante* determinable; and (3) the interpretive information-defining criteria of the constraint must be sufficiently precise to classify the universe of accused products as infringing or not. More generally, a patent claim will have improved scope certainty to the extent it is bivalent with respect to unambiguously classifying, *ex ante*, the set of potential accused products into two sets: those that literally infringe the claim and those that do not.

The first desirable property in a constraint is *ex ante* determinability. If we consider a constraint as a classification-rule then *ex ante* determinability means that we are able to determine ahead of time the precise content of the rule itself. If the content of a constraint is itself *ex ante* contestable, then the constraint cannot have a narrowing effect because we do not know which version of a filtering rule will ultimately be applied to narrow meaning. This is the primary problem encountered earlier with implicit constraints inferred contextually from usage in the specification.

In our set theory/constraint model we can now understand the problem of implicit constraints. Claim scope certainty is improved when an *ex ante* constraint definitively removes from plausibility some possible interpretations for a claim word. An implicit constraint is typically not able to perform such an *ex ante* filtering function. This is because the content and scope of the constraint *itself* is open to contestation. A lay interpreter cannot rely on such an implicit constraint to definitively narrow the set of possible scope interpretations because it is not clear that a legal official, *ex post*, will either adopt that same constraint or apply it at the same interpretive scope.

The multiple meanings pattern of underdetermination provides another example of an ineffective *ex ante* constraint. Consider the use of a dictionary definition as a constraint to resolve the meaning of a claim term in litigation. Suppose that there are five respected dictionaries, each with its own set of definitions. For each dictionary, the included definition has multiple meanings for the word. If we were to say that the meaning of a patent claim term should be resolved by reference to "external dictionaries," we will not meaningfully narrow the "solution space" of possible interpretations *ex ante*. We do not know, as a threshold matter, which dictionary will be used and which numbered meaning within that dictionary will ultimately be selected. Rather, the content of the constraint is probabilistic and is not *ex ante* determinable with certainty.

Contrast an implicit constraint on meaning—the way the patentee uses a word in context in the patent document—with an explicit constraint—a formal, explicit, patentee-provided definition for a word. The content of the latter explicit constraint is *ex ante* determinable as compared to the former. The content of an explicit definition included by a patentee in the four corners of the patent document has the possibility of being *ex ante* determinable. At the very least, if the rules require the interpreter to use the patentee-supplied definition, we know, *ex ante*, the specific version of the interpretive rule that must be applied *ex post*.

The fact that the patentee has supplied an explicit definition in the four corners of the document does not by itself guarantee precision in claim scope. After all, patentees can always supply definitions that are vague or ambiguous on their face. But as I will argue, such a scenario is preferable to the scenario without any explicit definitions. If an explicit, unitary definition is vague or ambiguous, there is at least a possibility that the patent office can require specific additions to make it more clear and precise. When a definition exists implicitly in a probabilistic range of possible background definitions—the set of plausible definitions according to a person of ordinary skill in the art—a patent examiner cannot know with precision the ultimate definition that will be employed, or may overlook such an implicit constraint altogether.

In sum, the set theory constraint satisfaction model tells us to aim for a theoretical target of bivalence for claim scope: a well-scoped claim will classify the set of relevant objects as literally infringing or not. Constraints that are explicit and *ex ante* determinable in form tend to be superior to constraints whose content is probabilistic. Moreover, the model gives us a target for improving scope certainty with a baseline patent claim: Given a patent claim as currently scoped, what additional pieces of scope-defining

information are likely to exclude foreseeably relevant claim word interpretations, moving incrementally closer to bivalence?

The set-theory/constraint model is clear: Scope certainty is generally improved via explicit constraints that reduce the set of plausible interpretive scopes that patent claim elements can have. For example, consider that a patent often includes implicit limitations that can be arguably inferred from the specification—particularly features that are common across all included embodiments. Scope certainty can be improved by an explicit constraint that definitively indicates whether such a constraint should or should not apply. As I will suggest in the next section, patent examiners can efficiently reduce scope uncertainty by requiring explicit articulation of such boundary lines—effectively turning ambiguous implicit constraints into explicit, determinable, set-narrowing constraints. This will make the claim's boundary more certain relative to the class of products that seek to invent around the claim. The model also suggests an efficiency limitation—when the marginal benefit of additional interpretive information will not meaningfully narrow the set further. The next Part will explore the policy and efficiency implications of the model.

V. Policy Changes

A. Implications of the Model on Patent Rules and Practices

The model has important policy implications toward improving overall patent scope certainty. The first section of this Part will explain why the model provides some limited justification for the Federal Circuit's patent interpretive doctrine. The second section includes suggested modifications to the patent system based upon the model. These generally seek to improve claim scope certainty by requiring patentees to include clarifying information in the *ex ante* public record. The target will be disclosures that disambiguate uncertainty in foreseeable[190] scope uncertainty scenarios.

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190. There are common, repeated patterns in which patent scope is commonly contested. For example, defendants often seek to impute limitations from the embodiments. Such ambiguity can be resolved *ex ante* by requiring scope clarifications by the patentee on the record.

1. Theoretical Justification and Patent Interpretation Doctrine

The Federal Circuit's claim interpretation jurisprudence identifies different sources that act to constrain the scope of meaning of patent claim words (e.g., dictionary definitions, plain and ordinary meaning standard, specification). This Part critically evaluates these different constraints in light of *ex ante* scope definition and this Article's formal model.

Recall that the boundaries of a patent claim are often uncertain *ex ante* when claim words are capable of multiple, plausible scope interpretations. A third party cannot easily know which scope will ultimately be chosen until it is determined by a judge or jury at litigation. The model represented this scope uncertainty problem by the set of plausible interpretative scopes that any given patent claim word can have *ex ante* after applying the interpretive rules that restrict the potential meanings of the scopes of words.

The model highlighted three general properties of constraints associated with increased scope certainty. An interpretive constraint that provides *ex ante* notice as to boundaries should: (1) be *ex ante* determinable (e.g., explicit); (2) provide distinct criteria with enough precision such that a lay interpreter can exclude particular interpretive scopes; and (3) be bivalent—classify the relevant set of accused products as either infringing or not with some degree of legal certainty. Constraints that exhibit these properties are more likely to restrict the set of plausible interpretive scopes, excluding relevant products from the literal scope *ex ante* and *ex post*.

We can use these properties to normatively evaluate patent law's various interpretive constraints. The rules for interpreting claim words are largely established by the Federal Circuit's claim construction (interpretation) doctrine.[191] During the process of claim construction, a presiding judge often seeks objective guidance on the appropriate scope to give the contested words of the claim.[192] According to doctrine, there are two main categories of sources upon which interpretive decisions are to be made—intrinsic (e.g., evidence internal to the patent document and prosecution history) and extrinsic (e.g., external sources such as dictionaries, expert testimony, and treaties). In 2005, the Federal Circuit in

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191. Some portion of the claim terms (primarily non-technical terms) may go directly to the jury for infringement determination without first being construed by the judge. In that instance, the jury implicitly decides what the scope of a claim term is in conducting the infringement analysis. *See* Menell et al., *supra* note 80, at 731.

192. As indicated previously, claim construction is the process by which the presiding judge fixes the meaning of a claim term during the course of an infringement lawsuit.

Phillips v. AWH Corp.[193] instructed district court judges to give "intrinsic" sources of evidence considerably more weight than "extrinsic" sources of evidence in making claim interpretations.[194]

Did the *Phillips* court reach the desired outcome in terms of improving claim scope certainty? This Article's model suggests that the court's approach is generally sound. However, I will argue that the courts "intrinsic/extrinsic" classification, while useful, is undertheorized. The important question is not whether various sources of interpretive constraints are classified as "intrinsic" or "extrinsic" in the court's typology, but whether they are consistent with the theoretical properties of *ex ante* determinability, bivalence, and set-narrowing precision.

To understand this distinction, consider the benefits of intrinsic evidence for scope purposes. A primary characteristic distinguishing intrinsic from extrinsic evidence appears to be *ex ante* determinability. The label "intrinsic" primarily refers to evidence from the "four corners" of the patent document and prosecution history. Extrinsic evidence is characterized by contrast to intrinsic, consisting of "all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionary, and learned treatises."[195] An important feature of intrinsic evidence for scope defining purposes is that it is part of the *ex ante* publically accessible record. To a lay interpreter attempting to discern boundaries, intrinsic evidence is relatively more determinable *ex ante* than extrinsic evidence. The interpreter knows exactly where to look for intrinsic evidence and what its primary content will be. By contrast, extrinsic evidence is largely undetermined until litigation. Consider reliance upon expert testimony *ex post* to establish claim scope. The specific testimony of particular expert witnesses cannot be known with precision until established during the course of an actual infringement suit, except at perhaps a very broad level.

The court's prioritization of intrinsic evidence—publically available information—is consistent with the model's determinability property. *Ex*

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193. Phillips v. AWH Corp., 415 F.3d 1303, 1317–22 (Fed. Cir. 2005) (en banc) (reestablishing the priority of intrinsic evidence over extrinsic evidence, and stating, "extrinsic evidence may be useful to the court, but it is unlikely to result in a reliable interpretation of patent claim scope").

194. *Id*.

195. Markman v. Westview Instruments, Inc., 52 F.3d 967, 980 (Fed. Cir. 1995), *aff'd*, 517 U.S. 370 (1996).

ante claim scope boundaries are enhanced when a lay interpreter can know with certainty the form and substance of the restrictions on possible claim meanings that will later be employed *ex post*. Intrinsic evidence is fixed to some degree in the written record. The problem with extrinsic evidence generally is that it is not typically a static, but a probabilistic, proposition with a wide range of variance, until determined at litigation. Because of this, lay interpreters attempting to discern literal scope boundaries typically have less legal certainty about those boundaries. They will ultimately be determined by reference to such probabilistic, extrinsic evidence.

This is further illustrated by a prototypical extrinsic source—a dictionary. If a claim term is not defined, doctrine requires judges to construe it from the "plain and ordinary meaning" of the term to one of ordinary skill in the art.[196] For courts seeking objective indicia of contemporaneous technical understandings of a term, one natural source is a technical dictionary.[197] In a typical case, there are several such dictionaries that might plausibly be used.[198] For each dictionary, the relevant entry may have multiple meanings or scopes for a given word.[199] If extrinsic dictionaries are used *ex post* to resolve the scope of a word, the scope-delimiting rule that will be employed during litigation cannot be firmly established *ex ante*. A third party cannot know, for instance, which dictionary will be used, which definition in that dictionary will control, or what the ultimate scope the definition will be held to consist of will be.

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196. The patent document serves to establish the boundaries of the patent holder's exclusive rights. 35 U.S.C. § 154 (2006). In interpreting patent claims, judges look to hone in on the meaning of the claim words by consulting evidence from multiple sources. *See* Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996) (noting that the court may utilize a number of sources). These indicia of likely meaning come from within the patent document itself (intrinsic evidence) but also include evidence of meaning external to the patent document such as dictionaries (extrinsic evidence). *See Vitronics*, 90 F.3d at 1582–83 (discussing the proper weighing of intrinsic and extrinsic evidence). Judges typically use these indications to restrict possible meanings of claims to their most reasonable interpretation in light of various sources of evidence. *See Vitronics*, 90 F.3d at 1582–83 (characterizing unambiguous language as highly relevant).

197. Other sources that might be used to refine that meaning include expert testimony, technical books, or contemporary scholarly or operational literature from the field.

198. *See, e.g.*, L & P Property v. JTM, LLC, 578 F. Supp. 2d 318, 326 (D. Mass. 2008) ("Defendants take issue with L & P's definition of 'encryption' by citing numerous definitions from technical dictionaries.").

199. *See* Mullally, *supra* note 26, at 369 ("The unfettered discretion that judges had in choosing among a considerable number of dictionaries without explanation and then selecting a particular definition within a given entry gave rise to a highly uncertain environment for claim construction.").

Such an uncertain constraint will often not provide needed certainty to define *ex ante* boundaries. For this reason, the default "plain and ordinary meaning" standard, resolved via extrinsic sources like dictionaries, often provides illusory scope restrictions. It represents, not one, but a probabilistic set of possible constraints.

By contrast, intrinsic evidence typically fares better than extrinsic evidence in terms of scope-defining properties (although it is by no means perfect). This is illustrated by the paragon of scope-defining intrinsic evidence—the patentee—supplied definition. Patent applicants are permitted (but not required) to explicitly define their patent claim terms in the specification.[200] Such explicit definitions have the potential to maximize *ex ante* notice because they will meet at least two desired constraint properties. First, because a definition is embodied in a fixed, reified, textual form in the specification there are not threshold contestability issues about the primary content of the definitional rule to be applied. Contestation is limited to refinements of meaning. Second, if properly linked to a specific claim word, there will not be normalization problems. Moreover, third parties can know if the definition, on its face, contains ambiguities, open-texture, or explicit discretion. The Federal Circuit has also touted intrinsic evidence as more reliable because the patentee created it contextually at the time of drafting.[201] This contextual benefit of intrinsic evidence can be seen in terms of increased *ex ante* determinability relative to typical extrinsic evidence. There is a greater chance that the patentee deliberately intended to employ a constraint of which they were potentially in control during drafting, as compared to a constraint provided by a completely extrinsic source, of which the applicant may not actually have ever known about.

2. Federal Circuit's Approach: Both Over and Underinclusive

The Federal Circuit's approach, while mostly supported by the model, is both over and underinclusive. There are examples of intrinsic evidence defining scope poorly and of extrinsic evidence providing adequate scope guidance. For this reason, it is helpful to consider constraints in terms of

200. *See* MPEP, *supra* note 5, § 2173.05(a).

201. Phillips v. AWH Corp., 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc).

underlying theoretical properties rather than in the Federal Circuit's intrinsic/extrinsic typology, which fails to guide in several cases.

Some extrinsic evidence sufficiently narrows the scope of possible meaning *ex ante* at the level of precision needed for infringement distinctions. Examples come from research areas with technical words that are inherently well-bounded[202] or which have well-defined, widely agreed-upon meanings. This is exemplified by certain aspects of the biological and chemical domains. In some instances, references to molecule formations or other technical terms are sufficiently well-bounded in the art so as to make further, intrinsic, refinement unnecessary. In that case, a lay interpreter can actually determine extrinsically defined boundaries *ex ante*. Extrinsic references, such as technical treatises, may share common meanings. Such examples of scope-defining extrinsic evidence can be *ex ante* determinable, precise, and bivalent.

Similarly, simply because evidence is intrinsic does not mean that it will clarify scope boundaries *ex ante*. Part III provided examples of implicit constraints that are often inferred from intrinsic evidence. When intrinsic evidence is implicit, there are typically problems of *ex ante* determinability of scope, content, and applicability of the constraint similar to extrinsic evidence. For example, defendants often infer constraints from the specification based upon limitations shared across embodiments. Such implicit constraints are often ambiguous and contestable and tend not reduce scope uncertainty *ex ante*. Similarly, even explicit definitions in the specification employ imprecise words leading to similar scope uncertainty issues.[203] Moreover, intrinsic constraints may effectively turn into extrinsic constraints if a judge resorts to external sources (e.g., dictionaries) to further define them. Certain intrinsic evidence is endowed with all of the extrinsic limitations just described. This suggests that we should evaluate constraints specifically in terms of actual content, explicitness, and precision.

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202. Clarisa Long, *Information Costs in Patent and Copyright*, 90 VA. L. REV. 465, 476 (2004) ("[A]ttributes that are easy to recognize and define make it easier for observers to cognize the boundaries of the good.").

203. Scope disputes often concern words that are framed at an open-ended or high level of abstraction. It is easy to imagine an explicit patentee-supplied definition in the specification that did not improve scope certainty simply because it employed imprecise criteria. In this respect, the mere addition of a definition in the specification does not necessarily improve precision if the included definition is poorly or broadly defined.

The fact that considerable scope underdetermination is common may partially explain the Federal Circuit's high reversal rate in district court claim-construction decisions.[204] In such underdetermined contexts there are simply multiple, plausible interpretive scopes available in light of the existing intrinsic and extrinsic constraints on meaning. Thus a high reversal rate would be expected under de novo review. A reversal may not indicate that a district court necessarily arrived at an objectively wrong (i.e., implausible) interpretation. Rather, it may be that the Federal Circuit has simply elected a different but reasonable interpretive outcome given the latitude of options permitted by intrinsic and extrinsic constraints.

B. Changes to the Patent Drafting Process Suggested by the Model

In this section, I suggest changes to the patent system indicated by the model. They are largely centered on strategically increasing scope-defining information disclosed by patentees *ex ante*. The model's principle of bivalence provides a useful theoretical guide: Does a patent record provide sufficient constraints on claim scope so that a lay interpreter could determine whether relevant products infringe or not? If the answer is no, then there may be foreseeable boundary lines that a patent examiner can require a patentee to clarify during the application process. I will analyze these suggestions in terms of efficiency, noting that they are compatible with *ex post* approaches to managing patent uncertainty.[205]

1. Patentees Should Be Required to Be Their Own Lexicographers

One theoretically supported approach is to require patentees to include definitions in the specification for all claim words. Currently, patent applicants have the option of including claim word definitions in their

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204. *See, e.g.*, Kimberly Moore, *Markman Eight Years Later: Is Claim Construction More Predictable?*, 9 LEWIS & CLARK L. REV. 231 (2005) (finding a claim construction reversal rate of roughly 34.5% from 1996 to 2003); David L. Schwartz, *Practice Makes Perfect? An Empirical Study of Claim Construction Reversal Rates in Patent Cases*, 107 MICH. L. REV. 223 (2008) (citing reversal rates of between 30% and 40% in various years from 1995 to 2005).

205. *See* BURK & LEMLEY, *supra* note 7, at 18; Hubbard, *supra* note 10, at 327.

specification if they wish to act as "their own lexicographer."[206] Since the patentee-supplied definition is the paragon of a scope-defining constraint, a rule requiring patentees to include definitions could increase overall scope certainty for issued patents. Putting net efficiency concerns aside for the moment, consider why definitions are desirable in this regard.

From a theory standpoint, a patentee-supplied definition has the potential to maximize scope notice. Because such definitions are fixed in the public record, several points of contestability, and hence, *ex post* uncertainty, tend not to apply. There will be less uncertainty *ex post* about whether the definition should be interpreted as a scope restriction and less uncertainty about the general substance of that constraint. In short, such explicit definitions are *ex ante* determinable.

Second, such definitions can potentially provide precise scope-defining criteria. The goal of a well-scoped constraint is to refine the contours of the claim boundaries to more precisely distinguish *ex ante* literal coverage. According to the set-theoretic model, the approach is to provide incremental, additional explicit clarifications in the record that include or exclude particular scope interpretations (i.e., narrow the set of plausible interpretations). In this way, these explicit, additional declarations interpreted together as a set of constraints that must be met more finely demarcate boundary lines. This allows for more reliable *ex ante* distinctions relative to potentially infringing products. This principle is illustrated by the earlier example involving the claim term "board." A refined set of constraints might distinguish *ex ante* the types of boards the claim is meant to cover in terms of its component material. Such an incremental clarifying definition might add that board covers "only wood." Precise claim scope contouring is achieved by adding successive "classification rules" that provide additional criteria likely to classify external products as literally infringing or not.

One might imagine that patentees would routinely pick the broadest interpretation to ensure maximum future coverage. But even a broadly scoped declaration of "all materials" is preferential to an ambiguously scoped claim because its broad scope is explicit on the public record. At a minimum, third parties can know that the claim is broad on its face and can more easily identify prior art or enablement issues that limit its validity. In

206. *See* Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996) ("Although words in a claim are generally given their ordinary and customary meaning, a patentee may choose to be his own lexicographer and use terms in a manner other than their ordinary meaning.").

principle, *ex ante* scope delineations could be more complex than the example, to more finely approach the actual boundary contours of the patentee's invention. A variation of this logic is already at work in patent law. Patentees make explicit disavowals of claim scope on the public prosecution history record to avoid invalidating prior art. Such explicit disavowals have the effect of demarcating scope boundaries *ex ante* (and *ex post)* with greater precision.[207] *Ex ante* clarifying declarations make contrary *ex post* scope arguments vastly less plausible.

The constraint satisfaction model also addresses problems of "infinite regress"—that arguments simply shift to "definitions defining definitions."[208] A well-specified and properly interpreted patentee definition should not suffer from this issue, as all additional scope constraints should be applied additively. This means if we have a patentee-included definition, and we are using an external dictionary to further define it, the external definition should be interpreted with an "AND" to the existing definition. All constraints must be interpreted together to successively narrow scope. An additional constraint on meaning, should rarely[209] serve to *broaden* the scope beyond that which is already specified. It should instead provide another classification rule for refining scope. The problem of infinite regress (definitions of definitions) occurs when courts mistakenly interpret additional external definitions in isolation from existing constraints. To the extent a new external definition contradicts or supplants existing constraints on meaning, it is improper.

There are a few caveats to the suggestion for patentee-supplied definitions. First, intrinsic definitions themselves do not necessarily

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207. During the patent application process, patent applicants have to contend with patent examiner rejections due to prior art which already covers the applied-for invention. Patentees will often amend claims to narrow the scope to avoid the prior art. The doctrine of prosecution history estoppel is a limitation on infringement under the doctrine of equivalents. There is a presumption that patentees cannot cover equivalents that would fall under the scope that they have previously surrendered during prosecution. *See* Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 732–33 (2002) (addressing the issues stemming from the uncertainty of a patent claim's extent); s*ee also* Holbrook *supra* note 143, at 13 ("The prosecution history will act as an estoppel in the literal infringement context just as it will in . . . infringement under the doctrine of equivalents.").

208. *See, e.g.*, Kristen Osenga, *Linguistics and Patent Claim Construction*, 38 RUTGERS L.J. 6, 69–70 (2006) (suggesting that defining claims using additional words simply generates "meta" debates over the meaning of the words used to define).

209. Constraints that are disjunctive or contain an "or" may not be set-narrowing. Thus, adding a constraint that says "X or Y" might expand the set of possible interpretations.

improve scope if not done correctly. As suggested, even explicit definitions in a specification can be ambiguous on their face or provide inadequately precise criteria. Scope definition likely has to be an interactive process, with patent examiners taking an active role in requiring clarifications regarding the scope of supplied definitions and with such clarifications appearing on the public record to aid *ex ante* interpretation.[210] Second, scope uncertainty is *legal* uncertainty and is ultimately related to interpretive procedures *ex post* by judges in infringement proceedings or on appeal. Thus, any improvement in clarifying formal boundary lines *ex ante*, must be accompanied by commitments by judges, *ex post*, to generally follow those boundary lines when the constraints are on point. Notice requires a policy of *ex post* forbearance on the part of judges in crafting deviations or shifting uncertainty downstream to the equivalents analysis. Third, there could be exceptions for areas of inventions in which the terms are already extrinsically well-bounded and have a well-understood meaning with a low range of variability (e.g., pharmaceuticals). Finally, there are efficiency concerns when increasing demands on patent applicants and examiners with more stringent requirements. I will explore some of these concerns below and suggest some more limited approaches.

2. Efficiency and Increased Ex Ante *Disclosure Requirements*

It is important to consider the net costs of any mitigating strategies requiring more *ex ante* information from patentees. When applying for a patent, it is difficult to predict the ultimate commercial value of the protected technology. Some researchers estimate that only 5% of issued patents actually turn out to be valuable enough to be worth contesting after issuance.[211] Rules that require increased application disclosures broadly create private costs that are borne by all patent applicants, whether or not the patents turn out to be economically viable. From a society-wide perspective, it might be inefficient to require applicants to expend resources

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210. For a good approach to such active examination by patent examiners, see Petherbridge, *supra* note 14, at 174. I will presently discuss how to strategically limit expenditure of examiner resources.

211. Lemley, *supra* note 60, at 1507 ("As we have seen, only about 1.5% of patents are litigated at all. The total number of patents licensed for royalties without even a complaint being filed is likely somewhat higher, but I suspect the total number of patents litigated or licensed for a royalty (as opposed to a cross-license) is on the order of five percent of issued patents.").

refining the scope of all patents, when only 5% of those patents end up being consequential. The resources expended refining the remaining 95% appear to be a social loss and would not be efficient if that cost outweighs the scope improvement benefits gained for the 5% of consequential patents. If patent rules require too much additional *ex ante* information, the net costs may outweigh the net benefits from a society-wide perspective.

Because of the small percentage of patents ultimately of value, some scholars have advocated *ex post* solutions focused on active, judicial filtering at litigation. William Hubbard and others have argued that it only makes sense to increase the costs of improving patent certainty if the marginal costs of such *ex ante* investments are outweighed by the net social benefits.[212] I agree with this position. However, as Part II suggests, current cost-benefit analysis is likely underestimating the external costs imposed by even the 95% of patents that remain unused on third-party firms and also on end-users. Firms cannot know which patents will be asserted and, to some degree, must internalize the risk of all patents and not just the 5% that ultimately are asserted in some way. Similarly, a much larger percentage of patents are the subject of threatened litigation, which can have a similar cost-inducing effect.[213] Thus, the net external costs of uncertainly scoped patents are likely to be somewhat larger than the percent that are worth asserting, in the cost-benefit analysis.

However, Hubbard's marginal benefit/cost approach is ultimately correct. There is some efficient balance between requiring enough information from patentees to provide reasonable scope notice, and not so much information *ex ante* so as to broadly waste resources that could be put to more productive uses. Existing patent requirements already cause applicants to incur considerable costs. Application rules currently require a considerable level of detailed information on an application (e.g., specification, claims, statutory requirements). Providing such information is often difficult and costly for a patentee. In the spectrum of "too much *ex*

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212. *See* Hubbard, *supra* note 10, at 359–60 ("[D]rafting more explicit patents and patent claims requires additional investment by patentees and may require additional work on the part of patent examiners as well. These additional costs will not be efficient unless they are outweighed by the benefits they produce.").

213. It is a very low-cost strategy for a patent holder to mail threatening "cease and desist" letters and to demand relatively low licensing fees. Simply receiving such a letter is enough to cause most firms to expend resources analyzing and perhaps internalizing the expected risk of infringement.

ante information" and "not enough *ex ante* information," it is difficult to know where the current balance lies relative to some theoretical optimum. However, the evidence in this Article suggests that we can recalibrate the rules incrementally towards the *ex ante* end of the spectrum to achieve net benefits in improving overall claim–scope, given its external costs.

Rules that create more certain claim scope boundary lines also have costs in terms of patent value. As suggested in Part II, there is some public benefit to patent scope uncertainty because it allows judges, *ex post*, to flexibly adapt claim construction scope to reflect the patentee's inventive contribution. An interpreting judge can give an uncertain claim a wide scope if he believes that coverage is merited given the accused product and inventive contribution. Similarly, a judge can elect a narrower interpretive scope to ensure that an accused product falls outside of the literal range. If patent scope boundaries are "too" rigid *ex ante* and *ex post* interpretations are "too" constrained, the scope of meritorious patent claims may not adequately cover unpredictable after-arising technologies or avoid claim boundaries through insubstantial changes. If rigid *ex ante* patent requirements create the perception among inventors that the patent system leads to inadequate coverage and value for their claims, inventors may not be incentivized to develop inventions in the first instance.[214]

There is an inherent tension between *ex ante* notice of boundary lines and *ex post* flexibility in claim coverage that is common throughout law.[215] On the spectrum of *ex ante* formality and *ex post* discretion, this Article suggests a moderate recalibration toward the *ex ante* spectrum. Patent law has a policy that the infringement coverage of a patent claim should be proportional to the patentee's inventive contribution.[216] Formal and precise

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214. *See, e.g.*, Autogiro Co. of Am. v. United States, 384 F.2d 391, 396–97 (1967)

> The inability of words to achieve precision is none the less extant with patent claims than it is with statutes. The problem is likely more acute with claims. Statutes by definition are the reduction of ideas to print. Since the ability to verbalize is crucial in statutory enactment, legislators develop a facility with words not equally developed in inventors. An invention exists most importantly as a tangible structure or a series of drawings. This conversion of machine to words allows for unintended idea gaps which cannot be satisfactorily filled.

215. *See, e.g.*, Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557 (1992) (offering "an economic analysis of the extent to which legal commands should be promulgated as rules or standards").

216. Indeed this policy is represented by the enablement requirement from 35 U.S.C. § 112. *See, e.g.*, *In re* Fisher, 427 F.2d 833, 839 (C.C.P.A. 1970) ("[Section 112] requires that the scope of the claims must bear a reasonable correlation to the scope of enablement provided by the specification to persons of ordinary skill in the art.").

patent boundary requirements risk that a patent holder's coverage will be underinclusive relative to its inventive contribution. However, existing patent drafting rules already have a significant amount of formality, and already tolerate the risk of underinclusion. Patent applicants are required to specify their patent claims with a significant level of precision, dividing them into descriptive elements. There are most surely cases where this formality requirement results in *ex post* underinclusion.

Again, it is difficult to know where current patent drafting rules are on the optimal *ex ante*, *ex post* spectrum relative to underinclusion of coverage. As indicated, a possibly beneficial artifact of an uncertainly scoped claim is that it permits courts *ex post* flexibility to correct for underinclusion and undercompensation. However, a more straightforward approach would work better. Significant cases of underinclusion are likely rarer compared to marginal scope disputes. In the presumably rare cases of significant undercompensation due to rigid claim boundary lines, judges should aggressively employ the doctrine of equivalents.[217] This has the benefit of achieving the same effect more transparently without the negative externalities of scope uncertainty applying in the larger remainder of the patent pool in which underinclusion is not a problem. In the (comparatively small) instances of *ex ante* delineation that are unavoidable—as described in Part III—judges should be responsive *ex post*.[218]

Patent applicants are also likely to be the least cost avoiders for such scope coverage and uncertainty issues.[219] Placing a greater *ex ante* scope-defining burden on applicants may properly align incentives to reduce net uncertainty costs. Defining patent boundaries precisely *ex ante* is often costly, difficult, and prone to error.[220] In one view, the boundary-defining problem can be reframed in terms of risk: Who bears the *ex ante* risk of over or underinclusion of patent boundaries, the patentee or the public? Patent holders often benefit from scope uncertainty because they can draft their different claims at successively narrower levels of precision and

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217. *See* John R. Allison & Mark A. Lemley, *The (Unnoticed) Demise of the Doctrine of Equivalents*, 59 STAN. L. REV. 955, 956–58 (2007) (discussing the "demise" of the doctrine of equivalents).

218. For an approach suggesting stronger *ex post* involvement of judges in mitigating patent problems, see BURK & LEMLEY, *supra* note 7.

219. Menell et al., *supra* note 80, at 748.

220. *See* Long, *supra* note 202, at 477.

coverage and can often selectively change the asserted scope *ex post* to dynamically reflect limitations, such as invalidating prior art.

Patent law has issues concerning uncertainty that are unique compared to other, superficially similar areas. Patent drafting is a hybrid between public law and contracting. Like contract law, patent drafting allows one to be a "private lawmaker" by allowing private citizens to be in control of drafting legal obligations.[221] Unlike contract law (and like public law) the scope of the privately drafted obligations are not limited to the contracting parties, but imposed on the entire public.[222] Given that broad patent rights depend upon words chosen by applicant, and that patentees benefit from ambiguity, it is somewhat surprising that applicants are not required to bear this risk. Most drafting attorneys deliberately employ as much ambiguity in patent drafting as will benefit their client and still survive the examination process.[223] Uncertainty is often beneficial to patentees because it allows them leeway in *ex post* coverage to prevent underinclusion in infringement. Indeed, canons of construction dictate that judges interpret claims *ex post* to preserve validity. *Ex ante*, patent applicants can assert claim scopes through the entire valid and invalid range of plausible interpretation. Rules that permit uncertain claims to issue simply shift the risks of over and underinclusion away from the patent holder and onto third parties who bear the costs of such uncertain boundaries in internalizing infringement risk.

Requiring more precise and rigid *ex ante* boundary delineation by patentees, and thereby increasing the risk of *ex post* underinclusion of a claim's literal coverage, may actually reduce net transaction costs. The patent applicant is usually the party in the best position to know the actual contours and inventive contribution of her invention. Thus, to the extent a patent claim can be precisely defined *ex ante* to better match the inventive contribution and cover relevant products, the patentee is clearly the best party to do so. Given that patentees may not currently suffer the consequence of uncertainty, increasing *ex ante* disclosures may reduce the level of deliberate uncertainty and better align incentives to better reflect

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221. Of course, this "control" is somewhat limited, given that the patent drafter has to proceed through the patent examination process. It may be more accurate to say that the patent is partially drafted by the applicant (or the applicant's attorney) and partially by the patent examiner through rejections or allowances that shape its scope.

222. There is admittedly a limited scope of these privately drafted obligations. Unlike lawmakers, patentees cannot broadly legislate. Rather, their privately drafted legislation is strictly confined to delineating the boundaries of their exclusive rights.

223. *See generally* FABER, *supra* note 119.

actual scope. A similar effect may occur through interpretive "penalty default" rules that incentivize clarification.[224]

C. Foreseeable Interventions: Strategic Uncertainty Reduction

One might be concerned about burdens on patent applicants and examiners if adopting a broad requirement that definitions be supplied for every claim word. This section suggests a series of more limited approaches that might be more feasible. Because they are guided by the model, these targeted policy changes can still produce significant benefits in reducing scope uncertainty with comparatively small costs.

1. Internalization of External Disclosures

"Disclosure internalization" is one approach aimed at improving scope certainty while reducing up-front application burden. This method involves referencing particular extrinsic sources within the text of the patent document. This can be thought of as "converting" extrinsic evidence into intrinsic evidence by bringing external sources of meaning partially within the four corners of the document. In the previous section, I detailed the benefits of patentee-supplied definitions in terms of *ex ante* determinability of scope criteria in the public record. Drafting specific definitions for each patent claim involves significant information costs above and beyond the drafting burdens already required. Internalization occurs when patentees explicitly identify, in the specification, specific intrinsic sources of meaning to be used later in interpretation. Internalization of an extrinsic source can be direct, through copying the text of a source into the specification, or indirect, through explicit reference to a particular external source.

There are several variations on this approach. The most cost-intensive change would be to require, for each patent word, a copy of a specific definition from a treatise within the four corners of the patent document. A slightly less cost-intensive approach would be to permit a reference to a

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224. *See* Ian Ayres & Robert Gertner, *Filling Gaps in Incomplete Contracts: An Economic Theory of Default Rules*, 99 YALE L.J. 87, 96 (1989) (describing penalty default rules which penalize *ex ante* non-clarification). One version involves construing ambiguities against the drafter. *Id.* at 104 n.80.

specific version of a dictionary or treatise, a definition within that edition, and a specific meaning within the chosen definition. Finally, the least burdensome variation on this theme would be to specify one or more specific editions of dictionaries and treatises that would be used to resolve questions of meanings within the document. Joseph Miller and James Hilsenteger have previously advocated for the increased use of dictionaries by reference in the patent document.[225] Others have suggested that the Patent and Trademark Office create an official default technical dictionary with specific definitions for common claim words.[226] A patent applicant could explicitly incorporate these standard definitions deliberately by reference.

Internalizing extrinsic sources of information can help reduce scope uncertainty at minimal up-front cost. The most tangible benefit of internalizing external sources of meaning is that it potentially reduces the *ex ante* determinability problems typical of extrinsic sources. For example, if using an extrinsic dictionary *ex post* to define scope, a lay interpreter cannot predict ahead of time which dictionary or which definition will ultimately be used. Internalization mitigates this problem if we require reference to a particular dictionary/treatise and one specific meaning for a claim word. During prosecution, a patent examiner can reference the external source both to know the intended scope, and to seek clarification if the elected scope is not precise enough. Similarly, lay interpreters can reference specific meanings, thereby reducing, but not necessarily eliminating, one source of uncertainty. Such external references must be readily available to the public for the technique to be useful.[227] In this way, extrinsic sources become part of the *ex ante* determinable public record.

Internalizing extrinsic disclosures also addresses another problem with extrinsic sources—lack of contextual integrity within the scope of the patent process. The *Phillips* court considered extrinsic evidence less reliable because it "is not part of the patent and does not have the

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225. *See* Joseph Scott Miller & James A. Hilsenteger, *The Proven Key: Roles and Rules for Dictionaries at the Patent Office and the Courts*, 54 AM. U. L. REV. 829, 886–87 (2005) (advocating for the patent office to require inventors to indicate a preferred dictionary in patent applications).

226. Joseph Miller has suggested this very promising idea.

227. Alternatively, the meanings could be copied (or paraphrased) directly into the text of the specification to avoid this problem. There may be copyright issues with extensive copying.

specification's virtue of being created at the time of patent prosecution."[228] Internalizing extrinsic sources partially mitigates this problem. The patent applicant has the ability to examine the extrinsically defined meaning and explicitly adopt that meaning by reference in the specification. Finally, internalization of extrinsic sources can help overcome the temporal problem of changing meaning. By reference to specific meanings in specific editions of past dictionaries we are able to conceptually make meaning static to a greater degree by fixing past understandings of words in the interpretive context of the various constraints at the time. Although partial internalization is a compromise approach it could provide a meaningful, marginal improvement in certainty with the least amount of cost tradeoff.

2. Foreseeable Boundary Clarification

A slightly different approach focuses upon clarifying foreseeable claim boundary issues in the public record. There are several, common patterns of scope uncertainty that arise in patent litigation. Many of these are predictable and can suggest a strategic use of limited patent examiner resources during examination to efficiently reduce uncertainty issues.[229]

At a general level, rather than requiring definitions for every word, examiners could require explicit clarification only for particular claim words that are poorly scoped.[230] Highly abstract or open-ended criteria are likely to be particularly problematic in this regard. Examiners can quickly identify problematic terms by adopting a theoretical frame based upon the model's principle of bivalence. Given a claim word "X," is there sufficient interpretive information to distinguish a product *with* X from one *without* X? If not, then the patent applicant should likely be required to provide some additional scope-refining disclosure on the record. Examiners can ask two highly relevant scope-defining questions for the record: "What is an example or definition of an X, and why?" And importantly, "What is a

228. Phillips v. AWH Corp., 415 F.3d 1303, 1318 (Fed. Cir. 2005) (en banc).

229. This approach would involve adopting patent examiner incentives and requirements to aim at improving the scope certainty of issued claims.

230. In areas that involve inherently well-scoped terms, or terms with widely agreed upon meanings, such as molecular structures, examiners could use their discretion and assess that *ex post* extrinsic analysis would still provide sufficient scope benefits.

definition of something that is *not* an X, and why?" It is this latter, excluding aspect of scope-limiting disclosures that bivalence highlights.

There are also specific areas that are efficient targets for examiners' focus. Although claims are usually made up of multiple elements, not all elements are equally important. Usually there is a subset of the elements that capture the invention's unique contribution over the prior art. The remainder of the elements often consists of structures or combinations well known in the prior art and potentially less likely to be of future controversy. With limited resources, examiners can focus scope-defining resources on those novel elements likely to be the source of controversy.

Other predictable scope issues concern embodiments. Defendants often argue that features that are common to all embodiments in the specification should be read as implicit scope limitations. An examiner could easily spot such a limitation by scanning the embodiments and require an applicant to explicitly clarify this scope ambiguity, whether the implicit limitation is intended or not, on the prosecution record. Similar scope issues surround common points of debate: whether the scope is limited to materials that the parts of the embodiments are made out of, the location and positioning of key parts of the embodiments and whether they matter, whether the invention is limited to the inventive context displayed by the embodiments, timing, which claim elements are meant to refer to what parts of the invention, and so on.[231] As previously argued, there is justification in requiring explicit *ex ante* clarification from the applicant.

Finally, the adequacy of the scope of a term is relative to the set of potentially accused products. Examiners could compare abstract claim text against relevant competitive products to determine if scope criteria are adequate. These are some examples in which problems of scope underdetermination may be efficiently reduced *ex ante*. Not all uncertainty issues are foreseeable or tractable, but some may be efficiently reduced with only relatively minimal clarification costs. In this way, patent examiners will surely not remove all scope uncertainty *ex ante*, but they can efficiently head off particularly foreseeable uncertainty issues and reduce external costs to competitors.

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231. Scope defining questions can forestall certain but not *all* scope issues. Most scope issues can be reduced to "all" or "some" questions. For example, does the term "motor vehicles" apply to all motors or just internal combustion motors?

VI. Conclusion

It is often difficult to discern, with any degree of certainty, the coverage of patents issued by the Patent and Trademark Office. Given the broad liability possible under patent law, such scope uncertainty can result in significant external costs to firms and users. This Article develops a model of one common source of scope uncertainty—scope underdetermination. Scope underdetermination exists when the words of a patent claim are capable of a broad range of plausible interpretations in light of the patent document, under the interpretive rules. Underdetermination creates *ex ante* uncertainty about patent scope because a lay interpreter cannot know with certainty which interpretation will ultimately be used in an infringement proceeding. The choice of one interpretive scope over another could be dispositive on the issue of literal infringement.

This Article models the underdetermination issue by the set of possible interpretations plausible after restricting the scope based upon interpretive constraints internal and external to the patent document. These constraints limit the range (and set) of possible meanings to varying degrees of certainty. The set-theoretical model suggests an approach to marginally increasing the precision of a claim by adding targeted, clarifying constraints aimed at distinguishing potentially accused products or processes as literally infringing or not. These additional pieces of scope-clarifying information can increase scope certainty to a lay interpreter.

The Article concludes with policy modifications suggested by the model. Generally, scope can be improved by requiring more precise scope delineation *ex ante* from patent applicants. One approach is to require explicit definitions for claim words in the specification. This has the benefit of reducing uncertainty by placing claim boundary lines in the determinable public record. Patent examiners can require that these definitions be precise enough to make literal infringement determinations. A more limited approach enables patent examiners to focus upon requiring patent applicants to clarify foreseeably problematic claim boundary lines. These include disambiguating implicit scope limitations that might be inferred from included embodiments and similar predictable scenarios.