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Innovation Policy and Friends of the Court: Intellectual Property Advocacy before the U.S. Supreme Court

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Abstract

This paper conceptualizes four patent rights stakeholders. These groupings are developed by integrating pre-existing management literature concerning intellectual property appropriability and law and economics literature concerning property rights. The governance mechanisms available to the four stakeholders are then examined in reference to the existing literature. The second part of the paper provides initial justification for the four categories. This is done by assessing firm behavior through the filing of amicus briefs before the U.S. Supreme Court in patent cases since 1982.
I. Introduction

Management research on patent appropriability suggests that patents are an effective appropriability mechanism in only a few industries (Mansfield, 1986; Levin et. al, 1987; Cohen et. al. 2000). This literature, which has made important contributions, emphasizes the relative importance of patents compared with other institutional arrangements without deeply examining the nature of patent rights as a property rights concept (Gittelman 2008). As a consequence, patents are treated as one homogenous theoretical construct. All patents, such a theory would explain, must be treated conceptually as one and the same. Given this conceptual trajectory, patent property rights are largely regarded as exogenous variables in management appropriability literature (Pisano, 2006).

The present research introduces the nature of patent rights as a theoretical construct to complement existing appropriability frameworks. Introducing the nature of patent rights is important since it aligns law and economics literature on transaction costs with the appropriability literature. Doing so explains why some firms utilize patent governance mechanisms the way they do under differing conditions. Under the existing appropriability view, there is an inadequate theoretical basis for predicting why firms choose the governance mechanisms they do to apportion patent rights in a market exchange (Andersen and Konzelman; Ceccagnoli 2008). There is discussion about the strengthening and weakening of the patent regime under the courts' interpretations of patent law (Cohen et. al. 2000, ; Kortum and Lerner, 1999; Ferrell and Shapiro, 2008). This discussion, however, equates these changes as exogenous policy-making shifts.
There is also discussion about the various governance options, but there has been little systematic or theoretical basis for distinguishing the various mechanism choices employed by the wide swath of patent right stakeholders (Andersen and Konzelman, 2008). Conceptualizing the stakeholders and explaining why they choose the governance mechanisms they do is the object of the proposed theoretical union between the law and economics theory of property rights and managerial appropriability literature.

Moving the discussion from patents to patent rights involves developing a synthetic framework. The proposed framework identifies four distinct patent law stakeholders, which employ a wide range of governance mechanisms. The subject of patent law stakeholders has remained largely unexplored in legal and managerial literature (Ibid). The existing literature incompletely identifies under what circumstances firms will choose to pursue, e.g. exclusivity vs. a more "open" approach. This inquiry is timely from a policy perspective since some industry participants have called for patent reform while others have fought against it. A review is helpful since extant research approaches the issue of patent appropriability largely from a particular industry vantage point. The danger of failing to understand diverse and dynamic appropriability-related phenomena, from a policy and research standpoint, is over-reliance on a limited perspective to support generalizations (Ibid). Also, failing to take into account the endogenous nature of patent rights and governance mechanisms ignores the rich set of competitive behaviors firms employ to shape their and their competitors' appropriability (Pisano, 2006).
A qualitative secondary legal data source known as *amicus* briefs is used to provide initial exploratory justification for the stakeholder categories.¹ *Amicus curiae* is a Latin phrase that translates into 'friend of the court'. These friends of the court file *amicus* briefs, an activity which has been widely researched in the fields of law and political science as a way to measure the social significance of court cases (Epstein and Knight, 1998; Caldeira and Wright, 1988). Firm behavior captured through *amicus* briefs provides a fruitful and appropriate data source since it exposes a diverse set of advocacy groups under varying circumstances attempting to shape the rules of the game, in contrast to firms playing by the rules of the game within a narrow industrial context, e.g. semiconductor cross-licensing (Hall and Ziedonis, 2007). Firm behavior observed through *amicus* briefs provides the opportunity to examine new puzzling questions related to patent appropriability. For example, under what conditions do biotechnology and pharmaceutical firms espouse opposing positions with respect to patent appropriability? Under what conditions do companies in complex technologies adopt differing positions? The goal of the remainder of this paper is to provide insights to these questions.

II. **Background**

Appropriability refers to the degree to which firms preclude imitation to preserve the value generated by innovation. The topic has been investigated ever since it was explored by scholars like Joseph Schumpeter and Kenneth Arrow (Ceccagnoli, 2008). It took on additional importance after David Teece's pioneering work which led to the

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¹ The data contained in these briefs has recently been used by management scholars (Conley) although such use is still highly exploratory.
Profiting from Innovation (PFI) framework (Teece, 1986). As discussed in Teece's work, appropriability is intimately linked to property rights, namely intellectual property rights. Increasingly, it is important that the firm create, transfer, assemble, integrate, protect and exploit knowledge (Nonaka and Takeuchi, 1995) and intangible assets such as intellectual property (Teece, 2000). Scholars, therefore, have sought to gain a clearer picture of managerial decision-making involving intellectual property (Chesbrough 2006; Somaya, 2003), and the policy dimensions which influence this behavior (Jaffe and Lerner, 2004; Levin et. al., 1987).

To gain a better understanding of the theoretical nature of patent rights under differing contexts, this study offers a glimpse into a process by which policymakers and firms shape intellectual property entitlements, i.e. how the players in the intellectual property game shape (or try to shape) the institutional rules of the game (Andersen and Konzelman, 2008). It is expected that firms will, in industries where patents matter, devote substantial resources to shape patent rules to their advantage (North, 1981). These firms coalesce into industry sub-groups to promote regulations that best suit their specific private interests (Oster, 1982).

In the past, major policy changes have resulted from property rights advocacy. Patent rights were deemed to be so vitally underserved by some that a specialized appellate court called the Court of Appeals for the Federal Circuit (CAFC) was created in 1982 to harmonize the patent laws and increase legal certainty in this legal domain. In advocacy situations patent rights have been expanded. For example, in *Diamond v.*
*Chakrabarty* patent rights were extended to cover living organisms and in *Diamond v. Diehr* these rights were extended to software\(^2\). Similar evidence is observed in other intellectual property contexts, e.g. copyright. Copyright duration has been extended numerously by the legislature in part due to interest group sponsorship (Lessig, 2004).

Recent calls have been made by some industry groups to reduce the strength of patent rights, in opposition to the calls made by others. This suggests, as extant appropriability research would confirm, that firms in different industries, on average, place different weights on the utility of the patent regime. This view, however, fails to explain why some firms contradict these findings. For example, why would some firms in complex industries file *amicus* briefs which advocate a stronger patent regime? Or why would pharmaceutical firms, the quintessential patent right supporters, advocate for a weaker patent regime in their *amicus* briefs? To explain this seemingly aberrant behavior this research examines *amicus* brief advocacy and brings together in a novel way managerial literature and property rights theory from law and economics.

The managerial literature reviewed next are the PFI framework and survey research evaluating the relative value of patents compared with other appropriability mechanisms. Property rights theory from law and economics then provides an important and unappreciated theoretical link for conceptualizing patent right stakeholders. Uniting these research streams generates four distinct appropriability groups and provides a novel and more comprehensive explanation of patent-related *amicus* brief advocacy.

III. Patents, Appropriability and Interest Groups

A. Patent Policy

Creators of inventive knowledge may obtain entitlements to their innovation through timely patent registration. Assuming well defined, limited life property rights and low transaction costs the patent regime promotes economic efficiency (see Demsetz, 1967) and the Constitutional objective of promoting the progress of science and useful arts (Art. I. §8, cl. 8). This property regime limits the ‘information paradox’, which results when a seller of information goods discloses the nature of the information to a buyer, who may use the disclosure to acquire the information at no cost (Arrow, 1962). Through a grant of temporary exclusivity, patent rights encourage investments in functional knowledge goods and limit the ability of others to free ride from the innovator’s effort (Landes and Posner, 2003). Patent rights are granted at the expense of deadweight losses that may result from the temporary monopoly (Ayres and Klemperer, 1999). The current understanding of patent rights, however, has yet to adequately account for how the rights and the governance mechanisms employed by firms generate differing value outcomes (Andersen and Konzelman, 2007; Ceccagnoli 2008).

B. The PFI Framework

The significance of intellectual property as a strategic determinant for capturing rents, from the firm's perspective was first substantially developed within the PFI framework (Teece, 1986). In that work, the profits generated by innovation were determined partially by whether the innovator could appropriate the returns from their upstream innovative activities through legal exclusionary methods like patents, or by the
tacit nature of the technology (Nonaka and Takeuchi, 1995). Another determinant, and a
critical insight developed by the framework is the role of specialized downstream
complementary bottlenecks such as manufacturing, branding, and distribution (Teece,
1986).

Intellectual property governance mechanisms have remained, however, an
exogenous variable in research concerned with decision-making under the PFI
framework\(^3\) (Pisano, 2006). Recent studies suggest a new direction (Pisano and Teece,
2007). As viewed by one scholar, there is evidence that some firms view their
complementary downstream assets as fixed, and actively manage and shape their
competitors' upstream innovation appropriability regimes through mechanisms like
defensive disclosures and knowledge sharing (Pisano, 2006). Pisano’s work in this area
builds from Merges' earlier work on property preemption investments (Merges, 2004)
and presents two case studies to demonstrate this, the example of IBM using open source
to weaken competitors, and Merck's partnership with academia to weaken the patent
position of innovators in the field of genomics. Other scholars have recently researched
defensive publications as a mechanism to create a loose upstream appropriability
environment (Henkel and Pangerl, 2008).

The PFI framework, as interpreted by this emerging evidence, implies that the
existence of complementary assets, can in cases involving high sunk costs or asset
specificity, influence whether a firm would benefit from loose patent appropriability with

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\(^3\)This may be the result of different research methods employed in the fields of management and law
(Pisano, 2006; D'Amato, 2006). This reality has been acknowledged in strategic contract-based research
(Argyres and Mayer, 2007).
respect to external parties' technology. This may occur in cases where the external party's innovation is either a complement or substitute to the firm's existing innovation infrastructure. In the case of complements, firms with specialized or co-specialized downstream assets, which are difficult to replicate, are in a much stronger bargaining position viz. a viz. upstream external innovators. Such vertically integrated firms are better situated to appropriate external innovations, or purchase them at a cheaper rate in bargaining situations in environments characterized by loose patent rights (Teece, 1986). On the other side, firms with upstream innovations who lack specialized downstream assets would prefer a tight patent regime to ensure adequate bargaining power. (Ibid). These upstream innovators may also desire a tight appropriability regime to preserve the option to build their own value chains in the future and compete with established players in the market for products vs. the market for ideas (Gans and Stern, 2003).

In the case of substitutes, Pisano's research suggests a firm with fixed complimentary assets prefers to loosen the entrant's appropriability. Pisano's cases suggest temporal dimensions influence this decision. Incumbent firms with established market positions and relationships are likely to view their downstream asset position as being fixed, at least in the short-term. This is because the incumbent firms are in a period when their technology has entered a paradigmatic stage, i.e. once their technology design has become dominant (Abernathy and Utterback, 1978). Competitive advantage in this maturing stage of a technology lifecycle shifts to complimentary asset-based advantages of scale, branding, distribution and other downstream resources (Teece 1986).
C. Patents viz. a viz. alternate appropriability mechanisms

In addition to complimentary assets and temporal dimensions, the remaining crucial component of the PFI framework is the ability to appropriate innovations (Teece, 1986). Influential survey-based research has evaluated the role of patents as one value capture mechanism across multiple industries. These surveys all found that patents are but one mechanism for securing appropriability and are valued less in some industries relative to other mechanisms (Mansfield, 1986; Cohen et. al. 2000; Levin et. al. 1987). The latest survey examined firms in various industries and found that the preference for patents could be conceptualized along two dimensions: complex vs. simple technologies.\(^4\) The distinction among the two is that the former comprises numerous separately patentable elements and the latter relatively few (Cohen et al., 2000). The following illustrate discrete technologies: food, textiles, chemicals, drugs, metals (Ibid.). Examples of complex technologies include: machinery, computers, electrical equipment, electrical components, instruments and transportation equipment (Ibid). A review of the key literature in this area is offered in Table 1.

\(^4\) Cohen et. al. in their empirical study classify complex industries as those in SIC codes above 2900 and discrete industries as those below this number.
Table 1. Review of industry-related patent appropriability literature.

<table>
<thead>
<tr>
<th>Citation</th>
<th>Data</th>
<th>Nature of the Study</th>
<th>Industry-Related Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mansfield (1986)</td>
<td>Survey of 100 manufacturing firms across 12 industries with at least $35 million in Sales.</td>
<td>The extent to which firms make use of the patent system and the differences that exist among firms and industries</td>
<td>Patents important to: pharmaceuticals, chemicals, petroleum, machinery and fabricated metal products Patents less important to primary metals, electrical equipment, instruments, office equipment, motor vehicles, rubber and textiles</td>
</tr>
<tr>
<td>Levin et. al. (1987) (&quot;Yale Survey&quot;)</td>
<td>Survey of 650 R&amp;D executives from publicly traded firms across 100 manufacturing industries with R&amp;D expenses of at least 1% of Sales, or Sales greater than $35 million</td>
<td>To identify industries and technologies in which patents are effective relative to other appropriability mechanisms in preventing competitive imitation.</td>
<td>Industries that rate patents most effective included: (a) drug and chemistry related: drugs, pesticides, industrial organic chemicals, inorganic chemicals, plastic materials, synthetic fibers, glass; and (b) relatively uncomplicated mechanical equipment: air and gas compressors, power-driven hand tools, and oil-field machinery.</td>
</tr>
<tr>
<td>Cohen et al. (2000) (&quot;Carnegie Mellon Survey&quot;)</td>
<td>Survey of 1,478 R&amp;D labs across 34 manufacturing groups with at least $5 million in sales or at least 30 employees.</td>
<td>Examine how appropriability conditions and preferences have changed since the Yale Survey; Explain how firms from different industries have different reasons for patenting.</td>
<td>Among respondents who use patents for negotiations, the majority are in complex product industries: e.g. computers, semiconductors, electronic components, communications equipment, tv/radio, medical equipment, auto/truck, auto parts, aerospace.</td>
</tr>
</tbody>
</table>
The conceptual distinction of complex vs. discrete technologies is important since it introduces the firm’s subjective valuation of any individual patent and therefore the utility of the patent regime overall. For example, if a technology architecture involves broadly distributed rights across multiple participants the value of patents and the patent regime will be low relative to other appropriability mechanisms (Cohen et. al., 2000; Levin et al., 1987). The converse is true for technology architectures where the locus of valuable rights is limited to a few patents and firms (Cohen et. al., 2000).

The surveys' findings are reinforced by extant research which shows that complex product industries typically use patents as a defensive mechanism, mainly to achieve freedom to operate (Hall and Ziedonis, 2007; Teece, 2000; Henkel and Pangerl, 2008). These systems-oriented industries accumulate patent portfolios to cross license in case the firm is sued by a rival. Firms that innovate in these industries tend to view patents in a defensive light, and a measure to ensure value capture \textit{ex post} infringement (Somaya, 2003). Firms in complex product industries, as these studies show, tend to favor collaboration and implement knowledge sharing governance mechanisms.

The Carnegie Mellon survey conversely found that industries that produce discrete products tend to rely on patents differently. Subsequent research shows that patents work well for innovations characterized by their discrete nature and high technological certainty. Firms in these industries are generally in favor of tightening the patent environment related to their technologies and view patents as a way to preserve technological exclusivity \textit{ex ante} litigation or infringement. This would entail asserting
patents against infringers to either prevent imitation or to extract value from the third party’s usage of these rights. The value from such an offensive view of patents would be to preserve differentiation in the market for products or to monetize patents in the market for ideas.

The Carnegie Mellon survey, however, found evidence of similar use of governance mechanisms across complex and discrete industries. This suggests cross-firm differences within industries, reflecting heterogeneity in the features, goals and capabilities of firms (Cohen et al., 2000). One such source of heterogeneity is firm size (Ibid.). This suggests that smaller firms which participate in complex industries view individual patent rights as an important appropriability mechanism, in contrast to incumbents in the same industry. This may occur for two reasons. First, the smaller firms may have a niche technology capability or resource which incorporates only a few patents relative to larger firms. They may participate in a complex industry as a modular, i.e. sub-system innovator. (Pisano and Teece, 2007; Hall and Ziedonis, 2007). Modular innovators tend to benefit from industry and product architectures with clear and accessible standards that shift the locus of innovation to the component-level (Pisano and Teece, 2007). Second, they may be required to trade patent rights in the market for ideas due to their under-resourced position and lack of complimentary assets. Some non-practicing entities have gained notoriety by using their patent rights to target incumbents in complex industries. This has engendered a broad discussion of seemingly opportunistic firms which employ a hold-up tactic on incumbents in complex industries (Reitzig et. al.,
2007). Smaller firms may be innovating in technologies which have yet to enter the paradigmatic stage, and where the relative value of complimentary assets is low.

Supporting the existence of patent governance heterogeneity within complex industries, research shows that some firms in complex industries use patents offensively (Hall and Ziedonis, 2007). This is part of a broader phenomenon. Licensing revenues have increased dramatically over time in conjunction with patent litigation, suggesting the efficacy and attractiveness of the market for ideas, even among complex industry participants. The increase in patent litigation is often attributed to a strengthening of patents rights under the CAFC's jurisprudence (Kortum and Lerner, 1999; Ziedonis and Hall, 2007). Figure 1 shows the increase in patent litigation over a ten year period.

Figure 1. Civil patent cases filed in U.S. federal district courts

Source: Administrative Office of U.S. Courts.
D. Property Rules, Liability Rules and the Role of Contract

Managerial appropriability scholarship recognizes the importance and variety of patent governance mechanisms (Andersen and Konzelman, 2007; Cohen et. al., 2000). Extant research, however, fails to conceptualize the antecedent nature of patent rights and their direct influence on governance choices. Since appropriability is closely related to property rights (Teece, 1986) it is important to distinguish between the types of property rights the firm can rely on to appropriate its innovations and shape the appropriability of competitors. The role of contract and the spectrum of contract opportunities will then be apparent as private governance mechanisms which reflect the endogenous choice a firm makes to exploit property rights in any given context.

There is a rich body of law and economics research which explores an important analytic distinction between two categories of property rights (entitlements). The categorical distinctions depend on whether the Sovereign enforces the particular property rights with a property rule vs. a liability rule (Calabresi and Melamed, 1972). An entitlement is governed by a property rule in so far that anyone who wishes to remove the entitlement from its owner must purchase it in a strictly voluntary transaction in which the value is mutually agreed upon \textit{ex ante} (Ibid). Otherwise, an entitlement is governed by a liability rule whereby anyone may willfully take the entitlement from the original owner without their consent. The liability rule, however, allows the owner to seek an \textit{ex post} payment of some objectively determined value determined by a third party, usually a court of law or other binding authority. An example of a property rule would entail the

\footnote{In a related case, management scholars only recently established a conceptual link between contract theory from the law and economics perspective with the firm's contract design capabilities (Argyres and Mayer, 2007).}
patent owner's right to stop infringement *ex ante* through a preliminary injunction. A liability rule would deny the injunction (and permit the infringement) but grant the patent owner a reasonable royalty determined *ex post*, e.g. in a court proceeding, or by a government mandated compulsory licensing scheme.

Property and liability rules have been studied extensively in the law and economics literature from a policy perspective to determine under what conditions each rule is more efficient (Kieff, 2007; Ayres and Klemperer, 1999). An unrecognized fact in managerial literature is that property and liability rules are linked to the firm's patent appropriability choices. This occurs since the firm, to some degree, chooses to pursue either a property or a liability rule with respect to their and external parties' innovations. Their choice is based on several factors, e.g. the distributed nature of the technology, the degree of product and industry modularity, the rate of technology diffusion, the innovation's fit with existing complimentary assets, firm strategic patenting capabilities, strategic alliances and decisions motivated by competitors' behavior. Transaction costs relevant to technology development, litigation, negotiations, search and coordination along any of these dimensions will involve exogenous factors. Patent thickets, for example, may raise transaction costs to an extent that they outweigh any benefit from reaching a property rights arrangement amongst rights holders (Shapiro, 2001). Legal scholars have identified situations when firms choose to contract into liability rules (Merges, 1996). These contracts in some cases may be motivated by competitive pressures. For example, a competitor's response to a rival's innovation may be to develop a patent portfolio that "surrounds" the competitor's technology (Granstrand, 1999). The
goal of pursuing a property rule with respect to the surrounding patents is to ultimately secure a cross-license and weaken the property rule exclusivity of the competitor, and in the process create a more loose patent appropriability environment overall.

In the absence market failures, such as patent thickets, firms can endogenously shape the entitlement rule since they may choose, e.g. to exercise the right of patent exclusivity and therefore assert a property rule\(^6\). Alternatively, they may willfully enter into private collective actions to coordinate their intellectual property entitlements. In the process they will establish *quasi* liability rules through private coordinating mechanisms such as patent pools, copyright collectives such as ASCAP and standard setting bodies (Merges, 1996; Lemley 2002). The members of these coordinating mechanisms agree to establish general principles applicable to all members and to all users of the members' rights. In this respect their contract decisions amount to generally applicable liability rules (Merges 1996).

In the case of discrete technologists, due to the ease of imitation and the focused locus of property rights within the firm, they often favor a property rule to derive the greatest value from the rights. Firms that integrate complex technologies often favor a rule that ensures they can still participate in a technology market where the locus of rights is diffused across many firms with many patents (Cohen et al, 2000). In these cases where bargaining costs and the risk of hold-up are severe, a property rule would raise overall transaction costs. These firms favor a general liability rule and an *ex post* payment

\(^6\) Texas instruments and IBM for example have been widely reported to harvest their patent portfolios to extract licensing fees and aggressively enforce their patents in court.
coordinated by a third party, either a court via litigation or a private rights-coordinating body through contract.

E. Patent Rights Stakeholders

This section combines the ownership of downstream complimentary assets and property rule preference to conceptualize four distinct patent rights stakeholders. Taking the dimensions of complimentary assets and preference among property rules yields a matrix depicted in Figure 2. Each group is discussed in the sections that follow.

Figure 2.

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<table>
<thead>
<tr>
<th>Downstream Specialized Assets</th>
<th>System-Based Products</th>
<th>Modular Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Y)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(N)</td>
<td>System-Based Ideas</td>
<td>Modular Ideas</td>
</tr>
</tbody>
</table>
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System-Based Ideas

This group's innovations are conceptually systems-oriented, i.e. complex. These firms have nonetheless overcome the transaction costs of coordinating the rights among many rights holders. Since they lack complimentary assets, they participate in the market for ideas which implies use of a governance mechanism that allows the group to capture
value through a license. If the technology is intended for a group at the exclusion of other parties then the mechanism employed is a patent pool. If the technology contributors want non-members to participate they may transfer the technology to a standard-setting body that will widely distribute the technology under reasonable terms. Both structures represent quasi liability rules (Merges, 1996).

At an extreme, this stakeholder group may encompass parties who impose a near zero liability cost in exchange for access to its property rights. This will encompass groups in the open source community. They prefer liability rules since they encourage broad access their rights, typically in exchange for abiding by the terms of the open source license. These groups sometimes partner with firms who wish to invest in property preemption (Merges, 2004). In the event this group seeks a legal remedy for a party's misuse of their rights, they may in theory seek a judgment and demand redress. The redress would likely stipulate enforcement of the license terms, which in the case of open source licenses stipulate a low cost liability rule.

**System-Based Products**

Systems-based product stakeholders have complimentary assets and in the case of larger firms will likely place a relatively low value on patents for any of the reasons discussed above, e.g. ownership of a paradigmatic technology, patent thickets, royalty stacking, a defensive patent capability or participation in a complex industry as integral

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7 There are no open source firms in the amicus brief sample. Public interest advocacy groups, however, do routinely file amicus briefs on behalf of the larger open source community, e.g. the Electronic Frontier Foundation (EFF).
architecture leaders\(^8\) trying to minimize the threat of an emergent component innovator. These firms are susceptible to architectural innovation, where a change in a component's core design concept creates new interactions between other components in a system (Henderson and Clark, 1990). Established organizations may be hindered by a legacy of embedded and increasingly irrelevant architectural knowledge (Ibid).

System-based product stakeholders view patents as a tool to achieve freedom to operate and generate large patent portfolios to preserve this flexibility\(^9\). The portfolios are also relied on to negotiate settlements with other key technology holders who are competitors (Cohen et al, 2000; Hall and Ziedonis, 2007). Firms in these industries, therefore, favor the institutional governance mechanisms of cross-licenses when exchanging patent rights with rivals. They may also participate in intellectual property pools and standard setting bodies in the event they overcome the coordination costs with external participants. If competitors' innovation efforts are threatening to weaken their innovation infrastructure they may on their own, or by partnering with a system-based idea stakeholder, defensively disclose (Merges, 2004; Pisano, 2006). Also, if they are subject to the hold-up they may choose to secure a court-enforced liability rule, e.g. a reasonable royalty enforced by litigation (Orozco and Conley; Kieff, 2007).

\(^8\) In contrast to modular architectures, integral systems allow the systems-owner to control the degree of inter-dependence among components and shifts the locus of innovation rents to the systems owner (Pisano and Teece, 2007).

\(^9\) These large portfolios built for defensive purposes may contribute to a patent thicket (Shapiro, 2001).
Modular Products

Modular product stakeholders with downstream production assets place a relatively higher value on patents.\textsuperscript{10} If they participate in complex industries, modular innovators tend to benefit from industry and product architectures with clear and accessible standards that shift the locus of innovation to the component-level (Pisano and Teece, 2007). Tight appropriability of a component can be an important element for value capture in a highly modular industry (Ibid).

These firms likely possess technologies which are paradigmatic and which are integrated with an established value chain. Modular producers may enter partnerships with upstream modular idea generators, and are in a good position to extract value due to their bargaining strength. These firms therefore value patents to block competitors (Cohen et. al., 2000) and assert an exclusive technology position. Since they compete in the market for products they favor the hold (exclusivity) institutional governance mechanism for their proprietary technologies (Andersen and Konzelman, 2007). They may also favor the in-license governance mechanism to secure access rights to external technologies.

If a competitor's innovations are secured by strong patent rights and threaten to weaken their innovation infrastructure they may engage in any of the following governance mechanisms to shape the patent environment. First, they may choose to strengthen the property rule exclusivity position of their technology and develop patents.

\textsuperscript{10} If a firm in a complex industry focuses on a niche area it is likely to participate in a modular or component basis within a complex systems industry.
related to the core innovation, engaging in what is called "patent fencing" (Cohen et al., 2000). Alternatively, they may choose to pursue liability rules with respect to the external innovators' technology. They may do this by partnering with another stakeholder to defensively disclose (Pisano, 2006).

*Modular Ideas*

Firms in this stakeholder category possess niche technologies and lack the downstream specialized resources to compete in the market for products. They have a narrow technology focus given their limited resource positions and expertise. They, therefore, place a relatively high and *ex ante* value on patents since this is their main trading asset. In markets which require specialized assets, they are often limited to participate in the market for ideas, i.e. the out-licensing of their technology.

Smaller firms tend to specialize on a narrow technology area and are generally positioned in the matrix as property rule technologists, since at this stage they seek to exploit only a few but critical patents (Cohen et. al., 2000). These firms would favor the institutional governance mechanism of licensing out or selling (Andersen and Konzelman 2007) to generate growth and establish their technology as a paradigmatic one if they compete in the market for ideas. If they compete in the market for products they would favor the hold-on (exclusivity) mechanism (Ibid).

These propositions are synthesized in Table 2.
Table 2. Stakeholders' Preferred Governance Mechanisms

<table>
<thead>
<tr>
<th>Preferred Patent Governance Mechanisms</th>
<th>Systems-Based Ideas</th>
<th>Systems-Based Products</th>
<th>Modular Products</th>
<th>Modular Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent pool</td>
<td>Patent pool</td>
<td>Patent Fence</td>
<td>Hold-on (Exclusivity)</td>
<td></td>
</tr>
<tr>
<td>Standards</td>
<td>Standards</td>
<td>Hold-on (Exclusivity)</td>
<td>License-out</td>
<td></td>
</tr>
<tr>
<td>Open Source License</td>
<td>Open Source License</td>
<td>License-in, Buy</td>
<td>Sell</td>
<td></td>
</tr>
<tr>
<td>Public Disclosure</td>
<td>Public Disclosure</td>
<td>Reasonable Royalty</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IV. *Amici Curiae* – Friends of the Court

A. Background

The attention now will focus on *amicus* briefs as an objective data source used to offer preliminary assessment of these patent rights stakeholders. Since a goal is to expand the simple vs. complex categorization of patent rights stakeholders, it is desirable to rely on data that integrates a wide variety of firms across multiple industries. *Amicus* briefs are a data source that offers such pluralism. Before discussing firm advocacy an overview of *amicus* briefs will help expose the utility of this legal data source for future interdisciplinary research.

An *amicus* brief is filed by someone who is not a party to litigation but who petitions the court for permission to file a brief because they have a *strong interest* in the
subject matter\textsuperscript{11} (Garner, 1999; Supreme Court Rules; emphasis added). An appellate brief, of which \textit{amicus} briefs are a subset, is prepared by qualified legal counsel as the basis for arguing to affirm or deny the lower trial court’s ruling. The brief consists of legal and factual arguments and the authorities in support of them (Garner, 1999).\textsuperscript{12} The rules are designed so that anyone with a strong interest in the case and the resources to finance the brief is encouraged to file.\textsuperscript{13}

Each brief must state the identity of the party, a disclosure of who authored the \textit{amicus} brief and made a monetary contribution intended to fund its preparation (Supreme Court Rule 37.6). Each brief must also list the identity of the litigant supported (plaintiff or defendant) and whether it supports affirmance or reversal of the lower court decision under review before the Supreme Court (Supreme Court Rule 37(3)(a)). By looking at the \textit{amicus} filing activity, one can conclude that parties would not rationally engage in this behavior if they did not believe they might have an impact on the outcome. There is additional support, however, to explain why parties are inclined to file the briefs and why the courts value them.\textsuperscript{14}

\textsuperscript{11} There are two ways \textit{amicus} brief advocates may petition the Supreme Court. A party can obtain the written consent of the parties to litigation. In the event one of the parties withholds consent, the \textit{amicus} party can file a motion asking the Court directly for permission (Supreme Court Rule 37(3)(b)).

\textsuperscript{12} The Supreme Court can expect at least one \textit{amicus} brief for every case it hears, and the average for cases with at least one \textit{amicus} brief is 4.4 per case (Epstein and Knight, 1998).

\textsuperscript{13} A somewhat dated account calculated this amount between $15,000 and $20,000 (Caldeira and Wright, 1990) The general counsel of a pharmaceutical firm told the authors his firm routinely spends anywhere between $25,000 to $50,000 per \textit{amicus} brief.

\textsuperscript{14} Justice Scalia writes in his book, "Making Your Case: The Art of Persuading Judges" that Justices “don’t read” \textit{amicus} briefs. He qualifies his statement by saying that the Justices read briefs filed by certain parties, e.g. The United States, ACLU, AFL-CIO and any other party whose opinion the Court highly values. He counsels trial advocates to carefully read \textit{amicus} briefs and be prepared to counter them during oral argument, suggesting the Justices are aware of at least some of the briefs’ arguments.
B. The Role of *Amicus* Briefs in Supreme Court Decision-Making

It is widely accepted by judicial scholars that the nine U.S. Supreme Court Justices are motivated by ideological preferences for public policy and pursue their policy goals by deciding cases with maximum impact on political, social, or economic policy (Murphy 1964; Holmes, 1881). The Justices, however, decide cases within institutional constraints and are strategic actors who realize that their ability to achieve their policy goals depends on a consideration of the preferences of other actors, the choices they anticipate others will make, and the institutional context they operate in (Epstein and Knight, 1998). The actors whose preferences the Justices consider include the other Supreme Court Justices and external parties, e.g. Congress, the Executive branch, and the public (Ibid.). Given these political and institutional constraints, *amicus* briefs assist the Court in three ways.

Just as congressional representatives rely on interest groups as information sources, the nine Justices rely on *amicus* briefs to provide them with information that will help them make choices that maximize their preferences for establishing law that is as close as possible to their ideal policy perspective (Epstein, Knight, 1999). Supreme Court Rule 37, which governs the procedure for filing *amicus* briefs, states: "An *amicus curiae* brief that brings to the attention of the Court relevant matter not already brought to its attention by the parties may be of considerable help to the Court." The briefs also contain valuable information on the identity of the filing parties and the advocacy positions of these parties.\(^{15}\)

\(^{15}\) This is especially important in cases where the Executive Branch, for example, through the U.S. Solicitor General, files an *amicus* brief. According to one study, between 1954 and 1993, the Court adopted the
Secondly, *amicus* briefs are used by courts as a proxy of social significance. One study found that the level of *amicus curiae* participation provides information about the political, social and economic significance of a case (Caldeira and Wright, 1990). Using *amicus* briefs as a proxy for social significance allows the Supreme Court to efficiently manage its time, which is one of its most valuable resources. Lastly, a reason why the Court encourages *amicus* briefs involves its desire to enhance institutional legitimacy. Allowing for numerous briefs stimulates perceptions of responsiveness and inclusiveness, which in turn enhances the Court's institutional legitimacy (Ibid.)

From all indications *amicus* briefs play a non-trivial role in the Supreme Court's decision-making. One study, which supports this, found that one or more Justices directly cited an *amicus* brief in their written opinions in 18% of all cases for which briefs were filed from 1969 to 1981 (O'Connor and Epstein 1983). Of the fifteen Supreme Court patent cases analyzed in this research, _separate case opinions cite the arguments advanced by the U.S. Solicitors Office as an amicus_16.

C. Classification of Amici

Caldeira and Knight (1990) performed a comprehensive classification of parties who file *amicus* briefs. Given the nature of the data, their classification scheme is based on the most common thread among advocates, i.e. the unit of membership. Institutional groups like corporations, for example, unlike citizen groups and advocacy groups are not

position advocated by the Solicitor General in 72 percent of the 691 cases where the U.S. Solicitor's office participated as an *amicus* (Segal 1991).

16 Those cases are Festo v. Shoketsu, Merck KGAA v. Integra Life Sciences, Illinois Tool Works v. Independent Ink, Medimmune v. Genentech and Microsoft v. AT&T.
comprised of dues-paying members. Some groups are categorized by occupational membership, e.g. business or trade groups. Peak organizations consist of organizations of organizations, e.g. Phrma, the group that represents a collective of firms in the pharmaceutical industry.

The present research is concerned with explaining the patent appropriability behavior of conceptually distinct patent rights stakeholders. Firms participate in the market for patent rights as licensors, licensees or excluded users of the intellectual property rights (Andersen and Konzelman, 2007). Some basis, however, should be established for excluding some patent owners from the sample of amici. First, individuals routinely file amicus briefs as public interest advocates or independent inventors. To retain uniformity, individuals, even if they own patents, are excluded from the present analysis.

Also, some organizations would appear to readily fall into the category of a firm, e.g. university offices of technology transfer. These entities are nonprofit corporations, despite the fact that they may obtain licensing royalties from university-owned patents. Universities actively assert patent rights and license them under royalty-bearing agreements (West, 2006). Although university technology transfer offices are nonprofit corporations that license patents they are not included in the present analysis as firms. For one, they are not identified as either discrete or complex industry participants in the appropriability literature. Further, since the primary mission of the larger institutional

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17 University technology transfer offices are very active in filing amicus briefs accounting for _ total briefs in the sample.
setting within which they operate is a non-profit setting, we believe introducing this rather large category of participants would introduce more noise that insights.

The remaining firms and their advocacy positions are depicted in Appendices A and B. The data was obtained from Lexis Nexus, which offers amicus briefs for each Supreme Court case. Each table presents the fifteen Supreme Court cases where firms filed amicus briefs, and aligns them based on whether they advocated in favor of the upstream patent owner or the downstream patent non-owner accused of infringement.

Given that the creation of the CAFC was a watershed event in patent policy, this research examines amicus briefs filed in Supreme Court patent cases since 1982.

Since 1982, twenty one patent-related cases have been reviewed by the U.S Supreme Court. In seven of these cases firms did not file amicus briefs and are excluded from the present analysis, leaving a sample of fifteen cases. Firms are defined by Caldeira and Knight (1990) according to their institutional membership characteristics and commercial focus. Excluded from the total sample of firms who filed amicus briefs in the fifteen cases are those which did not clearly state which party they favored, e.g. they favored a reversal of the CAFC but stated that they favored "neither party". These responses were relatively rare.

D. Firm Behavior before the Court

As can be appreciated in Appendices A and B, there is a clear difference among
firms who advocate in their briefs either for or against the patent owner. In general the cases deal with the Supreme Court's interpretation of the CAFC's bright line rules or interpretation of patent-related statutes and precedent. In each of these cases, the patent owner is advocating in favor of an interpretation which grants them stronger exclusivity rights relative to the accused infringer. The cases are then a proxy for determining which firms support the patent owner and therefore a property rule. The cases also provide an opportunity for interested participants to support the accused infringer, and in this way provide a proxy for observing firms that wish to weaken the patent rights and endorse a liability rule.

Appendix A shows counter-intuitively that the majority of firms favoring a property rule are those in complex industries. Seventy one percent of firms who advocated in favor of property rules are in complex industries and twenty nine in discrete industries.\textsuperscript{18} At a glance, many of these firms are smaller and this suggests that they may possesses fewer patents and therefore participate as modular technologists, although further research needs to confirm this. As predicted by the literature, many of the firms that support a property rule are those in what are classified as discrete industries, e.g. pharmaceuticals. Appendix B, on the other hand, shows that eighty five percent of firms that favor liability rules are complex technologists and only fifteen percent are discrete. This is in line with the existing appropriability literature since firms in complex industries typically prefer liability rules do to the challenges discussed above, e.g. the hold-up

\textsuperscript{18} Several firms participated numerous times in the amicus briefs sample by advocating in more than one case. They were counted only once to obtain these and other percentages.
problem. The majority of these firms appear to be system-based product stakeholders with paradigmatic technologies and complimentary assets.

There is a unique case where discrete product technologists adopt the unusual position of advocating a liability rule. That case is Merck KGaA v. Integra Life Sciences, Ltd.\(^{19}\) In this case, Merck KGaA was accused of infringing several RGD peptide patents (research tools) owned by medical device maker Integra Life Sciences. Merck KGaA claimed their activities fell under a federal statutory safe harbor. The CAFC narrowly interpreted the safe harbor to a limited set of circumstances, and established a clear and narrow standard against Merck KGaA. The CAFC's interpretation benefited upstream patent owners by limiting the safe harbor against downstream pharmaceutical companies. On appeal, the Supreme Court reversed the CAFC's narrow interpretation and held in favor of Merck KGaA.

A reason why this case is unique may be due to its limited scope. The case dealt with the interpretation of a federal law dealing with the drug development process. Since the issue turned on a narrow industry-specific issue, the downstream modular firms were free to advocate a position that benefited their position in this narrow context, illustrating the endogeneity of patent appropriability decision-making. Since the downstream drug manufacturers possess complimentary assets needed to commercialize new compounds, in cases limited to this industry they sought to weaken the patent regime of upstream firms. A similar result was found in Pisano's research where Merck partnered with academic researchers to defensively disclose and weaken the position of competitors in

\(^{19}\) 545 U.S. 193 (2005).
the area of genomics (Pisano, 2006). This is supported by this article's framework since in industry-specific cases involving upstream patent owners and downstream producers, the presence of downstream complimentary assets can become an important factor in appropriability decision-making (Arora and Ceccagnoli, 2006; Gans, Hsu, Stern 2002).

E. Research Extensions and Limitations

This paper conceptualizes four distinct patent stakeholders and derives some of the factors that influence their appropriability decision-making under varying scenarios. These issues are relevant to the efforts advanced by strategy scholars who have struggled with fast changing intellectual property environments (Chesbrough, 2007). This research, however, needs refinement and has its limitations. Among the concerns are that the amicus brief data used to initially justify the stakeholder categories is limited. The number of amicus brief filers is relatively small and may be overrepresented by outliers, i.e. firms who rely on patent property or liability rules to an extent that does not adequately represent the spectrum of patent right stakeholders. Further research needs to assess the validity of amicus brief data in specific industry contexts and the availability of alternate sources of appropriability shaping behavior to verify the framework in these contexts. Another puzzle surrounds the decision-making involved in whether to participate as amici. Ideology may play a role to overcome the collective action problem these firms have to surmount (Olson, 1965). This research also needs empirical validation to ascertain whether there is a strong fit between the groups and their implementation of the various governance mechanisms described. Additional research
may also explore the embedded norms and knowledge routines that underpin stakeholder behavior and the potential effects these have on governance choices.

V. Summary

This research is relevant to intellectual property scholars and policymakers. Its principal goal has been to show that firms actively shape their and rivals' appropriability environments and that this decision-making is partially based on firm-related characteristics and the firms' preference among property rules. This supports the theoretical framework of Andersen and Konzelman (2007) where intellectual property governance choices are shaped by technological factors, strategic interactions, institutional capabilities and power relationships in bargaining situations involving intellectual property rights. Another goal has been to show that the decisions firms make with respect to patent rights are not homogenous. Each of the four innovator stakeholders has its own characteristics, challenges and incentives.

From a policy perspective, recent discussion has been directed to the shift from a property rule to a liability rule in patent rights (Kieff, 2007; Farrell and Shapiro, 2008). Weakening patent rights favors firms that prefer liability rules because, e.g. they are subject to patent thickets, own a paradigmatic technology, own specialized complimentary assets or are the dominant players in integral system architectures. Ultimately, policy makers will decide under what conditions it is best to align with property vs. liability rule advocates. This important policy consideration should take into account the unintended consequences that sometimes accrue through public regulation,
e.g. the erection of barriers to entry (Friedman, 1962). Opponents of the shift towards liability rules may make the case that the patent system was designed to promote the progress of science by granting patent rights to stakeholders in modular idea environments. Reducing these stakeholders' relative bargaining leverage may impact Schumpeterian cycles of creative destruction. On the other hand, the emerging patent liability rules landscape has raised the relative returns to competition (Gans and Stern, 2002) and will likely lead to fiercer competition in the market for products versus the market for ideas.

Acknowledgments:

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### Appendix A. Patent Owner Advocates

#### Supreme Court Patent Cases

<table>
<thead>
<tr>
<th>Amici Firms and SIC Codes</th>
<th>&lt; 2900</th>
<th>&gt; 2900</th>
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<tbody>
<tr>
<td><strong>1. Eli Lilly (2834) v. Medtronic (3845) (1990)</strong></td>
<td>Bristol Myers Squibb Co. (2834); Procter &amp; Gamble Co. (2844); Pfizer Inc. (2834);</td>
<td>Zimmer, Inc (3842);</td>
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<td><strong>3. Markman and Positek (3577) v. Westview Instruments, Inc and Althon (7371) (1996)</strong></td>
<td>Litton Systems, Inc. (3812); Exxon Corp. (2911);</td>
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<td><strong>4. Warner-Jenkinson (2816) v. Hilton Davis Chemical (3823) (1997)</strong></td>
<td>Chiron Corp. (2834);</td>
<td>Litton Systems, Inc. (3812);</td>
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<td><strong>6. J.E.M. (5084) v. Pioneer Hi-Breed Intl, Inc. (5261) (2001)</strong></td>
<td>Monsanto Co. (2074); BASF Corp. (2821); Delta and Pine Land Co. (0116);</td>
<td>Cargill Inc. (5153);</td>
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<td><strong>7. Festo (3535) v. Shoketsu (3491) (2002)</strong></td>
<td>Celltech Group plc. (2834); Chiron Corp. (2834); Eli Lilly and Co. (2834); Henkel Corp. (2843); Johnson &amp; Johnson (2834); Pfizer Inc. (2834); PPG Industries (2851);</td>
<td>Rexam Beverage Can Co. (3411); Sun Microsystems (3571); Verizon Communications Inc. (4813); Research Corp. Technologies (8111); Asta Medica Aktiengesellschaft (8732); Minnesota Mining and Manufacturing (3841); Litton Systems, Inc. (3812); Bose Corp. (3651);</td>
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<tr>
<td><strong>8. Merck KGaA (2833) v. Integra LifeSciences I, Ltd (3842) (2005)</strong></td>
<td>Benitec Australia Ltd.; Invitrogen Corp. (2836); Diversa Corp.; Quantum Dot Corp.; Isis Pharmaceuticals, Inc. (2834)</td>
<td>Vaccinex, Inc. (8071); Affymetrix Inc. (5047); Sangamo Biosciences Inc. (8731); Symyx Technologies Inc. (8731); Applera Corp. (3826);</td>
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<td><strong>10. Ebay (5961) v. MercExchange (2006)</strong></td>
<td>Procter &amp; Gamble Co. (2844); E.I. du Pont de Nemours and Co. (2879); Johnson &amp; Johnson (2834);</td>
<td>General Electric Co. (3724); 3M Co. (3841); Technology Licensing Corp. (3993); Fonar Corp. (3845); Intellectual Ventures (8742); Technology Patents &amp; Licensing. Inc (8742); Expanse Networks, Inc (7313); Rembrandt IP Management, LLC (8742); Research Corp. Technologies (8111); Qualcomm Inc. (3663); Tessera, Inc. (3674);</td>
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<td><strong>11. Labcorp (8071) v. Metabolize (8071) (2006)</strong></td>
<td>Perlegen Sciences, Inc. (2836);</td>
<td>Mohr Davidow Ventures, Inc. (7389);</td>
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<tr>
<td><strong>12. Medimmune (2834) v. Genentech (2834) (2007)</strong></td>
<td>Procter &amp; Gamble Co. (2844); E.I. du Pont de Nemours and Co. (2879)</td>
<td>Qualcomm Inc. (3663); Interdigital Communications Corp. (6794); 3M (3841); General Electric (3724);</td>
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<td><strong>13. Microsoft (7372) v. AT&amp;T (4813) (2007)</strong></td>
<td>N.A.</td>
<td>Research Corp. Technologies, Inc. (8111); U.S. Philips Corp.; Philips Electronics North America Corp. (5064);</td>
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<td>14. KSR (3469) v. Teleflex (3714) (2007)</td>
<td>Procter &amp; Gamble Co. (2844); E.I. du Pont de Nemours and Co (2879); Johnson &amp; Johnson (2834); Intermune, Inc. (2834);</td>
<td>Altitude Capital Partners (6282); Expanse Networks Inc. (7313); Inflexion Point Strategy LLC.; Interdigital Communications Corp. (6794); Ipotential LLC.; Ocean Tomo LLC.; Onspec Electronic Inc.; 3M Co. (3841); General Electric Co. (3724); Fallbrook Technologies, Inc. (7549); Intellectual Ventures (8742); Ellsworth International, Inc. (6733); Ge02 Technologies, Inc.; Mobile Productivity, Inc. (7549); Composite Technology International, Inc. (3355); Skyler Technology, Inc. (7389); Private Management, Inc.; Technology, Patents &amp; Licensing, Inc. (8742); Science and Technology Corp.; Research Corp. Technologies, Inc. (8111); Michelin North America, Inc. (3011); Arvinmeritor, Inc. (3714); Nartron Corp. (3674); Technology Properties Limited; Tessera, Inc. (3674); Qualcomm Inc. (3663); Amberwave Systems Corp. (7379)</td>
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<td>15. Quanta Computer (3571) v. LG Electronics (3631) (2008).</td>
<td>N.A.</td>
<td>MPEG LA, LLC (6794); Wi-Lan, Inc. (7374); Papst Licensing GmbH (6794); Qualcomm, Inc. (3663); Interdigital Communication, LLC (6794); Tessera, Inc. (3674); iBiquity Digital Corp. (3663); Rembrandt IP Mgmt, LLC; Yahoo Inc. (7375); Technology Properties Ltd.; Aerotel, Ltd. (3669); Amberwave Systems Corp. (7379)</td>
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<td>Supreme Court Patent Cases</td>
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<td>Cook Group Inc.(3841); Carbon Implants Inc.; Intermedics, Inc.; Teletronics, Inc.; Ventritex, Inc.(5047);</td>
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<td>3. Markman v. Westview Instruments, Inc. (1996)</td>
<td>Matsushita Electric Corp. of America; Matsushita Electric Industrial Co.; United States Surgical Corp.(3841); Honeywell, Inc.(3724); Airtouch Communications, Inc.(4899); General Motors(3711); Chrysler(3711); Ford(3711).</td>
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<td>4. Warner-Jenkinson. v. Hilton Davis Chemical (1997)</td>
<td>Union Carbide Corp.(2821); Gateway Technologies, Inc.; General Motors(3711); Chrysler(3711); Ford(3711); MCI Telecommunications Corp.(4813); Seagate Technology(3572); 3com Corp.(7373); Borland International(3724); Chevron Corp.(1311); Cisco Systems(3577); Coherent(3674); Eastman Medical Products(3841); Giro Sport Design(5091); Hewlett-Packard Co.(3571); Read-Rite Corp.; Storage Technology Corp.(3572); Sun Microsystems(3571); Western Digital Corp.(3572); Wyko Corp.(3599); Micron Separations, Inc.(3569); GHZ Equipment Co.; Intel Corp(3674).</td>
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<td>7. Festo v. Shoketsu (2002).</td>
<td>E.I. du Pont de Nemours and Co.(2879); Genentech, Inc.(2834); Medimmune, Inc.(2834); International Business Machines Corp(7371); Eastman Kodak Co.(3861); Ford Motor Co(3711); Agere Systems Inc.(3674); Applied Biosystems (via Appliance Corp.)3826); Celera genomics (via Appliance corp) (3826); Applied Materials(3674); Cisco Systems(3577); Micron Technology(3674); Oracle Corp.(3732); Intel Corp.(3674); Cypress Semiconductor Corp.(3674); United Technologies(3585).</td>
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<td>Genentech, Inc.(2834); Biogen Idec, Inc.(2836); Eli Lilly and Co.(2834); Wyeth(2834); Pfizer Inc(2834); Eon Labs, Inc (2834).</td>
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<td>Yahoo! Inc.(7375); Nokia Corp.(7375); Research in Motion, Ltd.(3633); Time Warner Inc.(4841); Amazon.com(5942); Cisco Systems(3577); Google Inc.(7375); IAC/Interactive Corp.(7389); Infineon Technologies AG(3674); Shell Oil Co.(5541); Visa U.S.A.(7389); Xerox Corp.(3579); America Online, Inc.(4813); Applied Materials, Inc.(3674)</td>
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<td>Hallmark Cards(2771);</td>
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<td>Intel Corp.(3674); Micron Technology, Inc.(3674); Cisco Systems Inc.(3577); General Motors Corp.(3711); Hallmark Cards(2771); Fortune Brands Inc.(3429); Electrolux North America(3631); Time Warner Inc.(4841); IAC/Interactive Corp.(7389); Viacom, Inc(4841)</td>
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<td>Motorola, Inc.(3663); Nokia Corp (3663); NCR Corp (7373); Dell, Inc.(3571); Hewlett Packard Co.(3571); eBay, Inc(5961); Cisco Systems, Inc.(3577); IBM(7371).</td>
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