

# Intellectual Property Protection in the EDA Industry

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**Abstract:** The worldwide EDA market is expected reach \$9.85 billion by 2015. With the increasing EDA industry, the grant of utility patents in Computer and Electronic Products has been also increasing. Recent Supreme Court cases such as Alice Corp. v. CLS Bank International and the changes in patent law by Leahy-Smith America Invents Act (AIA) are likely to cause changes to develop new strategies in the intellectual property rights (IPR) and protection in the EDA industry. In order to better understand the status quo of intellectual property (IP), basic IP definitions, recent IP developments, and advanced protection strategies are discussed.

**Keywords:** AIA, EDA, IP, patent, protection

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## I. INTRODUCTION

Wikipedia, the so called online encyclopedia, defines Electronic Design Automation (EDA) as “[a category of software tools for designing electronic systems such as printed circuit boards and integrated circuits. The tools work together in a design flow that chip designers use to design and analyze entire semiconductor chips[1].” NVIDIA explains that “EDA involves a diverse set of software algorithms and applications that are required for the design of complex next generation semiconductor and electronics products[2].” The School of Electrical and Computer Engineering at Cornell University puts the EDA in an area that “explores new algorithms, methodologies, and tools for automating the design, analysis, optimization, and verification of very large-scale integrated circuits[3].” According to the Electronic Design Automation Consortium, the EDA industry focuses on “developing and supplying highly specialized software- and hardware-based tools for the automated design of electronic products of all kinds.[4]”

Dr. Alberto Sangiovanni-Vincentelli, University of California at Berkeley, finds the genesis of EDA from the mid-1960s to the late-1970s[5]. According to Dr. Sangiovanni-Vincentelli, this period is viewed as the “Ages of Gods,” where the industry pioneers laid the foundations in EDA[6]. 1980s is when the EDA industry started to form its massive structure. After Carver Mead and Lynn Conway published “Introduction to VLSI Systems” in 1980, EDA started to develop both in academically and commercially[7]. Richard Goering describes the 1980s as the “Dazzling Decade” in the EDA industry, where the market developed to \$2.5 billion business from scratch[8]. The 1990s show a different story compared to the 1980s. Dr. Sangiovanni-Vincentelli sees that the innovation in the industry was slowing down due to the web-explosion as most of the funding was going toward the dot-com world. However, during this period the semiconductor industry pushed EDA to look at System on chip (SoC)[9].

Even in the midst of global financial crisis, the EDA industry has been constantly growing since 1981. The report from EDAC shows that the worldwide market reached nearly \$7 billion [10].

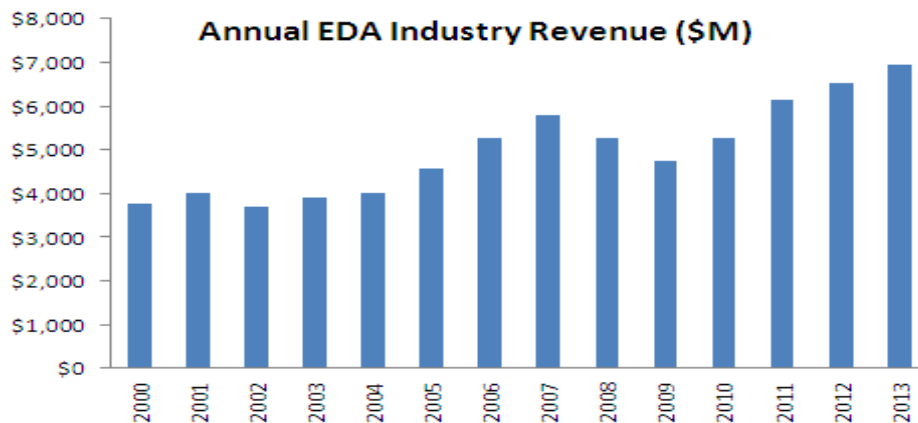


Figure.1 Annual EDA Industry Revenue

Source: EDCA

Also, Global Industry Analysts Inc. predicts that the worldwide EDA market will reach \$9.85 billion by 2015. The report asserts that the demand will come from SoC devices or SiP (system-in-package), which improve product performance, functionality and size requirements in one single IC[11].

The EDA industry can be divided into five big sectors. First, Computer-Aided Engineering (CAE), which are electronic design automation of projects in integrated circuits and computing devices. Second, Printed Circuit Board (PCB) and Multi-Chip Module (MCM). PCB deals with electronic interconnect product such as mount and interconnect chips, capacitors, resistors, and other discrete components. MCM is a technology mounting multiple, unpackaged integrated circuits on a single laminate or ceramic base material. Third, Integrated Circuit (IC) Physical, which is related to semiconductor devices or chips. Forth, Semiconductor Intellectual Property (SIP), which is reusing a design or testbench. Lastly, a Service sector[12].

As shown in Figure.2, most of the revenue in the EDA industry has been driven by CAE sector around, which has peaked to \$700 million/quarter in the 2013-14 period. The IC Physical and SIP market are also has been increasing, however, the SIP market surpassed the IC Physical market in the 2009-10 period, which could be interpreted as showing importance of IP and IP transactions. The PCB/MCM and Service markets are maintained a stable market.

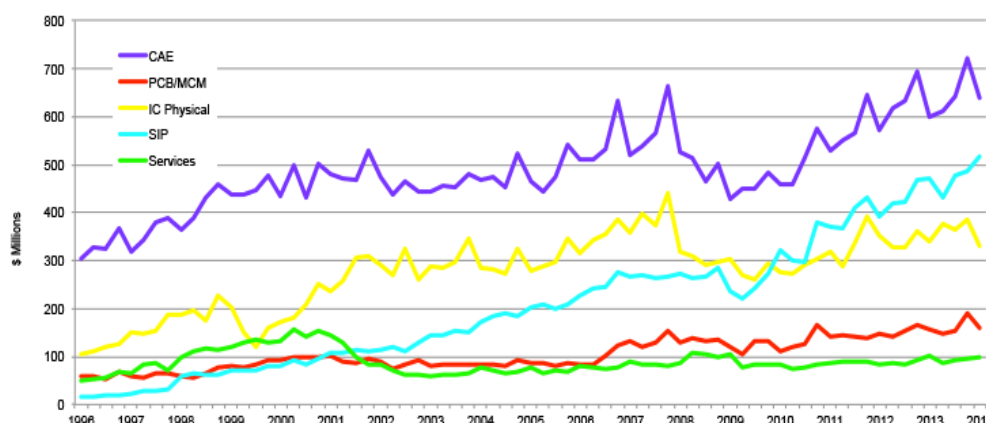
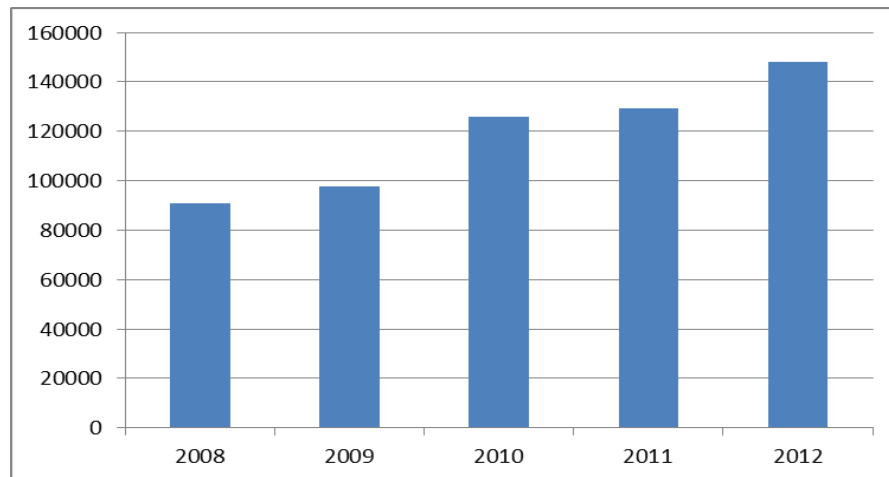


Figure.2 EDA revenue history, 1996 - present

Source: EDCA

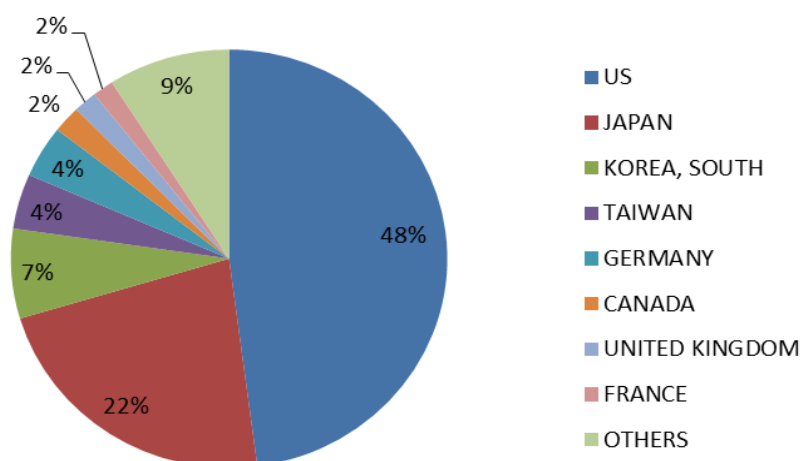
Related to the increasing trend in the SIP market, the grant of utility patents in Computer and Electronic Products (North American Industry Classification System, NAICS Classification 334) has been increasing. According to the statistics of NAICS, a total of 591,734 patents have been granted between 2008 and 2012 at growth rate of 13%.



**Figure.3 Grant of Utility Patents in Computer and Electronic Products**

Source: NAICS

Between 2008 and 2012, 48% of the patents originate from the United States followed by Japan (22%), South Korea (7%), Taiwan (4%), and Germany (4%).



**Figure.4 Computer and Electronic Products Patents by Country**

Source: NAICS

With a growing trend in the EDA market and the recent changes in the United States patent system, more careful attention must be given to strategic intellectual property prosecution in the EDA field. This paper will give a brief overview of intellectual property rights, its recent developments, and advanced protection strategies in the fields of the EDA industry.

## 2. BASIC IPR DEFINITIONS

### 2.1. Patents:

United States patent is a property right that protects inventions including any process, machine, manufacture, or composition of matter, or any improvement thereof that are novel, useful, and non-obvious [13]. The three types of patents are utility patents, design patents, and plant patents. It is important to note that a patent does not grant any positive or affirmative right to make, use, sell, offer to sell, or import an invention.

In theory, intellectual property, including patents, helps to foster intellectual and economic growth. The disclosure requirement assures the dissemination of innovation to the public, and in return the inventor or the owner is granted legal rights of ownership for duration of 17-20 years. Although some argue that patents are used for anticompetitive purposes that lead to monopolies, economists claim that patents provide important incentives for investment and trade, both of which are vital sources of economic growth.

In order to obtain a patent, an inventor must submit an application to the United States Patent and Trademark Office. The process is lengthy and often very costly.

**2.2. Copyrights:**

Copyrights protect the original expression of an idea [14]. Copyright protection is automatic so you do not have to register. However, it is wise to register the work with the US Copyright office since this will spare you from having to prove actual monetary damages from an infringed activity. Unlike the registration process for patents, registration process for copyrights is as easy as filling out a 1-2 page form, and the fee is dramatically cheaper. Copyrights are usually valid for the author’s lifetime plus 70 years or sometimes longer (75-100 years) if the work was created for hire [15].

**2.3. Trademark:**

Trademarks protect the goodwill and branding of one’s product or services. It refers to the distinctive signature mark used to protect the company, product, service, name, or symbol. A typical trademark registration takes under two years and costs under \$5,000 per registered mark. It can also be re-registered indefinitely.

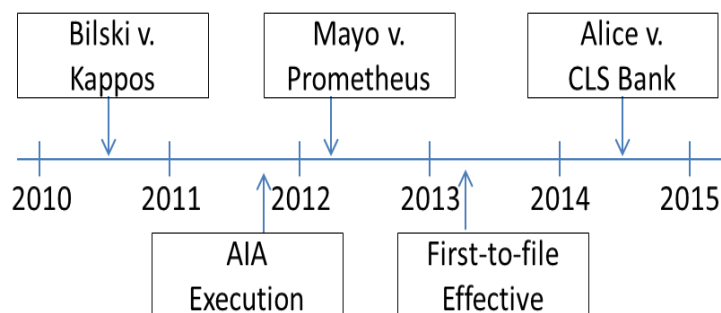
**2.4. Trade Secrets:**

Trade secrets are any confidential technical or business information that provides an enterprise a competitive advantage [16]. There is no formal filing procedure to register trade secrets. Companies must make efforts to protect their trade secrets through non-compete and non-disclosure agreements. Due to the lack of formal protection, once the information is publicly disseminated, a third party is not prevented from duplicating and using the information.

**3. RECENT IP DEVELOPMENTS**

*“Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title“ (35 U.S.C. § 101) [17].*

The two most important factors to consider in getting patent protection in the EDA industry is the patentability of the subject matter and the new Leahy-Smith America Invents Act (AIA), which is a major change in the patent system.

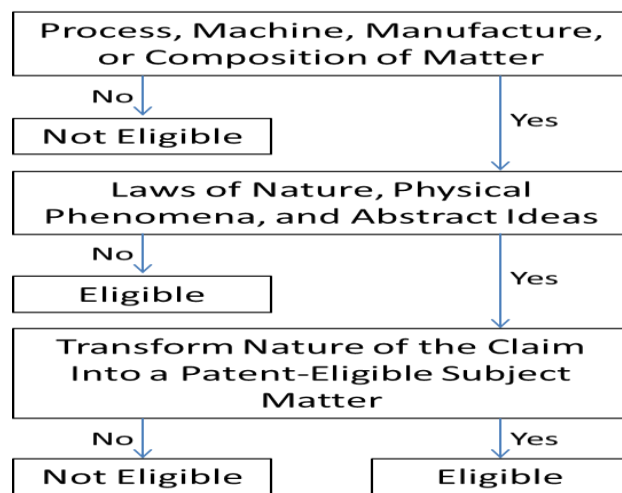


**Figure.5 Recent IP Developments**

The patentability of a subject matter follows a two prong test. First, is the claimed invention within the four statutory categories of a patentable subject matter: process, machine, manufacture, and composition of matter? Second, if the claimed invention is a statutory subject matter, does it fall under an exception? Laws of nature, physical phenomena, and abstract ideas are statutorily excluded from the patentable subject matter, which include the following: transitory forms of signal transmission, a naturally occurring organism, a human per se, a legal contractual agreement between two parties, a game defined as a set of rules; a computer program per se, a company, a mere arrangement of printed matter [18].

Whether an algorithm or software is eligible for a patent has been an issue for a long time in the patent system. Although an algorithm or software passes the first hurdle of being a patentable subject matter by falling under as a process, the issue becomes whether the algorithm is an unpatentable subject matter as an abstract idea. The two key cases that relate the EDA industry to the patentability of an abstract idea are *Bilski v. Kappos* (2010 Supreme Court) and *Alice Corp. v. CLS Bank International* (2014 Supreme Court). In *Bilski v. Kappos*, the Supreme Court reaffirmed the holding that “while an abstract idea, law of nature, or mathematical formula could not be patented, ‘an application of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection.’” The Supreme Court gives a leeway to the patentability of an abstract idea saying that “[t]he machine-or-transformation test is a useful and important clue, and investigative tool, for determining whether some claimed inventions are processes under § 101 [19].” Electronic devices and computers are more likely to follow the machine test which considers the following factors: 1) whether the claimed steps incorporate a particular machine; 2) whether machine or apparatus is merely an object in the method; and 3) whether the machine imposes meaningful limits[20]. Overall, the Supreme Court in *Bilski v. Kappos* tends to show leniency in forms of algorithms and software inventions that are patent eligible.

In *Alice Corp. v. CLS Bank International*, the Supreme Court unanimously reversed the Federal Circuit’s decision that the claimed invention was ineligible as ‘the claims at issue amount to ‘nothing significantly more’ than an instruction to apply the abstract idea of intermediated settlement using some unspecified, generic computer.’ The Supreme Court used the framework set forth in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, where the Court first determines whether the claims at issue are a patent-ineligible subject matter; and, if so, then asks whether the claim’s elements transform the nature of the claim into a patent-eligible subject matter[21]. The USPTO interprets this case by emphasizing on the words “significantly more” with giving examples that would qualify the standard as following: “improvements to another technology or technical fields”; “improvements to the functioning of the computer itself”; and “meaningful limitations beyond generally linking the use of an abstract idea to a particular technological environment[22].”



**Figure.6 Eligibility Framework**

As referenced in Fig. 5, another major recent development in the United States patent system is the Leahy-Smith America Invents Act (AIA). On January 25, 2011, Senator Patrick Leahy, former and current US Senator of Vermont, brought up the patent reform issue. This was not the first time for a proposal on the patent reform. A patent reform was first introduced by Chairman Smith and Mr. Berman in 2005. Senator Patrick Leahy mentioned that the patent reform will accomplish three important goals, “improve the application process by transitioning to a first-inventor- to-file system; improve the quality of patents issued by the USPTO by introducing several quality-enhancement measures; and provide more certainty in litigation[23].” After passing the Senate and the House, President Barack Obama signed the document on September 16, 2011.

After March 16, 2013, one of the biggest changes to the patent system is First-to-invent (FTI) to First-to-file (FTF). Pedersen and Woo, both from the law firm of Patterson Thuyente Christensen Pedersen in PA, asserts that “[t]he proposed

changes to § 102(a) redefines prior art, moving away from the notion that first inventors have the ability to eliminate some prior art by showing an earlier invention date, and moving toward an FTF system where an absolute novelty standard is applied.” They say that § 102(a) accomplishes two things, 1) “awarding a patent to the party who effectively filed an application first,” and 2) “changing the nature of the one-year grace period[24].”

Although the FTF system may not recognize the first inventor in some cases, it seems to be more efficient as the new system pushes the inventor to file a patent application at an earlier point. Assuming that a 3<sup>rd</sup> party and an inventor independently made a same invention and the inventor made the invention at an earlier time than the 3<sup>rd</sup> party, in the old FTI system, the inventor could provide evidence saying that he was the first inventor of the claimed invention after a 3<sup>rd</sup> party files a patent application, and retain the rights; whereas, in the new FTF system, if the 3<sup>rd</sup> party files an application before any publication of the inventor, the 3<sup>rd</sup> party maintain the rights of the claimed invention[25][26]. As a result, this will ask inventors to disclose new inventions as soon as possible or the inventor will lose an opportunity get protected by the patent system if he does not file and sits on the invention.

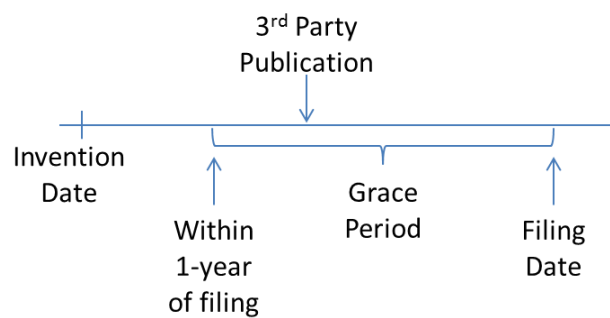


Figure.7 Grace Period Scenario

As to the grace period, unlike most of the world, the old FTI patent system in the US did not recognize absolute novelty, saying that any publication prior filing will be used against you, which was more pro-inventor. The one-year grace period within the filing date protected the inventor from other publications if the inventor could prove that the invention was before the publication[27]. In Fig.7, the 3<sup>rd</sup> party publication will give no effect to the application. However, the result will be different under the new FTF system, which recognizes absolute novelty. The one-year grace period will only be effective to the inventor’s own publications[28]. Therefore, in Fig.7, the 3<sup>rd</sup> party publication will invalidate the application.

Another major change by the AIA is the introduction of the Post Grant Review (PRG), which is similar to the European Patent Office (EPO) opposition practice. Under the AIA, a patent protection on a claimed invention is not in full after the grant of the patent. Some patents may face a new process called the Post Grant Review, could be requested by a 3<sup>rd</sup> party within 9-months from the issue of patent. For a 3<sup>rd</sup> party to initiate a PGR, the petition must meet one of the standards: 1) more likely than not that at least one of the claims challenged in the petition is unpatentable; or 2) important unsettled legal question. The PRG will be initially handled by Patent Trial and Appeal Board (PTAB), which will be decide within 1-year from the initiation and may be extended for 6-months for good cause. The patent owner may file a preliminary response, request rehearing to initiate, amend the patent, and supplement the patent. Also, limited discovery is permitted[29]. This is an area that more cases need to be developed.

	Application	Filing	Party	Grounds	Standard
Post Grant Review (PRG)	AIA only	Within 9-months from issuance	3rd	Any	More likely than not; or important unsettled legal question
Inter Partes Review	Pre-AIA and AIA	9-months after issuance; or termination of PRG	3rd	102 or 103	Reasonable likelihood of prevailing
Ex Partes Reexamination	Pre-AIA and AIA	-	Any	-	Substantial new question of patentability

Table.1 Reviews and Reexaminations

Overall, the changes by the AIA will ask the EDA industry to consider careful intellectual property protection strategies in order to survive in the highly competitive market. Before an initial filing, companies must assess and evaluate the current state of the intellectual property portfolio. With the assessments, the companies should align prosecution strategies with its future goals. One example would be, categorizing technologies into “utilize,” “likely not to utilize,” or “will not utilize.” This will help companies to make decisions on which business units can be expanded and which needs protection[30].

**4. ADVANCED PROTECTION STRATEGIES**

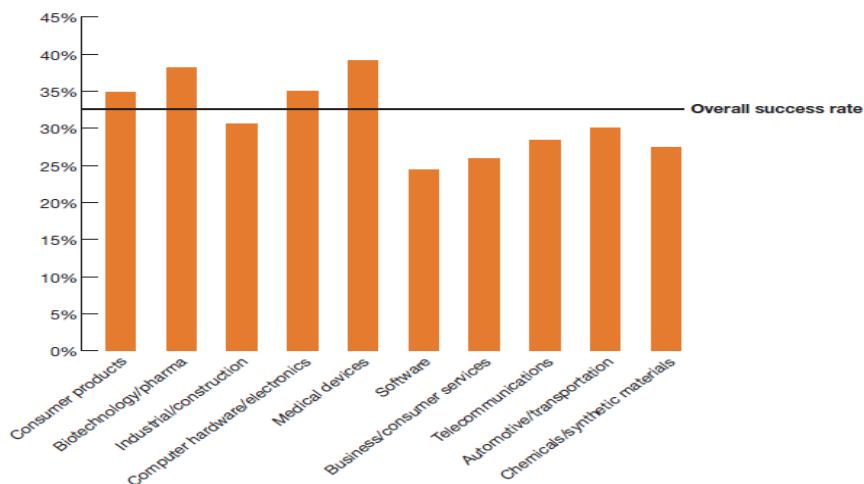
Utilizing patents can be categorized into two ways: offensive and defensive uses. The offensive use of patents is suing a competitor for damages caused by infringement. A recent remarkable case would be the Apple Inc v. Samsung case, in which Apple was awarded \$1 billion [31].

Year	Plaintiff	Defendant	Technology	Award (in \$MM)
2009	Centocor Ortho Biotech Inc.	Abbott Laboratories	Arthritis drugs	\$1,673
2007	Lucent Technologies Inc.	Microsoft Corp.	MP3 technology	\$1,538
2012	Carnegie Mellon University	Marvell Technology Group	Noise reduction on circuits for disk drives	\$1,169
2012	Apple Inc.	Samsung Electronics Co.	Smartphone software	\$1,049
2012	Monsanto Company	E.I. Dupont De Nemours and Company	Genetically modified soybean seeds	\$1,000
2010	Mirror Worlds LLC	Apple Inc.	Operating system	\$626
2005	Cordis Corp.	Medtronic Vascular, Inc.	Vascular stents	\$595
2004	Eolas Technologies Inc.	Microsoft Corp.	Internet browser	\$521
2011	Bruce N. Saffran M.D.	Jonhson & Johnson	Drug-eluting stents	\$482
2008	Bruce N. Saffran M.D.	Boston Scientific Corp.	Drug-eluting stents	\$432

**Table.2 Top 10 Patent Litigation Cases**

Source: PwC

The studies by PwC show that the patent holder in Computer hardware/electronic have success rate approximately 35% in litigation, which is higher than the overall success rate in patent litigation[32].

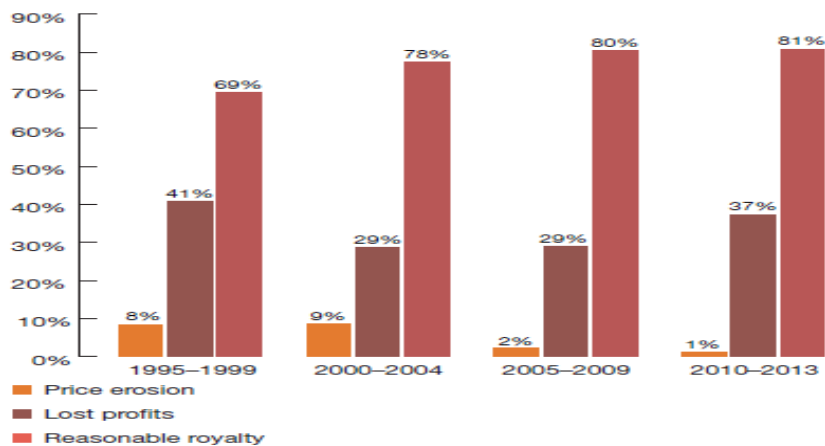


**Figure.8 Patent Litigation Success Rate**

Source: PwC

An alternative offensive use is having a business portfolio of licensing patents to generate royalties in a friendly manner. In addition, companies may want to cross-license, or trade patents, in order to obtain technologies that other companies possess.

Companies use patents defensively to protect investment in research and development. Without protection provided by patents, competitors are free to reverse engineer and steal your technology. Secondly, patents provide a bargaining option when competitors assert a patent infringement claim on a company. By having a strong intellectual property, you can increase the likelihood of settling a case through cross licensing instead of having to pay significant legal fees to either fight the allegations or pay royalties [33]. In addition, having ample patents may lead to counterclaims that will keep competitors from suing. According to the studies by PwC, many infringement cases end up in paying reasonable royalties. The studies give reasons on preferring reasonable royalties as following: “patent holders might not want to risk disclosing proprietary cost and profit information necessary for the calculation of lost profits”; and “lost profits entitlement can be more difficult to establish[34].”



**Figure.9 Composition of Damages Awards**

Source: PwC

## 5. CONCLUSION

The EDA industry is an expanding area that is growing rapidly. Many companies are facing uncertain outcomes as the AIA significantly changed the patent prosecution process and less cases has development since the new patent system applied. To adapt to the changes and overcome the challenges, companies must pay special attention not only to their business models but also to the activities of the competitors. By preparing efficient and effective patent pre-prosecution, post-prosecution, and litigation strategies, the companies in the EDA industry will continue to grow and mitigate the risks.

## 6. ACKNOWLEDGEMENT

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