What the technology executive should know about patent protection in the age of AI

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Introduction

I've spent more than 35 years in the wireless telecommunication industry, as both an inventor and senior technology executive. I'm a named inventor on more than 100 issued patent families in 27 countries, many of which are essential to certain wireless telecommunication standards that we all use every day. As a senior technology executive, I leveraged my technical and business education to build substantial applied research and development organizations in the areas of wireless and secure communication, networking, quantum computing, quantum sensors and other foundational technologies.

This tutorial is intended for the next generation of inventors and R&D executives regarding the somewhat mysterious domain of patenting, and I'm confident that I can help you avoid many of the errors I've made in the past as you develop your own career. In that sense, the principal market segment for this piece is the group that I think of as comprising people who are younger versions of myself.

This tutorial is based partly on a series of lectures I've given at the Wharton School of Business and Penn Engineering over the years. It's not intended to be an exhaustive course on patent law, litigation or corporate strategy but rather a practical, and actionable overview, of what the executive needs to know and can immediately apply when it comes to protecting intellectual property using patents.

Section one is about companies that innovate. What is innovation? How does innovation create value? How do companies encourage innovation and how does innovation fit into their value chain, or not? What is a "disruptive technology"? Why is

it difficult for large firms to create disruptive technologies? Why the accelerated interest in intellectual property and patenting? Rewarding the inventor: "Gold Badge Culture".

Section two is practical guidance. What are patents and why do they exist? How and why has patenting become the preferred method of protecting technical intellectual property? What rights do patents provide to their owners? How are patents different for small and medium-sized firms as compared to large multinationals? What are the obligations and liabilities of patenting? What is patent prosecution and what should the executive know about it? What are the realities of patent licensing and litigation? What are the elements of a patent strategy and how do we develop one? How do patenting strategies differ for large multinational firms compared to small and medium-sized enterprises? What are the guidelines regarding generative AI and patenting?

Section three is about optimism for the future and how to make the future yours. How do we incorporate a patenting strategy into the corporate value chain? What technologies are driving the uptick in patenting today, and how have certain technologies matured? How to create and maintain a culture of innovation, invention and excellence for your firm or organization.

Section 1 – About companies that innovate

What is innovation?

Broadly, the term "innovation" refers to the introduction of something new – a new idea, a new product, a new technique, a new procedure, or a new service. Innovation typically creates value by introducing a different, and usually a better way to accomplish a task or solve an existing problem. This all sounds fairly academic, and even simple. In the real world of technology and product management, innovation is that elusive concept that everyone talks about, but few can accomplish in the real world. Why is that?

Typically, there is a tendency by managers and executives, particularly in mature industries, to create procedures: procedures for manufacturing, procedures for financial reporting, procedures for product testing, procedures for product introduction and so forth. Managers tend to like procedures, because they're easy to quantify and make for the development of easy-to-follow recipe-like instructions that can be executed flawlessly by anyone who understands how to follow the given instructions in an environment having sufficient resources.

For example, consider a production environment for an enterprise that manufactures wireless network equipment. There are procedures for developing the requirements, architecture and design documents. There are procedures for building the electronics and writing the software and firmware to certain standards. Then there are procedures

for testing and integrating the equipment into the customer environment. So, a view of the value chain can show where each one of these steps takes place. Although these procedures are vital to the creation and release of a new product, following such a procedural recipe has nothing to do with innovation.

Real innovation in a technology-focused firm is based on problem-solving. I learned long ago that people will pay those individuals who are able to solve significant technical problems, usually the most difficult and commercially important ones. Because no one will pay me to solve easy problems or irrelevant problems, I needed to learn to identify the right problems, those whose solutions can produce significant economic benefit. The solutions to such problems frequently became some of the most economically valuable ones given the current state-of-the-art.

This notion of economic value based on creativity has, in some circles, given rise to the dream that management might be able to create procedures that generate innovation. Although many attempts have been made to "systematize" innovation, usually by large multinational companies, these efforts have largely been losing propositions that succeeded only in confusing engineers and researchers and wasting time that could have been better used by working on economically relevant problems.

So, if we're unable to create procedures that result in real innovation, then how do we address the problem of an enterprise that requires more innovation to grow, or even to maintain their market share? The answer is to create an environment that promotes and rewards creativity. This may sound slightly simplistic, but executing such a proposition is way easier said than done.

Innovation requires a certain openness to seeing solutions to problems that, by definition, are outside the realm of procedure-driven requirements. Innovation can occur anywhere in the value chain, not just in the research and development (R&D) stages where the fundamental problems tend to be solved, but anywhere that one can identify a problem whose solution, if found, would create economic value for the firm.

For example, consider a mobile wireless equipment provider whose factory is unable to consistently produce products that meet all the basic requirements regarding power output level. Maybe some of the products meet specifications, but others don't because the tolerance of component values may accumulate errors at times in the actual system that result in failure. The production team may bring this problem to a small team of radio frequency amplifier experts to get their views on how the problem might be solved. The obvious approach to such a problem might be to simply require high-tolerance components in certain areas of the circuitry, which may or not be practical or cost-effective, or even possible given the current state of the company's supply chain. On the other hand, if these experts are of the creative mindset, and are rewarded for creativity, then a small circuit might be devised to 1) identify the errors introduced by parts tolerances and 2) compensate for these errors. If the experts were creative, then

they might propose a novel method for introducing this change into the product via a firmware or software update, that requires no change whatsoever to the circuit boards or hardware. Such a solution might even be worthy of a patent filing if it was sufficiently novel to warrant such a filing.

Although very much simplified, the structure of a technology company's value chain may be seen in the following figure. Some of the activities represented there may be sourced internally or externally, but the concept is still basically the same. This representation also suggests a temporal view of technology research and development, which can greatly affect your return on investment depending on how these activities are managed. For example, the concept of "product development" is typically viewed as a 1 to 3-year activity – a product manager is unlikely to have any interest in potentially breakthrough technologies having a time to deployment greater than 3 years. Farther up the value chain there may be internal corporate or "industrial research" organizations, that focus on time horizons usually between 3 and 13 years to commercial deployment. We usually call this 3 to 13-year technology research activity "advanced technology", whereas anything with a possible deployment timeframe of greater than 13 years is usually referred to as "emerging technology". While many large multinationals have corporate research organizations responsible for advanced technology, the emerging technologies having a 13+ year deployment likelihood are typically the domain of universities.

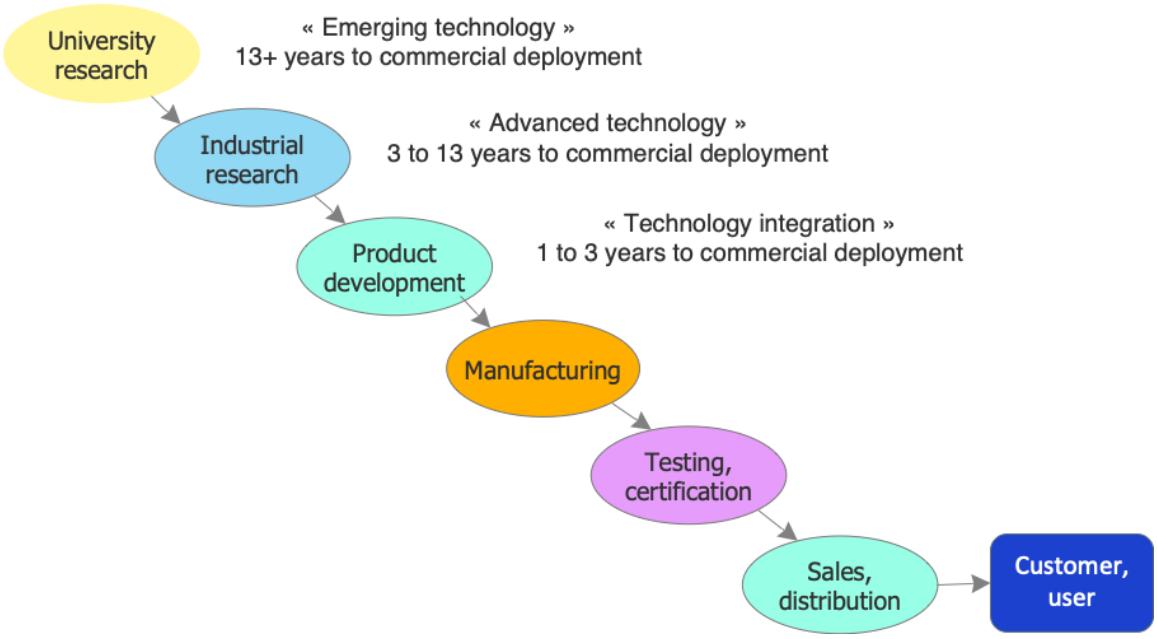

Figure 1: Simplified value chain of an enterprise that manufactures and sells wireless devices

Value creation generally runs downhill, that is the farther down the value chain, the greater the value generated. I once had a very smart cryptographic researcher working in one of my research teams, ask me to explain how business and technology are related

and how the two are somehow joined to create economic value. I demonstrated the downhill concept of value generation as ideas become proof-of-concept demonstrations, then prototype products, then many iterations later they become real products that are hardened, tested, certified and finally sold and deployed into real-world environments. He asked me "So you're saying that Einstein's genius ideas are low value while things you can buy on Amazon are high value?" to which I replied "Not exactly. Einstein created many useful theories that are applicable to many useful products today, the Global Positioning System (GPS), the photoelectric effect for solar power and the like. But at the time of Einstein's work, he discovered and developed the underlying theories, and theories can't put food onto someone's table until they're reduced to practice by building a real product." As you traverse the value chain of any company, you'll see value accumulating the closer the technology gets to the user or consumer of the product. All along the way there are needs and opportunities to innovate and invent.

Disruptive technology

Innovation also results in what we might call "disruptive technology", which is a term that has been floating around the technology management community for some time. Some years ago, my colleagues and I at Wharton School of Business considered this term and attempted to clearly define it. We finally came up with the following fairly reasonable definition: **a disruptive technology is one that creates a new market segment, but usually in the wreckage of an existing one**.

For example, Uber created a new market segment of consumers who want to order their transportation from their portable devices, and transportation suppliers who want to work part-time as drivers instead of those who work for traditional taxi companies. Uber's business design enabled a platform for ordering auto transportation from wireless devices by users and gave drivers the flexibility of working various hours depending on their individual availability, but it very soon destroyed parts of the incumbent taxi industry in the process.

Another example includes the demise of the coin telephone market segment, as this was replaced by the wireless smartphone in not very many years. Yet another example is the introduction of e-books that can be read on a personal tablet device, replacing much of the printed book market segment with the ability to store many books on a portable device plus the electronic searching and sorting capabilities that printed books certainly don't support. Disruptive technology was further identified and analyzed by Clay Christensen's work in *The Innovator's Dilemma*, by which the large steel manufacturers were eventually replaced by so-called "mini-mills" that made economical low-grade steel building reinforcements.

It should not be surprising that large firms have difficulty developing disruptive technology when the majority of their sales are based on mature technologies that management really doesn't care to disrupt. This became evident to me when I worked

for Motorola on the creation of the world's first digital cellular system called Global System for Mobile Communication (GSM), for which we did most of the work in Europe. Motorola's product group in the U.S. built a good business manufacturing and selling analogue cellular phones with old-school LED displays, and they really didn't want to hear about this new "European digital stuff". They therefore ignored GSM for a long time and as a result, they didn't have GSM phones on their roadmap until well after their competitors had GSM products already in the market. Even though Motorola was the number one supplier of cellular phones at the time, the fact that they were just not ready to implement GSM gave Nokia, which was just coming out of bankruptcy at the time, a head start to capture the mobile cellular market segment that Motorola had long dominated. On the other hand, Motorola owned most of the patents on the underlying technology and earned significant royalties on GSM standards-essential patents for a long time. This meant that for several years, Motorola earned more on every Nokia phone sold than the margin on their own devices.

I've observed this reluctance to innovate by many large firms who have built great businesses where their underlying technology is ageing, and at some time will become obsolete. If we're open and honest with ourselves, we must admit that all technology is ageing and it's just a matter of time before it becomes obsolete and forgotten. Think Command Program for Microprocessors (CP/M) which was used to control the first 8080-based computers in the 1970s, or IBM's Disk Operating System (DOS) for the first IBM PC, computer punch cards and paper tape drives, most vacuum tubes used in radio and television equipment. Even much of the entire on-air broadcast industry itself has been largely replaced by Internet-based content providers and social media.

One way for large successful companies to address this issue is to build a strong divisional structure, where the small innovative divisions are protected from interference from the successful large product development divisions. Another way to circumvent the issue is by careful acquisition of firms on the forefront of a "next-wave" technology that can be integrated into existing product roadmaps or even used to create completely new product lines themselves. This "growth via acquisition" method can be extremely effective, provided that the potential acquiring firms create a serious effort to collaborate with the venture capital and private equity communities. It requires some time to develop a network of people in the venture community, but if you want to grow via acquisition, these people will be your some of your best allies in sourcing reliable deals that fit your future roadmap objectives.

The key to disruptive technology is innovation, and the key to innovation is creativity and invention, both of which require the development of a corporate environment that not only supports creativity and invention but sufficiently rewards these activities to motivate their engineers and researchers to take action. Companies whose engineers are not prioritizing the filing of patents are clearly not being rewarded for these activities.

If you look at the reward structure for innovation and patenting in some companies, it should not be surprising that firms who don't reward invention reach a point where their once-innovative cool new products have aged out, with no real innovation on the future product roadmaps to fuel the next wave of cool new products. In such cases, they often try small tweaks to super-mature, ageing product lines to "cash-cow" their company until it eventually is disposed of by either winding it down in bankruptcy or selling it off to another company that might have better means of extracting its value.

Rewarding innovation: "gold badge culture"

A look at the highly innovative technology firms of the past and present shows that these firms have created and maintained a culture of creative problem-solving, innovation, invention, and patent filing. Companies like General Electric, IBM, Motorola, Google, Amazon and other large multinationals didn't wait until they became large and hugely successful. They became large and successful because started early to make innovation a part of the researcher's and engineer's job, and they rewarded those who invent the creative solutions that enable them to operate effectively in extremely difficult competitive market segments.

Motorola dominated many of the wireless two-way communication market segments for several decades since it was founded in 1928. Their leadership knew the importance of having new technologies in the pipeline, so that they would have the ability to create fresh new products as time went on. To ensure that they had access to the latest wireless and networking technology, they gradually created advanced technology research organizations to extend the work coming out of universities, and to apply this work to commercial problems and potential products. These research groups were encouraged to invent new ways of using the latest university research concepts with the focus being approximately 3 to 13 years to deployment, so beyond the current product cycle of 1 to 3 years. The management also began to build a reward structure that prioritized creativity and invention. Budgets were created for patenting activities and patent committees were set up over time. These patent committees were peer-review mechanisms that relied on domain experts to review invention disclosures and to decide whether to pursue patent filings for each of them.

There were reasonable incentives for Motorola researchers and development engineers to present their inventions to the committees. If a patent committee decides to pursue a patent filing based on a submitted invention disclosure, the inventors are awarded a certain monetary bonus. Each patent application filed requires prosecution in the various patent offices – prosecution refers to the legal steps of turning the patent application into an issued patent that the owner can use to protect their invention. For this reason, inventors were paid an additional bonus when a patent was issued, as an incentive to help the in-house patent lawyers with their prosecution efforts. This involves assisting the lawyers with their arguments regarding novelty, claims construction and other aspects of working with the various patent offices around the

world to hopefully issue a patent. As there was a fixed budget at any given time for patent filing and prosecution, it became difficult to pursue most of the disclosures submitted to the patent committees, and by the 1980s the Motorola patent committees would only pursue a very small fraction of the invention disclosures that were submitted each month.

Further incentives to Motorola inventors were the "Distinguished Innovator" and "Master Innovator" awards, which were based on the number of patents issued to an inventor and provided a significant monetary bonus along with a gold badge or platinum badge to signify the prolific inventor status. This "Gold Badge Culture", as it became known, helped Motorola to maintain an unprecedented lead in the creation of intellectual property for the two-way wireless industry for many years. But the Gold Badge Culture didn't develop at random at Motorola – it was the result of an extremely deliberate and well-thought-out effort on the part of Motorola senior executives over the years, starting with their first CTO, Dan Noble. Similar cultures prioritizing and rewarding invention and creativity were also built by other technology firms over the years like IBM, Hewlett Packard, Google, Amazon *et al*. These companies didn't wait until they were large multinationals to create the cultures of innovation, but rather the other way around – they became large multinationals because such an innovative culture was developed early in the firms' life cycles.

Section 2 – Practical guidance

What is intellectual property and how is it protected?

Intellectual property is a legal concept describing creations of the mind: discoveries, inventions, literary and artistic works, symbols, names, images, and designs. Patents are one of the basic mechanisms of intellectual property protection, along with a) trade secrets, b) copyrights, c) trademarks and d) geographical indications. For those in the industry of creating new technologies and/or the use of cutting-edge technologies, patents are the preferred method of intellectual property protection.

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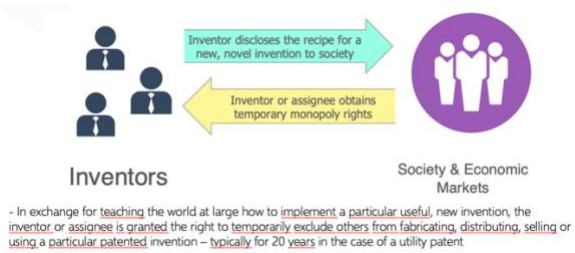


The concept of intellectual property has existed for well over 2,000 years and was described by the ancient Greeks in writings dating to 500 years BCE. The original idea of intellectual property protection was to balance the interests of society as a whole with an inventor, or owner, of certain technology, providing the inventor or owner of the

intellectual property with a means of producing economic rents based on limited monopoly rights for a specific period of time. In the case of the ancient Greek intellectual property agreements, the holder of a certificate of intellectual property rights had the right to exclude others from making and distributing a specific item, including certain recipes for food, for a period of one year.

Modern intellectual property law as we know it today is descended from the concept of patenting in the year 1450 in Venice, which gave the owners of a patent a 20-year period of monopoly rights to a certain invention as described in a document comprising a specification (story about how the technology works) and claims (exact description of the apparatus, system and/or methods). This basic form and the 20-year term are still the standard for patents issued today in most countries.

What the business executives of the 1400 – 1500s noticed was that enterprises tended to hide their intellectual property in the form of trade secrets, which is still sometimes necessary today in the age of Artificial Intelligence (AI) and quantum technologies. But it turned out that multiple enterprises were trying to solve the same problems, in a manner not much different than today, and devised similar solutions to these problems. They then attempted to hide the solutions from each other, for the most part unsuccessfully. Reverse engineering was rampant during these times, and many inventors during the Renaissance years only thought they were hiding intellectual property from their competitors by keeping them as trade secrets. Yes, there were many smart people in the world back then, just as there are today.

Patent systems were set up to encourage people to disclose their inventions, rather than to keep them as trade secrets, and to hopefully generate more overall innovation and value for society at large, while providing a means of compensating inventors and/or patent owners for their innovations [1-4].

Patents that protect the inner workings of a technology are sometimes referred to as "utility patents", but there is a class of patents that can protect the form of a creation, which are generally called "design patents". Design patents protect the form, or shape of an invention, such as the physical look of a device or product, for example, the shape of a telephone.

To patent or not?

Patent protection is not appropriate for all types of intellectual property. In some cases, it may be better to keep an invention as a trade secret, or to publish an article or disclosure to keep others from claiming the work as their own invention. Once a patent is filed, the workings of your invention are now in the hands of anyone who accesses a global patent database, such as the European Patent Office database, https://worldwide.espacenet.com/ which is freely accessible by anyone in the world. It

may be more strategic to avoid patenting certain inventions, which may be the case if an invention is not easily detectable and copyable in a product.

A patent provides only one single right to its owner: the right to exclude others from building, using, selling, importing, exporting a patented invention without the owner's permission for a specific period, usually 20 years from its effective filing date, called the "priority date".

The owner of a patent may choose to sell a licence to a patent, or even to grant a licence free of charge for all or a part of its lifetime. Licence terms may be extremely creative and flexible at times. For instance, if a licensee wants to produce a product in a certain geographical market such as Japan, then the owner of the patent may issue a Japanese licence, or a licence covering multiple jurisdictions, provided that the owner indeed owns patents in these jurisdictions and has kept current with their maintenance fees, which are fees owed to the patent office of the administration in which patents were issued.

If a company or individual produces, sells, uses, or otherwise markets someone else's patented invention in a product, that company or individual may be in violation of the patent, and is said to infringe. Patent infringement provides the possibility for the owner of the invention to file a lawsuit against the infringing party to seek compensation or to stop the infringer from using their invention. These infringement suits sometimes backfire on inexperienced patent holders, as litigation can be extremely costly, especially for small and medium-sized enterprises. The savvy executive will always rely on the advice of legal experts if there are any serious concerns.

Emerging trends in IP – AI revolution

The wealth of nations is related to some degree, to the amount of intellectual property they produce. Today, intellectual property has become the new battleground for waging global economic war. Consider the peak of patent filings from Japan in the 1980s and 1990s and how Japan had taken control of much of the automotive, video and camera markets globally during this period, many of which were previously controlled by Europe and the United States [4-8].

The U.S. had steady upward growth in patenting since the 1960s but has now significantly slowed in the innovation space compared to Japan in the 1980s and China since around 2015. This is partially because many of the innovators who used to work for U.S. and European high-tech firms have since been lured to Japanese, Chinese and Korean firms who offer substantial rewards for innovation and patenting. At the same time, the recent large uptick in Chinese patenting has raised some concerns about the quality of some of the new patents, although infringement suits based on low-quality patents can be just as expensive as for their high-quality counterparts [9].

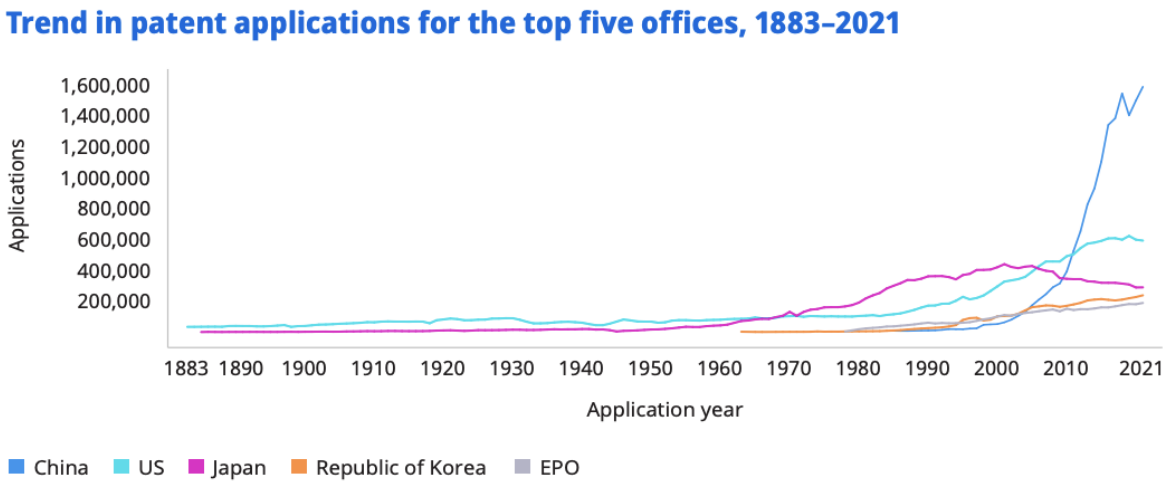
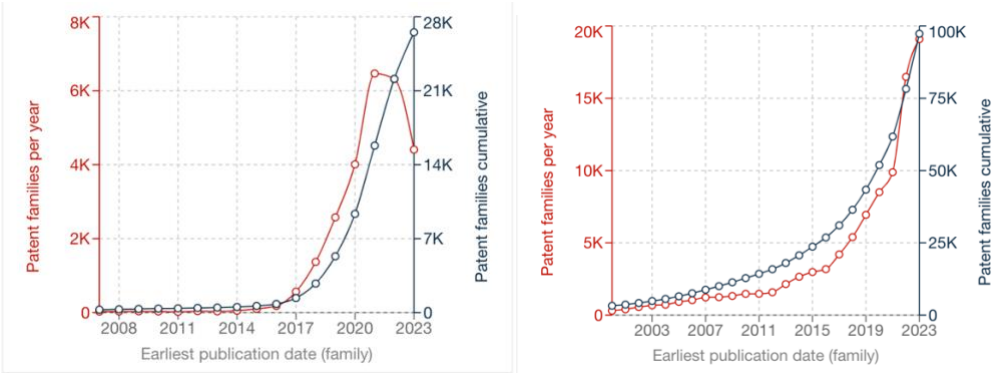


Figure 2 : Patenting trends 1883 – 2021 (Source: WIPO [4])

The following figure shows that there were not very many global patent filings referring to Artificial Intelligence (AI) before about 2017, and then AI became one of the principal drivers of patent protection as these new ideas were turned into viable commercial systems and products. The primary contributors to AI patent filings since 2017 were China, Korea and the U.S. in that order. The number of annual global patent filings appears to have reached a peak in 2021, so it may be that most of the important recent breakthroughs in AI have already been protected by patents, although more than half of the world's total patent filings that refer to AI were filed since 2021 [7].

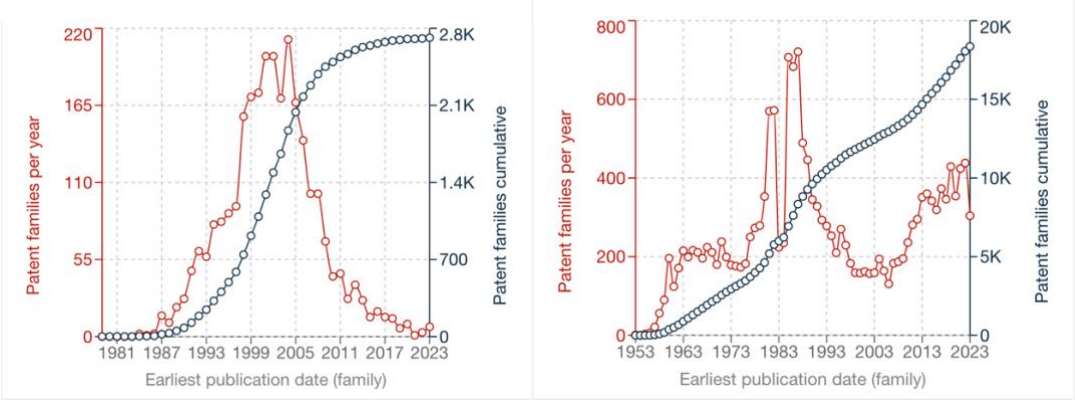


AI (left) and Quantum Computing (right) have become drivers for today's patenting activities (source: Espacenet [7])

Another major driver for patent protection recently has been quantum computing, with most activity beginning around 2003 with an upward influx of filings beginning around 2015. The primary contributors were China, the U.S. and EU.

In contrast, cellular wireless communication has become extremely mature, showing a peak in patent filings for cellular technology in the early 2000s, when activity in 3rd and 4th Generation wireless standards was extremely high. Although there have been many

important innovations in the evolution of wireless for 5th and 6th Generation technologies, the main breakthroughs appear to have occurred right around the years 2002 - 04.



Global patent filings on cellular technology (left), peaking around 2002-03 and evidence of a resurgence of interest in nuclear reactors fueled by renewed interest in fusion reactors (source: Espacenet [7])

As technologies come and go with respect to their market usefulness and maturity, we can identify whether a technology has been in the market for several years (mature), advanced technology (3 to 13 years to deployment) or emerging technology (13+ years to deployment) by examining the global patent filing trends. In the case of nuclear reactors, it is interesting to consider the impact of new developments in the area of nuclear fusion to fuel an uptick in patent filings in this area.

The use of AI in patenting

Artificial Intelligence (AI) is now at the forefront of modern technological innovation and is now the basis for many new products and services. As AI technologies evolve, they not only transform how many of us interact with the world but are also beginning to challenge our legal frameworks, especially in the area of intellectual property protection. Patents are not a perfect system, but they do play a critical role in protecting intellectual property, granting inventors temporary exclusive rights to their creations. Nevertheless, the unique nature of AI technologies raises complex questions about their use in the patenting process and the future of IP law. There has already been much concern regarding the impact of AI and its potential use for patenting new technologies, highlighting the challenges and opportunities it presents to inventors, legal professionals, and policymakers.

Traditional patent systems were designed to protect innovations developed by humans, but AI challenges these frameworks in several ways. First, some AI tools can autonomously generate what appear to be inventions, blurring the lines of traditional inventorship and ownership concepts. Furthermore, the complexity and unpredictability

of AI algorithms complicate the assessment of novelty and non-obviousness – two critical criteria for patentability. In other words, we might ask whether a generative AI tool can really be considered an "inventor" in light of the fact that the AI is actually extremely adept at shuffling information around in certain manners that may result in the proposal for an actual invention.

As AI continues to evolve, it increasingly becomes capable of tasks that were once thought to require human intellect. Whether AI-driven inventions will play a significant role in the creation of useful products and services remains a question at this point in time. On the other hand, AI-based tools have the potential to greatly assist the inventor, patent agent and attorney. For example, an AI tool may be effective in helping the patent agent or attorney to write patent specifications and claims, provided that the actual basis of the invention is clearly defined by the human inventor. Another area that an AI tool may be able to assist with is the analysis of patent text and claims. For example, an AI tool with certain domain knowledge may be able to identify if certain patents are essential to certain technology standards, such as ETSI, 3GPP, ITU and others. In addition, the fact that AI tools have the potential to generate vast amounts of what amounts to very human-readable text, there is some concern that AI-generated patent text may create a glut of patent filings that may have little or no use in the practical world, but instead simply create a traffic-jam effect in the world's patent offices.

Also at stake is the accuracy of AI-generated text, as it is well-known that much of the output of some generative AI tools produce completely irrelevant and/or completely incorrect results. This is largely dependent on how the AI algorithms are constructed and also how the parameter sets in input information are pre-processed, sorted and adapted for AI use. In October 2023, the U.S. President issued an executive order that gave direction to the USPTO to further study the impact and ethical considerations of the utilisation of AI in the filing of patent applications [12]. On 6 February 2024, Katherine K. Vidal, Undersecretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office published a memo giving guidance to the General Counsel of the USPTO, the Patent Trial and Appeal Board and the Trademark Trial and Appeal Board [13] stating that based on the USPTO Rules of Professional Conduct [14], all patent applications should protect the integrity of the information they contain, and that generative AI may be used as a tool to produce patent applications, but the resulting information must be reviewed to ensure factual accuracy.

Patentability

What is generally patentable?

The scope of protection and requirements are dependent on national laws. There are nevertheless some general, universal principles:

• Novelty: it must be new in view of the prior art. Every invention has prior art, and it is the inventor's responsibility to identify the prior art if possible, and to describe how the invention goes beyond the existing art. An example might be the first automobile, where the inventor identifies the prior art as a horse cart and describes the difference between a horse-drawn vehicle and a vehicle with a motor or engine.

• Inventiveness: there must be a non-obvious, inventive step with respect to the prior art. The term "obviousness" is a word you will hear often in the field of patenting and IP protection. In the example of an early automobile, there may be descriptions of how the motor or engine is coupled to the wheels, and the described invention needs to be non-obvious at the time of the patent filing.

• Industrial Application: the invention needs to be applicable to a product or process; it cannot be a mere mental act or thought experiment. This means that an idea is not considered an invention until it is reduced to practice. If you have ever worked for a large company and have submitted invention disclosures to a patent committee, you would notice that a large percentage of patent disclosures are not pursued because there was no "reduction to practice" described.

Patent laws usually require sufficient disclosure so that someone skilled in the art such as an average technician can implement the invention, and patent offices usually conduct an examination of each patent application to check whether the conditions for patentability are met. Although sufficient disclosure is required by patent offices, many real-world patents contain a number of causal ambiguities that make implementation of a piece of equipment, system, etc. difficult if not impossible at times. This is due to the fact that what might appear to be a rigorous and non-ambiguous disclosure to one person might be completely incomprehensible to another. This difficulty in implementing an actual system by using the contents of a patent is fairly common.

What is generally not patentable?

Most legal systems and international treaties exclude the following items from patentability:

• Discoveries of materials or substances already existing in nature. It would be unlikely that you would be granted a patent for air, for example. On the other hand, you might be granted a patent for some creative method of blending various gasses together to create a new and improved type of air suitable for some specific deep-water scuba diving expeditions.

• Scientific theories or mathematical methods. Again, while these items are outside of the practical domain, you may be able to use known mathematical methods as the "how" part of the manner of implementing an invention. An example might be the use

of a discrete Fourier transform in the implementation of a music coder/decoder (CODEC).

• Plants and animals other than microorganisms, and essential biological processes for the production of plants and animals.

• Schemes, rules or methods, such as those for doing business, performing purely mental acts or playing games – an exception is the business method patent permitted in the United States, although this has been under question for some time in the U.S.

• Aesthetic creations – paintings, sculptures, etc. with the sole property of being aesthetically interesting but providing no additional utility value.
Practical guidelines for patenting

A good invention doesn't need to be groundbreaking to be patentable, just sufficiently novel compared to prior art. Your engineers and researchers can just do what they're doing already, but just document what they perceive as novel along the way.

Guidelines for patentability

The following guidelines can be a useful checklist of what you and your patent committees consider when evaluating whether to pursue the prosecution of a new patent:

- Novelty: What is the closest prior art? How does the invention extend existing art?
- Reduction to practice: Does the invention teach how an apparatus is constructed, or how to implement a method? If you can describe the idea in detail so someone could build it, it could also be patentable.
- Utility value: Is the invention useful? Does it solve a real problem?
- Business value: Does the invention solve a problem incident to the firm's current or future business, or an adjacent area?
- Detectability: If the invention were implemented in a competitor's product, a network, etc., how easy would it be to detect infringement? Can you readily observe if the invention is being used by simple visual inspection, or do you need specialized analytics and equipment? If it requires an electron microscope, atomic force microscope or similar equipment to detect, this is not necessarily a negative, because at certain scales of manufacturing it may be worth paying for reverse-engineering to determine infringement.
- Claims-breadth: Does the invention refer to a single, narrow idea or can it be broadly applied? If the claims-breadth is extremely broad, you are unlikely to succeed in obtaining a patent, since any super broad claims might cover many pre-existing technologies. If the claims-breadth is extremely narrow, you might obtain a patent, but one that might be useless from a protection perspective if there are many ways

to achieve the same objective. On the other hand, narrow claims are not necessarily a limitation, especially if your particular narrow claims describe the only possible way of implementing the solution using today's technology.

- Possibility of standards contribution: Is it something completely new that could be standardized in an existing standards body? Is the invention a potential fix for a problem in a standardized technology? Patents of this type may be extremely valuable, but the solution needs to be recognized and supported by most industry players involved in the development of the technology or standard.
- Is it something you can see your competitors doing? In the wireless industry, for example, we often encounter the same problems across the entire industry. If an invention solves a problem that your competitors have, then you may do well to pursue the filing, as it may be a general solution to fix a common problem.

Patent prosecution

Patent prosecution is the formal legal procedure of protecting an invention, from the filing of a patent application to its issuance, and then the maintenance required after issuance. The process begins with the drafting of the patent application and continues through the lifetime of the patent itself.

The basic steps in prosecuting a patent are as follows:

- **Drafting the specification part:** This is the story and background of the invention in its field of science and engineering. It introduces the problem that the invention solves and explains how the invention solves this problem. It also shows how the invention goes beyond the state of the art presently in use for solving such problems. The objective of the specification is to provide context for the story of why the invention exists and identifies its novel elements.
- **Drafting of claims:** The claims are the heart of the invention, the exact method, apparatus and/or system that the invention comprises. There are certain legal terms that are used by patent attorneys and agents that have very specific meanings when used to construct claims. While the specification tells a story, the claims are much more prescriptive like a recipe. For example, the specification may describe a method for sending information over a wireless interface, along with the possible universes of techniques that might be used. The claims, on the other hand, might describe the exact steps by which a device receives information from a computer, sending the information through various processing stages and finally through a radio frequency modulation scheme that converts the information to a wireless signal that would be meaningful to a receiver somewhere.
- **Production of drawings:** Patent offices around the world require a certain style of drawing to describe the components of the invention and their relationship to one another. Patent attorneys and agents generally commission this work.
- **Filing of the patent application:** The agent or attorney files the completed patent application in the form required by each jurisdiction to the patent offices in which the applicant is applying for a patent. Each jurisdiction may require slightly different formats or

information disclosure, but since the founding of WIPO in 1967, most major countries have mostly harmonized on what is required in a patent application.

- **Responding to patent office actions:** An office action is a response to a patent filing by a patent office in a certain jurisdiction. This usually takes the form of a letter to the inventor that gives the patent examiner's opinion of the application. This opinion may indicate that the application was completely accepted with all claims. It may also indicate that the application was completely rejected, with an accompanying set of reasons as to why it was rejected. It may also indicate that some of the claims were accepted, but others were rejected with various reasons for rejection. It may further indicate that there was a problem with the wording of certain parts of the application and that the patent office requires modification to conform to its regulations. Typically, the patent agent or attorney responds to the office action with the supervision of the inventor(s). This may include a response to rejected claims that demonstrates that the examiner was indeed incorrect to reject them, with supporting evidence to show why the inventor is entitled to such claims. Responding to office actions may become an iterative process in some cases, requiring several responses before a patent is either granted or not.
- **Amending claims:** During the period when the inventor responds to office actions, the inventor has the right in most jurisdictions to amend the claims. This may be in response to a patent examiner's request or otherwise.
- **Filing continuations:** The continuation-in-part (CIP) is a useful tool for inventors who would like more coverage from a certain patent family. The CIP, if issued becomes another patent in the same family but has the same priority date, expiry date and specification. The only difference between a CIP and an original filing is the claims. In no way can the inventor introduce "new matter" or otherwise change the patent specification.
- **Paying of issuance fees:** Once the patent office in a particular jurisdiction has accepted a set of claims that the inventor finds acceptable, the patent office will issue a notice of issuance and an amount of payment that is due to place the patent in force. After the fee is paid, the owner of the patent has the right to enforce it.
- **Paying of maintenance fees:** Each jurisdiction has its own schedule of maintenance fees and time periods at which to pay them. This can be confusing and must be tracked and budgeted for by the patent owner. Failure to pay a maintenance fee may result in the patent becoming inadvertently abandoned and therefore non-enforceable. In some cases, if this happens, the patent owner can hire an attorney to contact the particular patent office and find out if a procedure exists for re-activating the patent, which usually involves paying back fees and reinstatement fees, which may be sizeable.

Jurisdictions, timelines, and strategy considerations

Patents are issued by patent offices in their respective countries and grant exclusionary rights only within the geographic jurisdiction of the country's patent office and are generally effective for 20 years from the effective filing date (the priority date).

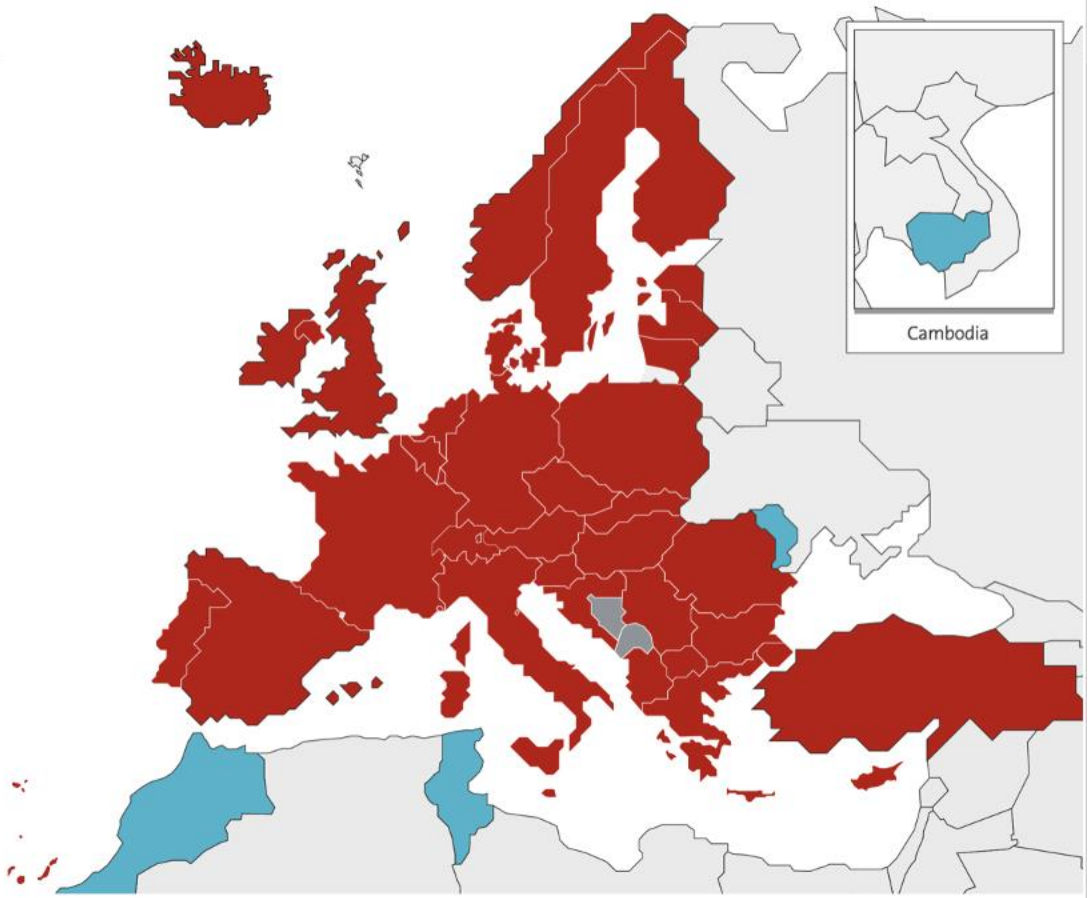
- The US Patent and Trademark Office (USPTO), in recent history, tends to grant patents that meet qualifications in about 4 years, but there exists now a U.S. Patent and Trademark Office (USPTO) fast-track that can be applied for. A fast-track application costs slightly more than a conventional one, but the applicant is

guaranteed to receive some indication of the patent office's opinion within 12 months of filing.

- U.S. Provisional filing – not a patent, but a placeholder for your priority date. This is an inexpensive public disclosure that some countries allow and is fairly common in the U.S. The provisional filing may take the form of a memorandum or patent specification with or without claims. The applicant in the U.S. has 12 months to promote this provisional to a full utility patent filing. While the provisional filing has some optionality advantages, it also has drawbacks. When the patent attorney or agent contacts the inventor after the initial filing, it is often the case that the inventor has moved on to other difficult problems and has some difficulty remembering the subtleties of the invention. Combining this fact with the need to rewrite the specification and/or claims in most cases can make the provisional filing an expensive alternative to a utility filing drafted and filed completely the first time. A very good use of a provisional filing is for cases where a product presentation is to be made public where the invention is evident. The provisional provides protection of the priority date for these cases.

- The European Patent Office (EPO) has the authority to grant patents within the countries comprising the European Union patent treaty. Once a European Patent is granted, it needs to be "activated" to give the holder patent rights. Activation of a European Patent is done on a country-by-country basis and must be done for each country in which patent protection is desired by requesting activation and paying an activation fee. The European Patent Office (EPO) historically has issued qualified patents in 4 to 8 years, but there have been cases that have been completed much faster.

- The new European Unitary Patent has gone into effect as of 1st June 2013. The Unitary patent is similar to a U.S. patent, in that there's no need to activate the patent in the various countries of the EU to obtain protection. Once issued, the holder of a unitary patent can enforce the patent throughout the 27 European states plus other members of the treaty = 38 countries in total. Litigation can be heard by a single, unified patent court. One needs to request unitary treatment when filing in the EU. There are some limitations of the Unitary Patent in Europe, one of which is that if your patent is ever invalidated in the EU, then it is no longer valid in all the jurisdictions that have signed the European patent treaty. Another issue may be enforcement – we don't know as a global community the tendencies of European patent courts and how they will treat litigation involving the Unitary Patent. Because the value of a patent is based on its enforceability, it is something to watch and a potentially useful tool for the innovator if used wisely [12].



The 38 member states of the EPO, also including the two extension states and four validation states.

The World Intellectual Property Organization (WIPO) provides the ability to file global patent disclosure documents. There is no such thing as a global patent, but the WIPO filing provides a global search report, formal disclosure, and the ability to file a utility patent in any of the 193 member states of the U.N. An applicant usually has 30 months after filing to either promote the filing to a utility filing or abandon it. This period is called the "national phase entry" and ranges from 20 to 30 months depending on the country. Canada, for example, has a 30-month national phase entry, so sometime after filing at WIPO and 30 months from then, the applicant can use the WIPO filing and search report as a Canadian patent application, which is subsequently prosecuted individually. This enables the WIPO filing to be used as a relatively inexpensive option that functions like a call option on an underlying asset. The WIPO filing gives the applicant 30 months in most cases to determine whether to continue the prosecution process in any of the U.N. Patent Coordination Treaty (PCT) countries. When the filing is within the national phase window of the target country, the applicant has the choice – either file a utility patent application in that jurisdiction or just simply abandon the filing.

You may make the strategic decision to abandon a patent filing, because over time your invention may have become less relevant to your core technology and/or product – and in some cases, you may have a much better invention to replace the one originally filed. You may also want to abandon a filing due to budget priorities. For example, the patenting budget supports a certain number of filings, and your research group has produced a series of important breakthroughs in a new technological area that is extremely important to the firm's future product direction. In this case, you may want to de-prioritize the promotion of certain PCT filings to utility patent applications in the various countries and rather use your budget for filing on your firm's new breakthrough technologies. In this case, strategic abandonment of your original filings can be a useful direction, since two things occur once a patent filing is abandoned: first, there are no more legal or patent office fees and second, the record of the filing including full text and any claims that were drafted stay in WIPO's database and become prior art for anyone else wanting to file on the same area. This is important because you may want to still use the invention in the abandoned filing, but you've prioritized budget for the newer and more important work. In such a case, a competitor might copy your invention for use in their own product, and then claim that your firm owes them royalties, because you would technically not have an issued patent on the invention. But because the abandoned patent filing remains in the global database at EspaceNet with all relevant dates, your abandoned filing becomes prior art, and no one else can claim that they are the inventor of your abandoned intellectual property. Along with issued patents, these abandoned filings also appear in the global patent database: https://worldwide.espacenet.com/

About priority dates

Because the priority date is defined as the effective filing date, most patent filings show the same date for filing as for priority. But there are some exceptions, for example, when an inventor uses a U.S. provisional filing to lock in their priority date for a patent that will be filed and prosecuted later. This may be the case where an inventor is scheduled to attend a meeting or conference to present their team's work, including an invention that they intend to patent. But in some cases, there would not be sufficient time for the patent attorneys or agents to draft a reasonable specification and set of claims in addition to the required drawings. In a case like this, the specification may be abbreviated and the provisional may be filed with or without claims. Then at a later date before the 12-month deadline, the actual utility patent application is drafted and filed. The resulting patent application will appear in the global patent database as having an earlier priority date than the actual filing date. And it's this priority date that sets the expiry date, which would be 20 years from the filing of the provisional and not from the filing date of the actual patent application.

Cost of patenting

Patenting can be extremely expensive, especially when considering the cost to create and maintain a portfolio over the 20-year lifetime of each patent. In terms of 2024 prices, the drafting of a patent, whether done by an attorney or patent agent can range from around $7,000 USD to more than $40,000 USD, depending on the complexity of the filing and the pricing policies of the firm doing the drafting.

Different jurisdictions also charge different rates for filing fees, search fees, examination fees and issue fees. Many corporations around the world rely on filing first in the U.S., as the patenting system there has been considered for years to be the gold standard for examination and enforcement. For example, in the U.S., a large corporation might pay $320 for a basic patent filing followed by a $700 patent search fee. Then, each time the patent office contacts the inventor, agent or attorney regarding an office action, the fee is $800, but can range up to $2,320 in the U.S. in the case of a re-issue examination, where a patent was abandoned and later re-activation was desired. Once the examiner is satisfied that the patent application merits the issue of an actual patent, an issue fee of $1,200 is required to place the patent in force.

Now that the patent has been issued, there remain the maintenance fees, which in the U.S. are levied at 3.5, 7.5 and 11.5 years after the issue date in the amounts of $2,000 USD, $3,760 USD and $7,700 USD respectively for a total of $13,460 USD.

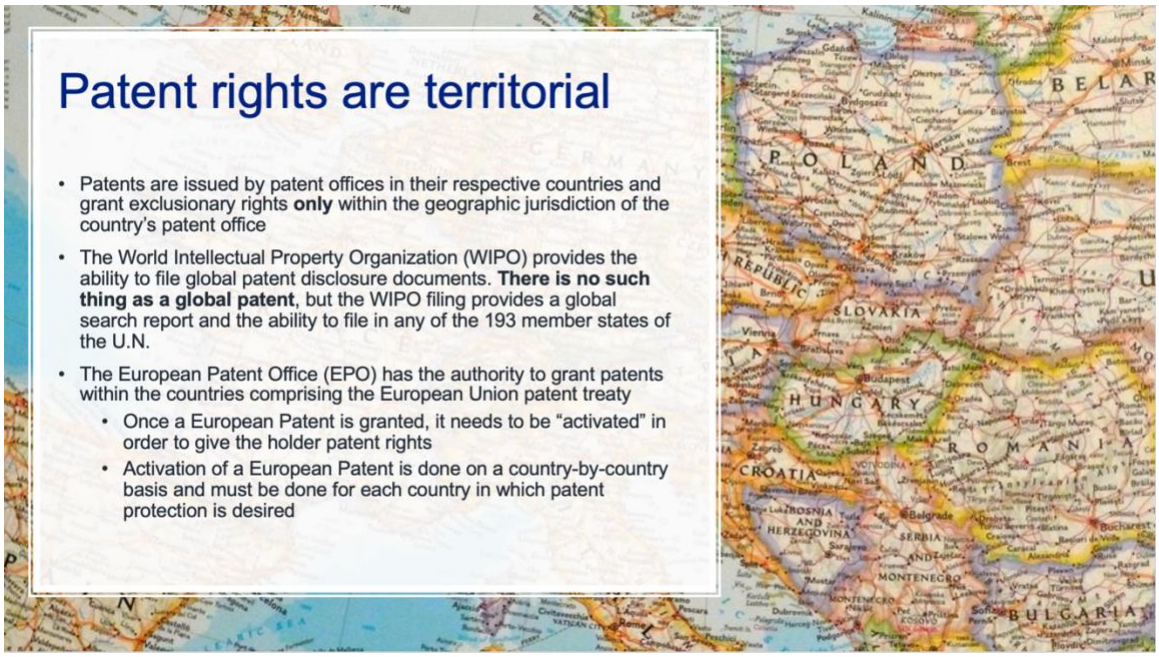
If we therefore take a single patent example for a large corporation to file, prosecute and maintain a patent in the U.S., a budget of around $50,000 or more may be required over the 20-year lifetime of the patent. The filing, examination, search, issue and maintenance fees are substantially lower for small and medium-sized businesses, but the drafting of the specification and claims require the same amount of legal work and are often about the same for small and large companies.

If this same exact patent were prosecuted and activated in all 27 member states of the European Union, the fees in each one of the member states would push the 20-year cost of patent ownership to around $1,000,000 over the 20-year patent lifetime – almost 50 times the ownership cost of a patent in the U.S. Even for large multinational companies, this cost of ownership is prohibitive, and also unnecessary because not all of the member countries would be relevant in terms of protection or enforcement.

Where to file – cost effective strategy

Many opinions exist on this topic of where to file, but the answer to this question is highly specific to the industry and objectives of the organisation. It is important to consider where the firm does business, as well as the available resources, enforceability, availability of patent courts and budgets. A common large enterprise strategy is to use the “fortress” approach by building a moat around key technology areas in the primary countries of usage. This approach may sound generally applicable, but the applicant may be shocked when they receive the bills for maintenance fees, which can be

extremely high. For some large multinationals, this fortress approach may be perceived as the only reasonable way to protect their intellectual property. Others target jurisdictions that support excellent enforceability in their areas of technology commercialisation. There are many ways to strategically analyse the use of patents, and the approach taken by one company is almost certainly not applicable to other companies.



Certain large companies, especially in telecom, may do much business in Japan, the U.S., France, U.K. and Germany. The court systems are excellent in these jurisdictions, and telecom innovators typically find it useful to protect their inventions there. If a major firm is infringing on another such firm, the possibility of injunctive relief in any of these countries may put sufficient pressure on the infringing firm to settle the infringement suit. This is because if the infringing firm sells many units in these target countries, a potential injunction could cause major economic distress to their company. Of course, each industry has their own geographic profile that must be considered, which includes the ability to enforce patents in the jurisdiction.

The technology executive should determine the total lifetime cost of filing, issuing and maintaining patents, and then analyse the potential benefits as compared to the costs. These data can be acquired by studying the information on the various patent office websites, or more realistically by engaging a competent patent agent or attorney to what the cost of drafting the application would be, the current filing fees, the fees to answer "office actions" where the patent offices ask for more information and provide an opportunity to amend claims or file for continuations, issuance fees and the amount and schedule of maintenance fees. This information is highly variable in the real world, but knowing the ranges of costs can give some sense to the budgeting work.

A common strategy that has proven to be useful for some start-up companies is to set aside a budget for one patent each year for the first few years. Then to file first in the U.S., which has historically been a gold standard for patent scrutiny and enforcement. Often, small companies file simultaneously a WIPO filing along with their U.S. filing, or just a WIPO filing. Then, roughly 24 months later, before the WIPO filing goes to the national phase, the filings are re-evaluated in terms of their relevance to the core business of the firm. If the filings are still relevant to their products on the market before the 30-month limit, the firm may choose to add one or two key countries in which they do business. The firm may also take the strategic abandonment approach, and abandon further prosecution, preserving budget for newer and more important filings based on their current technical direction. The firm must consider the consequences of both prosecuting or abandoning the filings and weigh the potential benefits and risks.

Maintaining and tracking your intellectual property

Most large technology-focused firms have what is sometimes called a Technology Asset Management (TAM) organization. This organization usually organizes and manages patent committees, tracks the prosecution of patents, and tracks and pays maintenance fees to ensure that all relevant patents are indeed in force. If the owner of an issued patent forgets to pay the maintenance fee, then the patent is no longer in force. In some jurisdictions, it is possible to reinstate the patent by paying additional fees to reactivate the enforceability of the patent.

While a small or medium enterprise is unlikely to budget for a Technology Asset Management group, this function can easily become a part of the accounting and bookkeeping responsibilities. Another reason that this is important for smaller companies is because a potential acquirer will find it easier to perform diligence on a well-organized set of files that include all documents to and from the patent attorneys and patent offices, all dates and amounts of maintenance fees for each jurisdiction and any other relevant information including patent disclosures and simulation results if applicable. When I've done diligence for large enterprises or family offices who consider acquisitions of smaller companies, I've noticed that having this information in a disk directory structure that contains all information regarding pending and issued patents is a tremendous positive for the potential acquirer.

Patent portfolios

A portfolio is simply a group of both issued and pending patent filings. As a technology firm grows, the Technology Asset Management organization will usually separate the entire portfolio into individual sub-portfolios, usually by technology area. For example, a maker of network equipment might have a sub-portfolio for power amplifiers,

modulation schemes, channel coding techniques, voice coding techniques, video coding techniques, data compression, base station antennas, mobile device antennas and so on. While there are many opinions on how many patents each technology area should comprise, I've come to observe that each area could eventually hold between 5 and 30 patents and/or applications.

The logic behind this is that if a large competitor wants to infringe on a single patent, it may mount an invalidation campaign against the validity of the patent in question. In some jurisdictions, like the United States, there is a clear procedure for potentially invalidating patents, if the opposing counsel can show that the patent was issued because of incorrect assumptions, insufficient information, or just plain lack of reasonable analysis on the part of the jurisdiction's patent examiner. While it may be possible to invalidate one to three patents, it tends to be much more difficult to invalidate 5 or more patents in a certain technology area. A minimum of 4 or 5 filings in each area is a reasonable objective.

A large company may have more than 5 or 10 patent filings in a given technical area but having more than 30 in that area with similar priority dates is unlikely to provide much additional protection. For example, going from 30 to 100 similar multi-band antenna patents with similar priority dates is only likely to increase the cost of filing and maintaining the patents with little additional protection.

As a company grows and matures, it must file more patents in its core technology areas just to ensure protection is relatively continuous. Over time, technology advances in each given sub-portfolio area as well, and the larger firm generally expands its portfolio into the newer areas of technological advancement. By the time a company becomes a multinational tech-focused firm, it could easily have many hundreds of patents in each sub-portfolio, some of which may be expired and/or strategically abandoned if they are no longer of use to the company.

About patent licensing

If a firm wants to make a product based on someone else's patented technology, that firm should technically offer to buy a license from the patent's owner. In reality, this is not generally how it works. First, the infringing company may not even realize that they're infringing. Second, even if they do know that they're infringing, they're not likely to identify the patent owners and offer to buy a license.

It's usually the case where the owner of the intellectual property contacts the infringing party and informs them that they're infringing and what they intend to do about it. For example, they can take the infringing party to court and ask for injunctive relief to stop the infringer from making and selling the product using their inventions. They can also ask for licensing fees and allow the infringing party to continue to do business if the license fees are paid.

What typically happens is that the owner of the patents, will file an infringement suit in the proper court, but only if the patent owner is sufficiently funded and has determined that it is worth the cost of a lawsuit, including any negative publicity and/or market uncertainty arising from the news of litigation. The infringing party may or may not settle in advance of the trial date, and the court may find that the infringing party is not actually infringing at all. The other thing that can happen if the patent owner is not sufficiently funded to participate in extensive litigation, is that an infringing party having sufficient resources may run the patent owner out of enough money that it becomes not worth the additional expenditure to keep coming back to court.

Through my involvement in the venture capital community, I've noticed many myths surrounding the concept of patent licensing today, especially around technology startups. Many small company founders would like to believe that they could create a "licensing model" for future revenue – just create a company that makes intellectual property and then license it to companies who want to use it. While this sounds great in theory, I've only known a very few companies who could do this, and none of them were small startups with limited budgets, but rather large research and development firms or R&D spin-offs from large technology companies with massive portfolios having excellent coverage in certain industry segments. The reality is that most patent portfolios, even ones with certain breakthrough technologies, are not worth very much unless the patent owner has products already in the market that use the patented technologies.

Even within the domain of large multinational technology firms, companies who want to make and sell similar products based on the same underlying technology generally won't even consider buying a license from the patent owner until products using the technology have been in the market at a reasonably large scale and for usually 4 or 5 years. By that time, the second-tier manufacturers might buy a license from the patent owner if they can create a business with sufficient margin when all costs are included. Otherwise, they may simply infringe and see if the patent owner tries to do something about it.

If you have evidence to suggest that your patent portfolio is being infringed, I urge you to contact one of the many law firms that specialize in patent litigation and learn about the consequences of each possible way forward to allow you to make a reasonable decision as to what path to pursue. There also exist firms that specialize in patent licensing that may be of help as well. Patent licensing and litigation are not simple or inexpensive activities, and it is usually well worth the effort and investment to discuss with relevant experts before launching into such activities.

Public disclosure

In most countries, once an inventor has publicly disclosed an unpatented invention, the inventor is no longer entitled to a patent, and the filing becomes prior art for inventions

in the same field. An exception to this is the United States. In the U.S., an applicant has 12 months in which to file for a patent after any public disclosure of the invention, but the inventor would still not be entitled to a patent in most other countries. Therefore, if an inventor discloses something in public or shows a non-patented technology to a potential customer without a non-disclosure agreement (NDA) the only protection that could be obtained is likely for the U.S. only. A reasonable policy for disclosing your invention to the public is to file for a patent first, then publish your technical paper, book chapter, conference presentation or product demonstration.

Patent offices also publicly disclose patent applications, whether a patent is granted or not, and these applications may be used as a source of prior art analysis and business intelligence gathering.

About Standards Essential Patents

The term Standards-Essential Patent (SEP) refers to patented inventions that may appear essential to the implementation of a standardized technology. There are many standards bodies around the world, each having a different policy and culture for the inclusion of patented technology in their standards. The members of some standards bodies welcome members to incorporate their intellectual property in their standards, if the owner of the IP identifies and declares it to the standards organization and membership. This is the case for the ITU, ETSI, 3GPP and many other standards organizations. There are other standards organizations whose members are openly hostile to the idea of incorporating intellectual property into standards. So if you're thinking about standardizing a technology or part of a product that is, or will be patented, you may want to compare the IP policies and member cultures regarding standards-essential patents.

A large database of SEPs is located at the European Telecommunication Standards Institute (ETSI), which holds patent declarations for both ETSI and the 3rd Generation Partnership Project (3GPP) standards for wireless communication. The ETSI and 3GPP policies regarding essential patents in their published standards are that a patent owner must notify the Chair of the technical committee working group or Principal Director General (PDG) of standards body with 1) the identity of the patent(s) that may be relevant to a standard and 2) all related standards documents to which the patent may refer. The owner of the patent, who by definition would be a member of ETSI and/or 3GPP, further agrees to license all SEPs for a "Fair, Reasonable and Non-Discriminatory (FRAND)" fee. Of course, the definition of FRAND is somewhat up to interpretation, as it's a bit difficult to define what constitutes "fair" and "reasonable" for all cases. The concept of "non-discriminatory" pricing is also fluid, as there can be cases made for certain price discrimination among licensees.

For example, a manufacturer who sells 1,000 cellular base stations each year is likely going to pay a higher rate per base station than a manufacturer who sells 100,000 such

devices. The fundamental point of this policy, to which each member agrees when they join the standards body as a member, is that gross price discrimination should not be practiced. For example, a $100 per unit royalty to one manufacturer and a $0.25 royalty for the same rights to another manufacturer, as extreme price discrimination may suggest an anti-trust violation in certain jurisdictions.

Generally, FRAND licensing fees are lower than non-SEP licensing fees, but the market segment associated with certain standards may be extremely large in terms of the number of units sold. The International Telecommunications Union (ITU), Institute of Electrical and Electronic Engineers (IEEE) standards association, International Standards Organization (ISO), Internet Engineering Task Force (IETF), Open Mobile Alliance (OMA) and others each have their own policies on the acceptance, or not, of patented intellectual property in their published standards and recommendations.

Another aspect of SEPs is that patent owners can easily identify infringement on the patents they have declared on the standard, which in turn simplifies licensing. If a manufacturer is making systems and/or equipment based on a particular standard, then such manufacturer is necessarily infringing on whatever patents are essential to the implementation and are required to compensate the patent owners.

Claims charting

The concept of claims charting is applied to issued patents that are believed to be essential to a technology standard and show the correspondence between the patent's claims and the text in a standard. In this case, the patent specification, basically the background story of the invention, is not mentioned in the chart. Only the claims are relevant. There are times when the essentiality of certain patents to a technical specification may be called into question, for example during litigation. A patent owner may have declared a set of patents to a standards body, but an infringing party may argue that one or more of the declared patents in fact do not describe some method, system, or apparatus in the specification, and that the party is not infringing at all.

This is where claims charting is utilized by the owners of the patent. There are several ways to make a claims chart, but they all attempt to show that certain claims do in fact indicate that the standard or recommendation is using the patent owner's invention, making them eligible for compensation.

The most ideal person to construct a claims chart is the inventor themself, especially if the inventor has great familiarity with the standard or recommendation in question. It is often the case that the inventor has submitted a written contribution to a standards body for a specification based on the solution found in the patented invention. The inventor may have also drafted the solution into the technical standard and is therefore the ideal person to construct a claims chart.

About patent attorneys and agents

Especially in the domain of small-to-medium enterprises, I've seen many otherwise smart and competent executives place way too much responsibility on law firms and patent agents. We in the industry need their expertise, as a good patent attorney or agent will have a strong command of the legal subtleties of patenting and how to work effectively with patent offices and litigation.

But unless the patent attorney is trained in corporate strategy, and furthermore has an intimate understanding of your company's corporate strategy, you would do well to limit the patent attorney or agent's role to strictly patent drafting and prosecution. I recently advised a firm whose senior execs allowed a large law firm to set their patenting strategy. They filed many patents in way too many jurisdictions, even those in which enforcement was impossible. It turned out that the only benefit we could find was the ability to generate more revenue for the law firm, as their "strategy" created the incentives to deliver more billable hours by filing patents in many more jurisdictions that were actually needed, given the state of the enterprise itself.

You are the senior executive, so you really should set your own strategy, whether it be for patenting or anything else, as you're the one ultimately responsible for its success or failure.

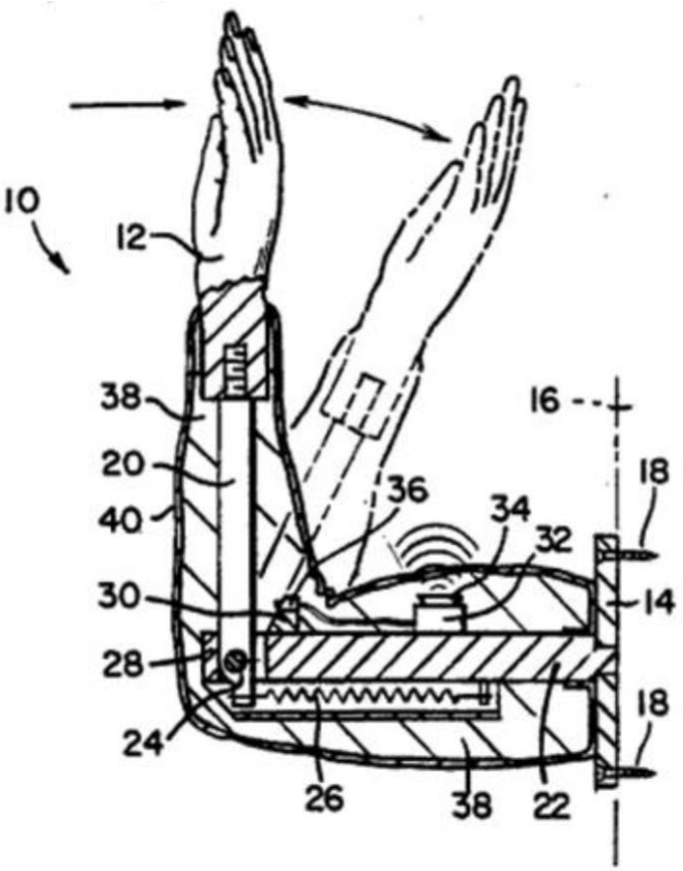
Patent weirdness: pushing the limits

Like many legal and regulatory concepts, there are boundaries, and sometimes grey areas between appropriate and inappropriate activities. While the patent system is in no way totally perfect, it generally functions. But there are cases in which the requirements for novelty, non-obviousness, utility value, etc. have been stretched slightly beyond the limits of the intent of the various patent offices.

Novelty taken to extremes

Generally, an invention is considered novel if it represents a concept that has never been reduced to practice before. This requirement, when pushed to the limit, creates the possibility for many potentially bizarre and questionably useful inventions. While an invention must be useful and exhibit some utility value, the novelty aspect may be considered open to interpretation, as evidenced by the many patents issued for super-strange inventions over the years.

Consider the "High-Five machine", patented in 1993 [15]. According to the patent application, this device was designed to boost your self-esteem by offering a mechanical high-five to celebrate your successes. It also claimed to have the ability to improve your hand-eye coordination and your overall mood.



The "High-Five machine" – received a patent in 1993

The comb-over patent, was another equally strange invention that shows a Method of Concealing Partial Baldness was filed in December 1975 by Frank and Donald Smith from Orlando, Florida. The application describes a "method of styling hair to cover partial baldness using only the hair on the person's head", involving the division of the remaining hair on a person's head and combing it over the bald part of the head. In other words, the now well-known "comb-over". I suspect there may be some prior art somewhere out there on this one.

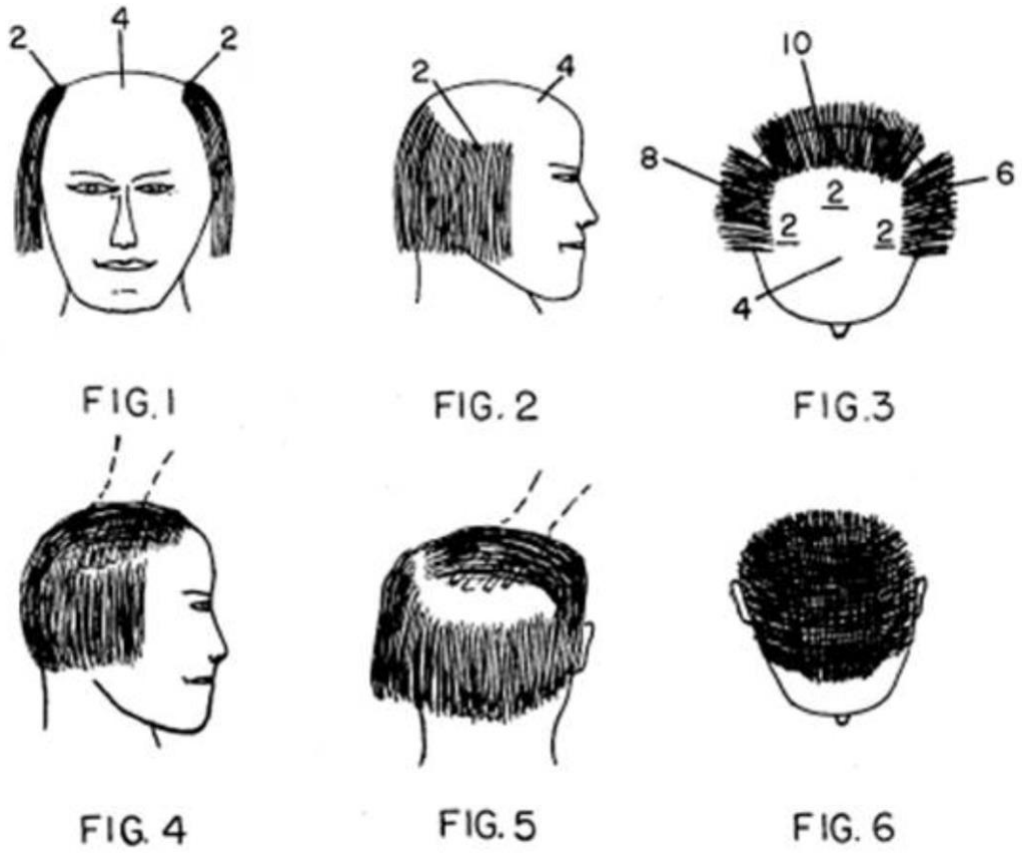


Figure 2: Method for performing a "comb-over", filed in 1975

A motorcycle with triangular wheels might be enough novelty for some patent offices. In the 1990s, I was a delegate to European Telecommunication Standards Institute (ETSI) SMG-2 working group, which was the working group that built specifications for the radio portion of the original GSM cellular network. The chair of the group at the time was Niels Peter Skov Andersen, who was also my co-inventor on several wireless inventions. Niels had this little story that he would tell the delegates who were relentless in their attempts to inject useless inventions into the standards simply because their company owned the intellectual property. The story went like this: "It's highly possible that you could invent a motorcycle that has triangular wheels, and it's likely to be sufficiently novel to pass the required novelty tests for many patent offices around the world. But why would anyone want to drive around on triangular wheels? So when you bring a contribution to this group, please make sure that it's actually useful." This would usually put a stop to the attempt to write useless inventions into the radio specifications – at least for a while.

While in theory, the requirement for usefulness in a patent application exists, there is no shortage of questionable filings. You can find a large collection of weird patents for inventions with questionable usefulness here: https://www.planetpatent.com/bizarre-inventions/ [14].

Prior art can be cited from the strangest sources

Let's turn now to prior art, and its potential impact on the ability to successfully prosecute a patent and/or the validity of an issued patent. When most people think of prior art, they usually think about searching patent databases and the like for similar patented inventions. This is one way to locate prior art, but in reality, prior art can be found in other domains as well.

Consider the case of a Danish inventor, Karl Kroyer, and the so-called "Donald Duck comics case". In 1964, Karl Kroyer invented a method to raise a sunken ship by filling it with "buoyant bodies" fed through a tube. In fact, Kroyer had successfully raised a sunken ship in Kuwait's harbor by filling the ship with 27 million floatable plastic balls.

Kroyer was issued a patent for the invention in the U.K., but the application was rejected in the Netherlands because the method had already been described in the 1949 comic strip "The Sunken Yacht" showing Donald Duck using the same basic principle and method to raise a yacht by shooting ping pong balls through a tube. Because ping pong balls were considered buoyant bodies, and they were fed to the yacht through a tube, the Donald Duck comic was believed to show the same method and apparatus as was disclosed by Kroyer and was therefore considered as novelty-destroying prior art [12].

Another example is the case of *2001: A Space Odyssey.* During one of the patent wars between Apple and Samsung, Samsung asserted that Apple was not the inventor of the tablet computer and submitted to the court a screen shot of the film showing a "thin, rectangular flat tablet computer, dominated by a display screen, similar designs were part of popular culture and commercial practice."

Yet another case shows that the Bible (Matthew 3:12) was used as a source of prior art to show that the separation of grain from chaff was known from time immemorial. This was used to reject the application of EP3886614, which described a method of binding dust to other particles in the process of cigarette manufacturing [13].

While these examples may appear bizarre and represent unlikely references to prior art, the important thing to remember is that prior art can originate from anywhere. This doesn't just include previously filed patents, but information published in scientific and engineering journals such as those originating in technical societies like the Institute for Electrical and Electronic Engineers (IEEE), and also from works of fiction, motion pictures, cartoons and any other publicly available source.

Dr. Salvatore Cezar Pais and the " UFO patents"

Dr. Salvatore Pais is an aerospace engineer for the Naval Air Warfare Center Aircraft Division (NAWCAD). Beginning in 2015, according to the global patent database, EspaceNet, Pais filed a group of 5 patent applications in the U.S. that came to be known as the "UFO patents". Having titles like "Craft using an inertial mass reduction device" and "Plasma Compression Fusion Device", the filings are all assigned to the U.S. Navy. According to military technology observers, the inventions claim to be major breakthroughs while others suspect they may represent mad science. Some of the filings even talk about a potential "space-time modification weapon", which could totally dwarf the impact of nuclear weapons, making them totally obsolete. The "Plasma Compression Fusion Device" filing claims that the invention could produce and maintain fusion reactions that could produce near unlimited amounts of clean energy in a form factor about the size of a sports utility vehicle, which would be a huge breakthrough if it actually worked [15-17].

The work of Pais turns out to be what we would call "advanced inventing", which is to say that the patents were filed before the technology was demonstrated. For me, an obvious red flag in addition to the extraordinary claims was that Pais was the sole inventor on the entire group of patents. When important technological breakthroughs occur, there are normally many inventors who made their contributions to the technology, as well as much peer review. I am named as an inventor on over 100 issued patent families in 27 countries and only a very few with myself as the sole inventor. I'm therefore a bit skeptical of this group of filings, three of which have already been issued as U.S. patents. You can see the filings for yourself here:

US2019295733A1 Plasma Compression Fusion Device
US10144532B2 Craft using an inertial mass reduction device
US10135366B2 Electromagnetic field generator and method to generate an electromagnetic field
US2019348597A1 Piezoelectricity-induced High Temperature Superconductor
US10322827B2 High frequency gravitational wave generator

Important technological breakthroughs or simply pushing the boundaries of the U.S. patenting system? We may know in years to come.

Section 3 – Making the future yours

Incorporating patents into a firm's value chain

As described earlier, the value chain of a technology-heavy firm is a reasonable way to view value creation as it flows downstream to the user, or customer. In many cases, the user and customer are not the same entity, as in the case of certain products like

smartphones, where the network operator is usually the customer who then subsidizes the device to the user as a way to stimulate customer acquisition.

One way to incorporate patenting into the value chain of an enterprise is to add a parallel value chain whose sole focus is the management and monetization of intellectual property. The addition of such a parallel value chain is shown in the following diagram for a typical technology-focused enterprise.

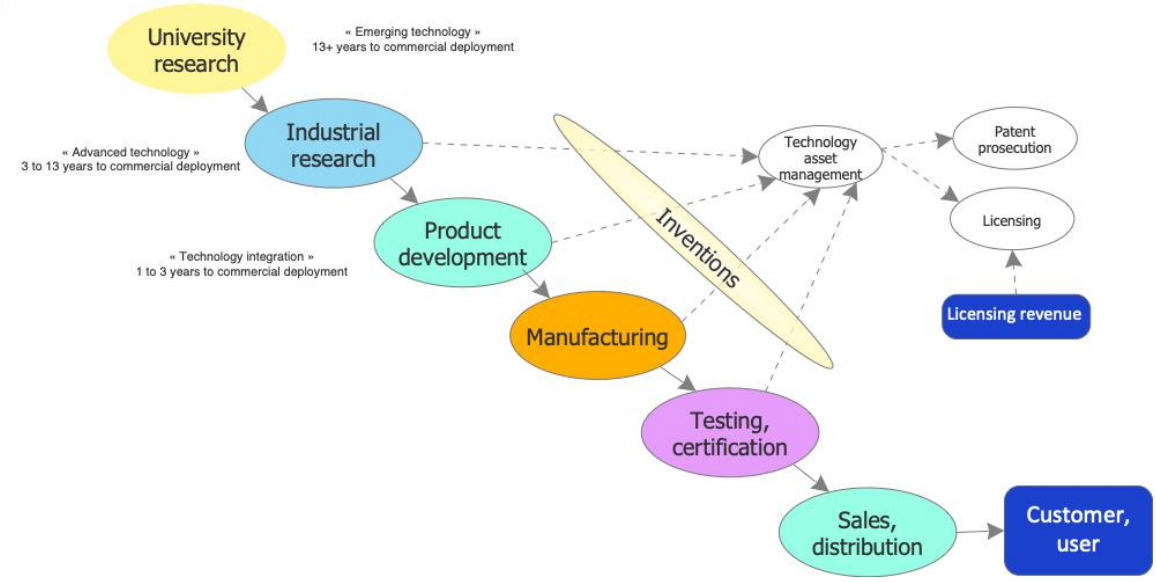


Figure 3: Simplified value chain for technology-focused enterprise, e.g. wireless communication equipment, with the incorporation of parallel value chain for the management of intellectual property

In this example, intellectual property that might be patented may come from anywhere in the R&D value chain. While this concept looks architecturally simple, the implementation of such an idea requires careful planning and budgeting. A first reasonable step in implementing such a system might be the creation of the Technology Asset Management organization. This might start with one person, who would develop a plan for creating patent committees, budgets and interfacing with the heads of the research, product development, manufacturing and testing/certification organizations as well as the patent attorneys and licensing organization.

The TAM organization would also track the status of both patent applications and issued patents, and also take responsibility for making the required maintenance fees at the proper intervals. The plan for the creation and operation of the Technology Asset Management organization would typically be presented to the senior management, who would set budgeting and strategy guidelines based on the current condition of the enterprise and existing growth plans. The TAM organization could also be responsible for the six strategies for IP advantage as outlined in the following, beginning with the concept of patent mining.

Six strategies for IP advantage in the AI era

The recent explosion of global patent filing has caused many executives to reconsider their patent strategy and budget. Patents are used very differently by large multinational companies compared to small and medium-sized firms. Both small and large firms use patents to protect their intellectual property, but their strategy must be consistent with the current stage of corporate maturity. A strategy that might be appropriate for a large auto manufacturer, for example, would typically not be anywhere near appropriate for a start-up company or other small to medium enterprise. As companies grow and mature, patenting strategies tend to change over time as well, and it pays to re-examine a company's patenting strategy periodically.

1. Patent mining

At many large firms, the company's R&D leaders hold "patent mining" sessions with researchers and engineers periodically. Patent mining is a procedure that is frequently performed just before the release of a product, where senior technical people work with product development engineers to understand what novel elements may have been implemented in the new product. These novel elements are identified, and then considered for patenting before the product is launched.

Patenting cultures in an organisation must be grown over time. Engineers and researchers know patenting their inventions makes it much more likely that their work will be used by a broader segment of society. Protecting corporate intellectual property protects the company's revenue stream, corporate valuation and other financial aspects that help protect their employment, compensation, and bonuses. Inventors know that being named as an inventor on patents is traditionally regarded as a prestigious position within the technology community.

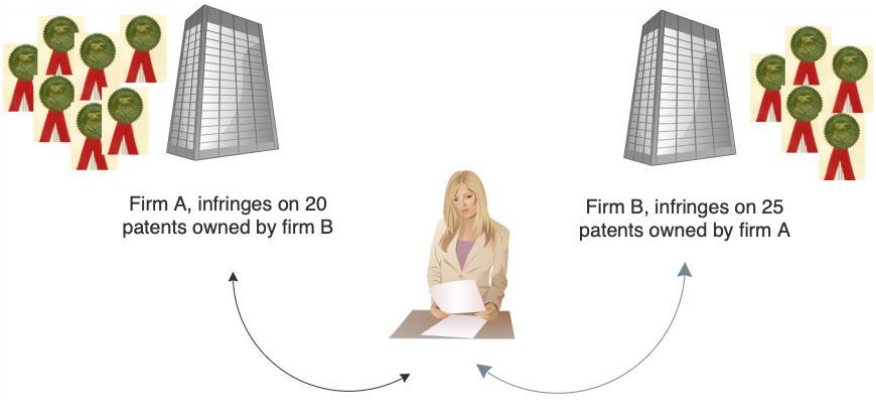
Nevertheless, many engineers and researchers at small firms still think that the extra work required to file patents is just not worth the effort. This is why many successful firms have made the effort to grow their inventing culture and to reward their inventors accordingly while the companies are still relatively small. Rewards for inventors at some firms can be substantial. As previously discussed, Motorola's "gold badge culture" came with significant financial incentives and was also a reminder to others in the company who the major innovators were, and who were the experts most likely to be of help when difficult problems needed solutions.

Because it is almost impossible to change a corporate culture once it has been established, small companies might want to consider ways to encourage and reward invention culture and the filing of quality patents where appropriate. The bonus structure for patent filing and issuance may not be immediately as generous as what a large multinational might offer, but the fact that innovation and patenting is being

rewarded in some manner will reinforce the importance of an inventing culture as the company grows. Remember that the large multinational technology companies of today were once tiny startups that created a culture of innovation and excellence in all aspects of their value chains.

2. Cross-licensing – strategy for large multinationals

For large multinational companies, patents are a currency used for trading intellectual property rights, and cross-licencing is a reasonable strategy. For example, if a large telecommunication equipment maker is found to infringe on certain patents held by another large manufacturer, the companies technically have the right to go to a patent court and attempt to obtain injunctive relief, preventing the infringing company from making and selling their products in certain jurisdictions. This approach is usually avoided because it may cause the parties to mount expensive legal counterattacks as well as some amount of reputational damage to both firms once the media becomes involved. In the case of public companies, negative media exposure can severely affect the stock prices, due to the uncertainty of the outcome of any pending litigation.



Example cross-licence agreement allows Firm A to use 20 of Firm B's patents and Firm B to use 25 of Firm A's patents for a limited time.

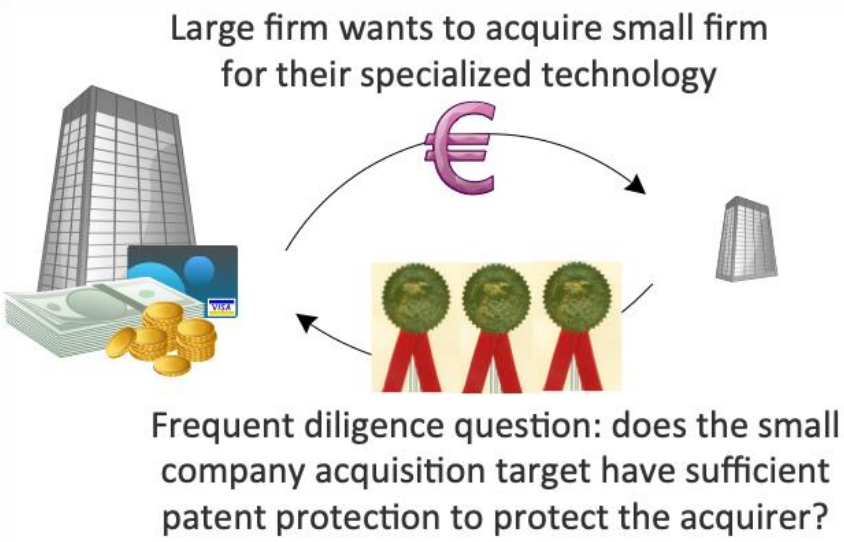
A more proactive solution might be for the two firms to sit down together and identify opportunities for cross-licensing. It may be that "Firm A" is infringing on 20 patents owned by "Firm B" but is later found that "Firm B" is also infringing on 25 other patents owned by "Firm A". An agreement may then be drafted to allow both firms to use the identified patents, usually for a limited period, for example 3 years. This allows both companies the opportunity to continue to operate their businesses without serious interruption, and the fact that the cross-licence contract has an expiry date also means that the parties may return to the bargaining table at a future date if they both remain interested in the use of each other's intellectual property.

As time goes on, large companies must create patenting strategies around their research and development activities that allow them to develop newer technologies simply to

maintain their global financial leadership. Patenting strategies for large multinationals must consider 1) the technical areas in which to file, 2) in which geographical jurisdictions to file, 3) maintenance fees, which are fees imposed by the various patent offices to keep a patent active and enforceable, 4) enforceability of patents in the various jurisdictions, as not all jurisdictions are equal when it comes to enforcement, 5) the budgeting for lifetime cost of patent protection for a given technology or product.

3. Protecting value of small and medium-sized companies

For small and medium-sized companies, patents are a different kind of currency than for a large multinational. Having appropriate patents can substantially raise the value of smaller firms by ensuring protection for the firm's potential acquirer. **If you're a founder or senior executive at a small company or start-up, you may want to construct a patent strategy to protect the (usually larger) acquirer.** The presence, or absence of patent protection by small companies greatly affects the value of the firm. Diligence by large firms considering purchasing a smaller firm sometimes fails, or simply depresses the acquisition price if there are no, or too few relevant patents protecting the product and its underlying technology.



Another aspect to consider is litigation. Multinationals can usually afford to litigate, and in some cases, can't afford not to litigate. Small companies should almost never litigate, as they can be easily run out of funding and/or be locked out of certain markets very quickly by the larger and better-funded opponent. Litigation is also a much more significant distraction for the smaller player where founders and executives play many more management roles and may interfere with acquisitions as well.

It is common for a small start-up firm to budget for a maximum of patent filings. The executive must also consider the lifetime cost of filing patents in various jurisdictions and all the associated costs of patent prosecution. A potentially hidden cost is the

maintenance fees imposed by the various patent offices periodically that the owner of the patent must pay to keep the patent enforceable. Each country has its own schedule for maintenance fees when they are due. These fees can become extremely costly as the portfolio of patent families grows. It is often the case that small company founders think that future maintenance fees will become "someone else's problem" once the company is acquired and fails to adequately budget for these fees. This can be a severe mistake when diligence time arrives, and the potential acquirer finds this invisible liability.

4. A real-options approach to patenting

The World Intellectual Property Organization (WIPO) provides a formal global disclosure mechanism, search report, and the ability to file a utility patent in any of the 193 member states of the United Nations [10,11]. The applicant has 30 months after filing to either promote the WIPO filing to a utility patent application in one or more countries or to abandon it. This long runway allows a WIPO filing to be used as a real option, like an inexpensive call option on an underlying stock.

A useful strategy used by some companies is to first file a WIPO filing, then roughly 24 months later before the WIPO filing goes to the national phase when the applicant must either file a utility filing or abandon it, the filing can be re-evaluated in terms of its relevance to the core business of the firm. If the filing is still relevant to their products on the market before the 30-month limit, the firm may choose to promote the filing to a utility patent application in the countries in which they do business.

The applicant may also elect to strategically abandon the filing if the invention is no longer relevant to the company's products or services before the 30-month period ends. When an applicant abandons a patent filing, there are no more legal, filing, or prosecution fees to pay and the WIPO filing stays forever in the global patent database as prior art to deter anyone else from claiming to have created the invention.

The U.S. Patent and Trademark Office (USPTO) historically has granted patents that meet qualifications in about 3 to 4 years, but there now exists a USPTO fast-track application that can be applied for. A fast-track application costs slightly more than a conventional one, but the applicant is guaranteed to receive some indication of the patent office's opinion within 12 months of filing. Knowing the opinion of the USPTO may reduce the uncertainty and potentially eliminate some of the expenses related to traditional simultaneous filings in many countries.

The U.S. Provisional filing is another strategic tool. It's not a patent, but a placeholder for the applicant's priority date and creates a real option much like the WIPO filing does. The applicant in the U.S. has 12 months to promote this provisional to a full utility patent application. U.S. Provisionals are particularly useful when R&D organizations are working on standards, where certain inventions may become essential to these

standards. For example, if a standards body adopts the applicant's invention, the applicant may promote the Provisional to a utility patent application, or otherwise abandon it if not.

5. Create a culture of innovation

If your firm already has an innovation culture, then examine it to better understand how it might evolve over time and may be made more effective. Does the firm have sufficient intellectual property protection for the core technologies developed internally? Are there patent committees set up to oversee the peer review of patent disclosures? Are all members of the value chain aware of the priority on innovation and invention? Are inventors rewarded in some tangible way that motivates them to invent more? Do your inventors feel like they are indeed adequately rewarded for their invention work? Are there reasonable budgets for patenting activities or do they need revision? These are most of the questions that can guide your decision-making in fine-tuning your innovation capabilities.

If your firm has yet to implement an innovation culture, it can be eased into the value chain in stages. You're not going to implement the complete Gold Badge culture in a matter of days or weeks. Putting such a culture into full operation requires some time and planning, usually beginning with the examination of the existing budget for patenting activities and a review of existing intellectual property and how adequately the senior management thinks they are protected. It may be that the budget needs to be revised just simply because more intellectual property protection is needed. Patent committees need to be created – usually for a small company, the patent committee is typically a few experts who review invention disclosures on an as-needed basis. As the company grows, the committees may schedule regular meetings, usually once a month to review all recent submissions and to make their recommendations on whether or not to pursue patent filings from the submissions. Budgets for incentive awards to inventors must be created as well, along with the basic rules for how these awards are given out. For example, if there is one inventor on the patent application the amount of monetary bonus is straightforward. But if there are two or four inventors on an application, there is typically some formula as to how to split up a maximum amount of bonus compensation.

In addition to monetary bonuses, there are other approaches to help inventors feel like they are appreciated by the firm for their inventing efforts. One way is to incorporate patent filing into the requirements for the promotion of a technical staff member to a higher grade. For a senior-level engineer or researcher to go to the next higher pay grade, one of the criteria for promotion can be a consistent effort on the part of that person to submit their invention disclosures to the patent committee. Having the inventor's name on an issued patent would have even greater significance when considering a technical staff promotion. Another approach to helping inventors feel involved and appreciated for their contributions is the Motorola approach of permitting

the inventors to earn a gold badge or other such honour. It seems like a small thing, but the gold/platinum badge at Motorola became a highly desired objective for many engineers and researchers over the years.

Innovation may found in many parts of the value chain, not just in the research labs. This is why it's important to periodically draw the attention of design and product engineers to the patenting process by engaging in patent mining. This activity makes product and development groups a part of the inventing culture, and be used for example just before a product is launched while it is still in the testing and certification stages. Product managers can be reminded that as new products enter testing and certification phases they might think about patent mining to identify any of the significant advances that their team may have made to solve certain problems as the product moves toward release. Often, one or more researchers from advanced technology groups can help in this effort, because it is often easier for an outsider to identify the novelty of something than the inventors themselves. Patent mining may also be applied to manufacturing and testing environments as well – there have been many novel breakthroughs in rapid manufacturing and testing such as advanced lithographic procedures for chip development or Accelerated Lifetime Testing (ALT).

While it is nearly impossible to change a company's culture, it is certainly possible to layer a new culture onto an existing one. A past client was a medium-sized technology-based enterprise. They had recently broken through the sales barrier and their sales were growing rapidly, but the company had almost no patents, either issued or filed. The senior management was new to the company, but extremely experienced at larger firms and had suggested that I come around every few weeks for a while to help them build a culture of patent awareness and innovation. The client identified the most relevant senior technical people and I set off to meet with them individually at first. Most were in their 20s or early 30s, and so clearly they did not enough experience to have observed the entire life cycle of research, patents, products and so on.

When I asked about their patenting efforts, the response ranged from the usual "We don't file patents. It's too much work and we already have too much real work to do." to the more hostile "Patents??? We're anti-patent around here! Technology should be free.", etc., all the usual excuses for not doing something. I told them that I understood their viewpoint, because I was once a young engineer too, and that learning about patents and intellectual property had subsequently served me very well, once I understood the implications on my own career and finances. I further explained that the company had just entered an inflection point where intellectual property protection and patents were becoming important, and that they can help protect their company's revenue stream, as well as their ongoing employment and bonuses, by engaging in the protection of their company's intellectual property, at least in a small way in the beginning. I gave the technical leaders a short presentation on patenting, what patents are, how they protect intellectual property and how the industry uses them. These tech

people were smart, and therefore became extremely curious about what I had told them.

In the meantime, I worked with the senior executives, who needed no convincing that they needed to protect their intellectual property. We put a set of requirements together for patent committees, financial and other incentives, identification of homegrown core technology and an initial budget. They communicated directly with the technical teams to explain what they were doing and why they were doing it. This is extremely important to technical people, as they tend to be highly analytical and will reject any activities that they don't perceive as useful, especially if they don't understand the big picture of why a certain activity is important to the firm and should also be important to them as well. The senior leadership also incorporated the filing and prosecution of patents into the human resources (HR) organization's promotion planning criteria, which HR briefly communicated to the technical teams. Most important to the inventors was the implementation of the patenting reward structure – when people are rewarded for a certain behaviour, that behaviour is usually repeated. So bonuses were implemented for patent disclosures that their newly formed small patent committee had pursued as well as bonuses for patents that issue.

I made a few more visits to the technical leaders, who by that time had mostly bought into the idea of patent filing, because it was now a totally sanctioned activity that had a positive impact on their careers and compensation. Their curiosity began to change to enthusiasm to some degree, with some of the tech team studying intellectual property on their own. We met with some of the product managers who had products in the testing phase and were almost ready to deploy in the field. These managers identified the key technical people on a particular product, whom I met with. I asked the technical leads, "What kinds of difficult problems have you had over the course of product development? Were there some creative solutions you came up with to get this product ready to go out the door?" At this point, the technical team could easily recall what problems they had and how they solved them, at which point I said, "Your patent attorney may want to do a prior art search, but this particular solution sounds to me like it might be patentable." As we engaged in this mini-patent mining session, we came away with several such innovations. I also stressed that your invention doesn't necessarily need to be ground-breaking, like the invention of the laser or transistor, but that there are many useful simpler inventions, the absence of which would prevent your product from working at all. And these inventions should be considered for patenting.

Time went on, with periodic meetings with the senior execs and technical leaders, who by that time had completely bought into the idea of patenting. They even budgeted for and implemented a small dinner for inventors whose patents have been issued, including a presentation of patent plaques and bonuses. So in about 4 years, a Gold Badge culture of sorts was created, and patenting activities became an important part of every researcher's and engineer's job. In the end, we see that getting to such an inventive culture was neither easy nor fast, but the worst consequence of not

encouraging innovative behaviour is the eventual ageing out of the product line with nothing new on the roadmap.

6. The "Technology Shelf"

When budgeting for the filing and lifetime ownership of patents, it is typically the case that there are many more good inventions than there is sufficient budget allocations needed to fund their patenting. For small companies, this means that the principals need to prioritize the filing of patents on the most important core technologies of the business periodically. It may be the case that a small enterprise has the budget allocation for two patent filings each year maximum. For large multinational companies, it's a similar story, except that patent committees and senior executives must periodically review and prioritize the most appropriate inventions to protect by patents, with the remainder being "rejected" for patent filing, at least at the time of the review.

One concept that is used successfully by some technology firms is the creation, and maintenance, of a "technology shelf". The technology shelf is usually a database or directory structure in a secure environment in which rejected, but potentially highly useful inventions are stored. This means that all documents associated with the invention, including patent disclosures, lab notebook scans and anything else of relevance is placed into the database for later evaluation, and possible deployment into the company's product lines if appropriate.

Depending on the company's rate of innovation, available budget and demand for certain product lines, the technology shelf may be reviewed periodically and the question of pursuing a patent filing is re-visited. I've seen some instances where entire suites of inventions for the potential creation of a new product were placed onto the technology shelf, because it was too early to introduce a new product line into the production environment. In some cases, later reviews of the technology shelf identified certain inventions that the product groups had no need of, for example 2 years prior, but were now relevant to the current development cycle.

An example of this might be development of advanced multi-band antennas for cellular handsets, where the research organization took their direction based on technical and political trends in the domain of wireless spectrum management coming from the International Telecommunications Union (ITU), the technical standards body of the United Nations. The research organization began working on the development of antennas having several new frequency bands, but having certain physical size and volume constraints of what might be deployable in a reasonable handset form factor. After a few years, the new antenna prototypes might be available to support the new bands allocated by the ITU, but due to budget constraints of the network operators, were not presently needed in actual products, as the operator community was late to deploy their new radio access networks commercially. The new antennas, their patent disclosures, experimental results and all other documentation were placed on the

technology shelf until product executives received sufficient requests from network operators for handsets that would support the new frequency bands. In cases like this, the first place the product groups would look when asked for a new feature such as this one, would be the technology shelf, to see if the company had any production-ready antennas that would fill the requirement, and appropriate ones were identified, protected by patents and deployed into the product development stream. Not only would this enable proper patent protection in time for commercial deployment, but it sometimes eliminates the need for the R&D organization to start from zero, resulting in much shorter time to market in some cases.

While the concept of the technology shelf is typically used by large tech firms, smaller firms may also benefit from the approach, conserving IP budget but protecting the inventions when the time to deploy them is right. In some cases, the inventions might never be used in a product line, in which case much time and budget might be saved by putting certain inventions on the technology shelf rather than blanketing the domain with patents that protect technologies that would never be used.

Conclusions

If you've gotten this far, you can see that the concept of intellectual property is fairly simple, in theory. The complications arrive when we implement a reasonable culture of innovation and intellectual property generation and management in the real world. This is especially true for corporate cultures that are resistant to change, hostile to patenting or just unable to see the benefit of managing a firm's intellectual property in a professional and realistic manner.

As I've outlined, you can be successful at such a task, but it requires time and a fair amount of diplomacy in many cases. We've all witnessed the inability to change most cultures directly. A major takeaway should be the observation of how "overlaying" a new culture can circumvent this issue by creating something cool and new in which researchers and engineers can participate, especially when the reward structures are introduced and adjusted to create reasonable incentives.

I hope the material presented here has helped you to understand the practical aspects of what you need to know about intellectual property and its management. At least at this point, you now know what questions to ask and how to talk with the experts.

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About the author

MARK PECEN is a senior technology executive and head of a specialized technology advisory group, Approach Infinity, Inc., with a focus on research, standardization, intellectual property and commercialization of advanced technologies.

Pecen is an inventor of more than 100 fundamental patents in wireless communication, networking and computing, and is a graduate of the University of Pennsylvania, Wharton School of Business and the School of Engineering and Applied Sciences.

He was awarded the titles of Distinguished Innovator and Science Advisory Board member by Motorola for his foundational research and standardization work on GSM, GPRS and EDGE cellular technologies at the European Telecommunication Standards Institute (ETSI) in France.

He continued to lead work in 3GPP for Motorola on UMTS 3G cellular technology. Then, as Senior Vice President, R&D for BlackBerry, he and his division contributed substantially to the work in 3GPP on 4G-LTE cellular technology and standards as well as critical wireless spectrum management in the International Telecommunications Union (ITU) in Geneva.

In 2015, Pecen co-founded the ETSI Technical Committee Cyber, Working Group for Quantum Safe Cryptography (TC Cyber WG QSC) and served as Chair for the first 5 years of its existence, producing some of the very earliest global standards on the topic. He further served as Chair of the Canadian government's task force on GDPR and served as president and executive advisor for Quantum Valley Ideas Lab in Canada, focusing on quantum radio frequency sensors using Rydberg atoms.

Pecen has served on over 20 advisory and governance boards for public and private companies over the years, including the University of Waterloo (CANADA) Institute for Quantum Computing, and Wilfred Laurier University Institute for Business and Economics (CANADA). He is an investor and advisor to several technology companies and venture funds and is a general partner of a Canadian venture fund.