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Thoughts on Patents and Information Literacy

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Abstract

Patents are an under-used information source, in part because of an often-narrow focus by patent librarians on the tools and techniques of patentability searching. This approach can ignore a range of potential applications of patent information, using patents in their contexts as technical, design, historical, legal, and commercial documents. This paper suggests the adoption of a flexible approach, viewing patents and patent information in the greater context of information literacy, including that of the Association of College and Research Libraries' Framework for Information Literacy for Higher Education, more commonly known as the ACRL Framework.

Introduction

Patents, the form of intellectual property that protects inventions, have traditionally been discussed by patent librarians through the lens of patentability searching; we focus on how inventors can determine whether their invention is patentable, using tools designed for this purpose. However, this approach obscures the range of information available in patent documents. Patents are a rich source of technical, design, historical, legal, and commercial information. The applications of patent information are correspondingly broad, sitting at the intersection of STEM subject areas, commercial concerns, and the humanities. Students who will never apply for their own patent still need to know what patents are, how they can be used, and what types of information they contain. We need an approach to patent information literacy (here defined as the application of information literacy skills to interactions with the patent literature) that meets the needs of students and other stakeholders across a range of disciplines and skill levels.

Background

A patent is a legal document issued by a government agency that confers upon an inventor the right to control the use, sale, import, and manufacture of their invention for a set period. In exchange for this protection, the inventor must disclose the underlying technical idea and provide a technical specification, which becomes part of the public record when published. The invention itself will become part of the public domain when the patent expires. There are separate categories of patents in the United States for useful processes or machines (utility patents, the documents we typically mean when we say

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"patents"), ornamental design (design patents), and certain types of asexually reproduced plants (plant patents). In order to be patentable as a utility patent, an invention must be novel, non-obvious, and useful, and it must meet the necessary statutory requirements for patentable subject matter (United States Patent & Trademark Office, 2015).

The idea of searching the patent literature to assess patentability, specifically searching existing patents and patent applications in order to assess an idea for novelty and non-obviousness, has been previously discussed in the library literature, both by patent librarians and by the USPTO itself (Lambert, 1996; Meier, 2015; United States Patent & Trademark Office, 2016b; Wherry, 1995; White, 2014; Wohrley & Mitchell, 1997). There is an official recommended strategy, the Seven Step Strategy, for performing a patentability search. The seven steps have shifted over the last few years as the USPTO has transitioned to a new classification system, but the overall structure has remained consistent (United States Patent & Trademark Office, 2016b)

Patent Contexts

Patents as technical documents

Inventors are required to disclose the details of their invention, so utility patents contain a wealth of technical information. By way of illustration, a patent on a mechanical device is likely to include detailed drawings (US7194994 B1, 2007). A patent on a chemical process is likely to contain specific operating parameters and may even contain example cases that illustrate the process (US7618976 B2, 2009). A patent on a business method might contain detailed process flow diagrams (US5206803 A, 1993). A patent on a genetically modified biomaterial may contain precise experimental methods for producing or isolating the material, possibly to the level of including specific DNA or protein sequences (US4363877 B1, 1998). The specific pieces of information you can find vary with the type of invention being patented.

Further, given that patents are often produced by people not in academia, the patent document may be the first and only place where this technical information is presented. Corporate research & development groups may not be interested in publishing in a scholarly journal but are likely to be very interested in obtaining a patent. To focus solely on the scholarly literature is to miss the research work being carried out by researchers in other contexts. Exact numbers are difficult to ascertain, and likely vary by discipline, but they are potentially significant (United States Patent & Trademark Office, 1977). A rough analysis of chemical compounds in CAS's SciFinder database indicated that approximately 90% of chemicals indexed were only described in the chemical patent literature. This number is likely inflated by the generalized style in which chemical structures are presented in the patent literature ("Markush

structure" drawings are used to represent entire groups of related chemical compounds in one image), but it still illustrates the potential value of the patent literature (Trippe, 2014)

Patents as design documents

"Design" has different meanings in the patent and STEM education worlds, and both are relevant here. In patent terms, design patents are subset of patents that cover the non-functional, ornamental elements of an object, in contrast with the more function-oriented utility patents. In STEM education, when we talk about "design" in the context of design classes and design projects, we are typically talking about the implementation of the engineering design process, or the process by which engineers apply their knowledge to solve problems. Patent documents can both provide graphic and industrial design information and show how inventors have applied engineering knowledge to solve specific problems.

The idea of using patents in the engineering design process is not new. Patent information is present in several pre-existing models of engineering design (Fosmire, 2014) and the patent literature could reasonably be described as a collection of useful case studies, in that each patent is that inventor's attempt to answer a question or solve a problem using technology (Whittemore, 1981). Beyond the technical side of the design process, patent information has been identified as relevant in the ethical context of patent design (Sapp Nelson, Ferullo, & Osif, 2014). Further, it has been observed that students in an engineering design class can use patent information to spur creative solutions and to support their design decisions (Phillips & Zwicky, 2017).

In terms of design in the aesthetic sense, "design patents" protect ornamental forms that have no specific utility. As an example, consider the form factor of an Apple portable device: round corners, the bezel, the placement of buttons, etc. These design elements do not directly impact the technical function of the device, but Apple has patents on them and the company has legally pursued cases of infringement (Samuelson, 2016). Design patents, aside from their impact in industry, are increasingly relevant in an academic world embracing rapid prototyping and 3D printing. While there are many potential pitfalls in operating a 3D printing service, not least among them the possibility of copyright and trademark infringement, allowing students to use library resources to commit patent infringement is a significant area of concern (Milch, 1986; Wilkof, 2016). Additionally, design patents impact associated fields like typefaces creation (Martinez, 1997) and fashion (McCall, 2016).

Patents as historical documents

Patents represent a historical record of science and technology, in the form of millions of documents dating back centuries. The U.S. Patent & Trademark Office's collection is complete from 1836 to the present, with partial coverage of patents issued between 1790 and 1836; there was a fire in the

patent office in 1836 and records were lost (Dobyns, 1997). The British Library has patent document holdings as old as 1617 and many other governmental bodies have archival collections of patents dating back to the implementation of their patent regime (British Library, n.d.). Access to these documents is not always easily accomplished, but they are all publicly available.

Patents can be used to explore the history of science, tracking how technology has changed over time and examining how succeeding generations of inventors attempted to iterate on existing technologies to develop new ones. Further, if each patent is an engineering case study, the sum of those case studies is the history of the problems that needed to be solved and the history of proposed solutions, both successful and not. On a broader level, the history of the patent system is also relevant to how society's view of intellectual property has evolved, through the question of what is and is not patentable (Anderson, 1992; Hamilton, 2009). An example of this might include modern patents on genetically modified organisms, as a focal point for broader discussions about GMOs more generally.

Patents as government and legal documents

The purpose of the patent system is to encourage innovation -- "[P]romote the progress of science and useful arts" in the language of the U.S. Constitution (Art. 1, Sec. 8, Cl. 8) -- by rewarding inventors with legal protection in exchange for disclosure. In the United States, patents give inventors the right to bring a lawsuit in federal court over infringement and the right to obtain exclusion orders on infringing goods from U.S. Customs and Border Protection.

Patents are legal documents and as such are often written by legal professionals. Lawyers with expertise in patents frequently have technical backgrounds in addition to their legal training. Non-lawyers with technical backgrounds who take the patent bar exam can become "patent agents" (United States Patent & Trademark Office, 2016a). From a technical writing standpoint, patents represent a challenge, with their complex mix of legal and technical content (Norman, 1989).

In addition to their role in American government and law, patents are legal documents in jurisdictions around the world. Despite the variety of laws and regulations relating to patents across these patent authorities, not to mention all of the different languages involved, there are certain commonalities. The Worldwide Intellectual Property Organization, or WIPO, has implemented a set of standardized codes that maintains consistency of structure. All of the patent titles are in field 54, for example, and all of the filing dates are in field 22. This system is called the Internationally agreed Numbers for the Identification of Data, or INID, system (WIPO, 2013).

At this point, it is important to emphasize that the legal aspect of patent information may be one that librarians are not properly equipped to address directly. While librarians are able to provide information about patents and the patent process, we must be careful not to be seen as offering legal

advice. Without a license to practice law, offering legal advice is against the law in most jurisdictions. Examples of this could include offering opinions on patentability, offering guidance on patent strategy to prospective patent applicants, or advising applicants on how to fill out patent office paperwork (American Bar Association, 2003).

Patents as commercial documents

Patents are tools for protecting your own intellectual property. This is where traditional patentability searching comes into the picture. In order to make certain that your invention is truly novel and non-obvious, you need to search for prior art that describes your idea. Prior art is any evidence that an invention is already known, encompassing all publicly available forms of information. A proper patentability search for prior art will start with the patent literature, but should also include scholarly, trade, and popular literature. This is also known as "state-of-the-art" patent searching.

As an extension of this protection, patents are tools for commercialization and entrepreneurship. Inventors and their assignees can use patents to take advantage of the protections offered by the government, such as the ability to fight infringement. Patents can be incredibly valuable, both in terms of the amount of money to be made and in terms of protection against infringement claims by competitors. Several recent patent infringement cases have led to billion dollar judgments against the infringers (Crouch, 2015, 2016).

Patents can also be used to track the research output of a business's competitors. Patent applications are published eighteen months after the patent application is filed, whether or not the patent has been (or will ever be) granted. While there is no guarantee that information about a given patent will offer competitive value, this does represent a unique opportunity. As previously mentioned, the patent documents may be the only place detailed information about certain topics is publicly presented. It is possible to use patents and patent applications to scan the state of the art in a given industry or market and assess the gaps where innovation is possible. This can be done using text and data mining tools. The international patent corpus is available in machine-readable formats from the European Patent Office, for a fee (Hoppenfeld & Malafi, 2015; Li, Azoulay, & Sampat, 2017; World Intellectual Property Organization, 2016)

Patents in information literacy

There has been some discussion of patents in LIS education (McKevitt, 1992) and in STEM education (MacMillan, 2005), but it is generally focused on patentability concerns and using the tools of patentability searching. In more general LIS discussions around using patent searching, there is a similar

tendency to focus on those same sources and methods (Meier, 2015; Roth, 1985; Wherry, 1995; White, 2014; Wohrley & Mitchell, 1997).

How Patents Are Taught

The most common approach in teaching patent searching is to teach patentability searching, using the USPTO's "Seven Step Strategy." It is important to clarify that this process is designed to be used by inventors, patent lawyers, patent agents, and patent examiners, not necessarily by those who might use patents for other purposes. Instruction related to the Seven Steps necessarily focuses on the technical process of classification-based searching and how to effectively use authoritative databases. Patentability searching as a process is rigid, rigorous, and time-consuming. The Seven Steps rely primarily, if not exclusively, on official government sources, which are not always the most user-friendly. It does this for a valid reason, in that an inventor doing an exhaustive patent search requires searchers to focus on the authoritatively complete system, but that may not be ideal for all use cases.

Why is patent searching often taught this way? As has been mentioned, this is the method that is taught by the USPTO and incorporated into their outreach efforts. The USPTO's mission is to foster innovation and economic growth (United States Patent & Trademark Office, 2014), so its approach to patent searching is necessarily narrow, aimed at the use cases of innovators and entrepreneurs who want to protect and commercialize their intellectual property. The official search method, the Seven Step Strategy, relies heavily on using comprehensive sources and parsing patent claims (United States Patent & Trademark Office, 2015), both of which are necessary for doing a thorough determination of novelty and non-obviousness and neither of which are necessarily required for other patent searching applications. This is not to say that the USPTO's methods do not have value for searchers with other needs. The USPTO's recommended search method is in part a result of the ways in which patents differ from scholarly articles. Patent information is organized differently, is written differently, and has different metadata. The Seven Step Strategy highlights and illustrates these distinctions.

With the focus on official patent search strategies comes a need to use official patent search tools. The patent search tools available to the general public, particularly those supplied by the USPTO, present a number of challenges. First and foremost among these is usability. Government databases like USPTO's PatFT and AppFT are designed to be used by patent examiners and inventors rather than researchers, and their interfaces and search features reflect this. Another USPTO database, PubEAST, is incredibly powerful, allowing users to construct complex Boolean searches, but its interface has a steep learning curve and it is only accessible to the public in specific locations (USPTO's Public Search Facility and partner libraries). If a researcher follows the Seven Step Strategy and can effectively interpret the results of their searches, these tools can be effective in assessing patentability; it is often difficult to

retrieve useful results if the databases are searched in other ways. These databases do nothing to mitigate the difficulties of working with legal/technical patent jargon and they often lack some of the search features (e.g. relevance ranking, faceted browsing and refining, automatic stemming) we expect to see in modern research databases.

There are many third-party patent search options, some with what we would consider more modern, usable search features, but they present their own set of difficulties. For example, Google Patents is as usable as the standard Google search tool, but it does not deal well with pre-machine readable patent data (roughly speaking, before the 1970s) and Google's personalized approach to search does not always return consistent results between users (Garb, 2008). Another free search tool, Lens, incorporates relatively sophisticated data visualization features into its search features, but it is still constrained by the general difficulty of keyword searching patent full text data. Derwent Innovations Index adds additional metadata for improved keyword searching, but it only covers patents from the 1970s forward and it is not a free resource. These resources, whatever their benefits, are often portrayed as less authoritative than the traditional USPTO-supplied tools (Meier, 2015; White, 2014).

How Patents Could Be Taught

The key to teaching about patents and patent information literacy in a broader context is to implement the principles of modern instructional design and practices. As an example, consider backward design, using the desired outcomes of instruction to inform the planning of the instructional activities (Wiggins, 2005). We need to understand the users' needs and tailor the instruction's learning objectives to those needs. Why are we talking to this group about patents? If the class is for entrepreneurship students who are prospective independent inventors, training them in formal patentability searching is likely appropriate; if the class is for freshman engineering students who are going to be using patents as part of their design projects, it may be more appropriate to focus on the nature of the information rather than the intricacies of the search technique.

We need to be flexible in our approach to which resources we use. Patent search tools present a range of options, from free and public resources to proprietary resources with additional metadata and data mining features. We need to recognize the strengths and weaknesses inherent in the available tools and determine where it might be acceptable to sacrifice comprehensiveness and rigor for usability, in the form of a third-party patent search options.

We must focus on the conceptual understanding of what patents represent, beyond the basic definition and beyond the legal specifics. While claim interpretation and concern for patentability are relevant in some situations, our students may be better served if we explain how patents fit into the

overall information landscape, as described in earlier sections, and how they can be used in the various contexts.

We need to determine whether or not specific aspects of patent information are relevant to the instruction. Does the distinction between granted patents and patent applications or the precise nature of patent citations matter in this specific instructional context? These elements of patent searching are unique and often need to be addressed when teaching patents, but they should be a part of the context of the patent system and of the documents as information sources, rather than the focus of the instruction.

Emphasis needs to be placed on the strategic, iterative quality of patent searching. Patent searching approaches the search process from a slightly different angle, versus searching for other forms of literature. As such, it presents an opportunity to remove students from their "just throw some keywords at the problem" comfort zone and force them to be more reflective about their search strategy.

Examples of Patent Information Literacy Instruction

Patents in engineering technology design

Working in an undergraduate engineering technology design class, students were connected with patents as design information sources. Given the focus of the class, strict patentability searching was eschewed in favor of a simpler explanation of the potential complexities of patent searching, then letting the students explore the patent literature. Rather than use government sources, students were directed to more user-friendly third-party tools. While some students did attempt to determine whether or not their idea was patentable, others used it to understand the technologies they were using, to validate their ideas as potentially feasible, and to inspire alternate solutions to their problems (Phillips & Zwicky, 2017).

Patents in chemical information

In a chemical information course, one session is focused on gleaning chemical information from the patent literature. As previously mentioned, many of the compounds in the overall chemical literature are only found in chemical patents. This allows for discussions of the information creation process, contrasting academia and industry. During the most recent iteration of the course, the class spent a significant amount of time on Markush structures, the style for drawing a molecule in a patent application in such a way that it captures a range of possible variations in structure. When patent searching resources were discussed, it was in the context of chemistry-specific resources that cover patent content (i.e. SciFinder) and patent-specific resources that incorporate added chemistry content (i.e. Derwent Innovations Index).

Patents in an invention competition

Several librarians consult with students as part of an entrepreneurial team competition in which students design and prototype a novel application for a specific agricultural product. Students work with the librarians on market research, scholarly research, and patent research. Past iterations of the competition have spent time on patentability searching, but the current version has been modified in several ways. First, students are now required to meet with the patent librarian very early in the competition, while they are still in the ideation phase, to leverage the commercial and competitive information available. Second, the content of the consultations has shifted focus away from full patentability searching to account for the scope of the students' deliverables. While they are ultimately hoping to determine patentability, an exhaustive search exceeds requirements and is unrealistic given the competition's timeline. Students are encouraged to combine keyword, classification, and reference searches to iterate towards the documents they are trying to find, but the overall emphasis is on developing a coherent and functional search strategy. Third, while the students do need to explain how their idea differs from the inventions described in the documents they've found, this can be accomplished through an analysis of the broad outlines of the inventions, rather than a close parsing of the claims. To complement this approach, a new preliminary judging rubric was developed. Rather than assessing students on the number of patents found, the rubric assesses the development of the students' search strategy and their analysis (Howard & Zwicky, 2018).

Patents and the ACRL IL Framework

Beyond these three examples, there are a variety of possible opportunities to incorporate patents into the information literacy conversation. Patents, in addition to their value as an information source, can be useful tools to illustrate various features of ACRL's (Association of College & Research Libraries) Framework. The Framework, a set of six threshold concepts about information and scholarship, is a resource developed by the ACRL to organize the various concepts around information literacy into a coherent whole. The six "frames" (in no particular order) are "Information Has Value," "Searching as Strategic Exploration," "Research as Inquiry," "Scholarship as Conversation," "Authority is Constructed and Contextual," and "Information Creation as a Process" (Association of College & Research Libraries, 2016). Discussions of patents clearly aligns with the "Information Has Value" frame, for multiple already-discussed definitions of "value," but patents present opportunities to explore the other frames in a STEM context.

Information has value

As mentioned, the value of information in patents is obvious in several ways. Patents represent information as a commodity, and their financial value to both inventors and society as a whole should be obvious. Beyond that value, however, patents represent a means of staking a claim to an idea, a mean of "negotiating and understanding the world" (ACRL, ibid). Patents could represent a lens for talking about how society decides what (and whom) it values. As an example, a class featuring social justice advocacy or critical information literacy could discuss of the technological and financial factors that can prevent under-resourced inventors from accessing the patent system or the social factors that can stand in the way of inventors from diverse backgrounds (Bell, Chetty, Jaravel, Petkova, & Reenen, 2017). There could even be a discussion of the idea of patentable subject matter, assessing the ways in which certain types of inventions are more valued than others under a given intellectual property regime. Defining what is and is not patentable can be used to privilege or exclude the creative work of specific groups (Pollack, 2005).

Searching as strategic exploration

Patent searching, whether using the techniques of formal patentability searching or not, is nonlinear and iterative. Brainstorming, identifying the inventive concept and expressing it in as many different ways as possible. Keyword, classification, citation searching need to be combined and connected in order to create an effective search strategy. As an example, a simple but effective patent search could start with a broad keyword search, the results of which could indicate the applicability of a specific set of classifications. Those classifications may suggest more appropriate keywords to further refine the search. If the searcher finds a specific document that seems relevant, they may want to follow the classifications, citations, inventors, etc. to expand their search into new areas.

Research as inquiry

Technology is the application of science to solve problems. Patents represent documented solutions to millions upon millions of problems. Through patents, it is possible to see how other people have approached a given problem and to track how solutions have changed over time. As mentioned earlier, not every patented solution is correct or necessary; examining the history of failed, flawed, and even silly patents can give students insight into the engineering design process. Tracking the patent output of a specific inventor or a specific company may give students insight into how their ideas developed.

Scholarship as conversation

Another interesting, under-utilized resource in the patent ecosystem is the trail of public documents that accompany a patent application as it moves through the examination process. Using

publicly available government resources, it is possible to see the messages exchanged by the examiner and the inventor (or the inventor's attorney) as they progress from the initial examination to the final grant or rejection. Unlike the scholarly publishing world, where you typically only see the final result of the peer review process, the entire patent examination process can be laid bare for students to observe.

Information creation as a process

Patents are often the end result of the research and development process. As has been noted, the products of research conducted by corporate R&D departments may only see the light of day in the form of patents. This is an opportunity to talk with students about the knowledge creation landscape, in particular the differences in purpose and emphasis between academic research and corporate research.

Patents can also give insight into how inventors synthesize technologies, both as new innovations and as new commercial products. Look at the different patents that go into a piece of technology, combining multiple innovations into a single commercial product. For pharmaceuticals, there can be separate patents on the molecular structure, the chemical synthesis, the method of manufacture, the formulation, the delivery mechanism, and the application of a given substance. A consumer electronic device can contain thousands of patented components, including patents on individual mechanical and electronic devices, software, materials, and design elements.

Authority is constructed and contextual

Patent documents can be seen as authoritative, in the sense that they carry legal weight. However, this opens the opportunity to discuss the patent process, in terms of exactly what the patent office is evaluating when they grant a patent. It is possible to start a discussion of patentability criteria (novelty, non-obviousness, usefulness, statutory language) and the reasons for which patent applications are accepted or rejected. Patent offices are assessing patentability, not necessarily quality. Inventions can meet all the relevant criteria to be granted a patent without being the optimal solution to a given problem.

Many patent search tools mix patents and patent applications in the same search result sets, assuming the searcher will be able to make the distinction between the two types of documents. In other words, documents found by researchers doing "patent searches" may not actually be granted patents. This can be further complicated by mixing documents from many countries into the search results. Depending on the search interface, the ultimate origin of each document is not always immediately obvious.

Additionally, patent examiners are human beings. While we would like to assume their work is flawless, inappropriate patents have made it through the examination process. Granted patents have been invalidated by the courts (Ford, 2013), and one of the provisions of the America Invents Act of 2011 (35

USC 31 §311 - §319) provides a mechanism intended to challenge improperly approved patents (Quinn, 2014). If a class is centered on politics, law, or current events, options could include discussion of legal processes such as inter partes review (a process by which the validity of a patent can be challenged) or legal/political issues such as the problem of so-called "patent trolls."

Conclusion

Traditional patentability searching is a relevant and useful skill for a narrow, albeit important, group: Inventors. For other audiences, particularly students in STEM and STEAM disciplines, a more expansive approach to patent information literacy can lead to richer interactions. As patent librarians, we must be flexible in our approach, tailoring our search strategy to the audience and selecting appropriate search tools. Despite the degree of difficulty and various complicating factors, we must frame patent searching within the overall understanding of strategic searching.

There is a broad range of potential applications for patent information literacy, beyond patentability. Patents can serve as primary sources for historians, aesthetic inspiration for designers, market research tools for entrepreneurs, and technical resources for scientists and engineers. The technical and design aspects of patents naturally align with the engineering design process, inspiring and informing the designer's choices.

With its increased focus on critical thinking, the ACRL Framework provides jumping-off points to consider patents in information literacy. In addition to the obvious case of "Information Has Value" with respect to the economic and commercial value of patents, patents can provide a basis for critical reflection. The complexities of patent searching naturally lend themselves to discussions related to "Searching as Strategic Exploration." The role of patents in engineering design is an excellent fit with "Research as Inquiry" and "Scholarship as Conversation," and their role in more general research and development work closely aligns with "Information Creation as Process." Patents, in their role as government documents, can be used to prompt discussion of "Authority is Constructed and Contextual."

Patents and patent searching have incredible potential as teaching tools, outside the traditional application of determining patentability. As librarians with patent searching expertise, we need to be conscious of this potential and not see teaching patents as separate from the other information literacy instruction work we may do or discussions we may have. Rather, it can be an integral part of our role as teachers and advocates of information literacy. While teaching independent inventors how to conduct patentability searches is no small thing, our impacts can be even greater when we use our expertise to benefit students, researchers, and other potential users of patent information

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