WAKE FOREST
JOURNAL OF BUSINESS AND
INTELLECTUAL PROPERTY LAW

VOLUME 11 2010–2011 NUMBER 3

ADVANCING TECHNOLOGY IN THE CONTEXT OF THE COMPETITIVE LANDSCAPE: AN INDUSTRIAL TECHNOLOGIST'S PERSPECTIVE

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ABSTRACT

An integrated strategy is required to identify, manage, and capture the value from intellectual property that arises in the research environment. Experimental results must be screened routinely to identify potential intellectual property, including novel or improved methods and compositions as well as new or expanded applications. Strategic evaluation of potential intellectual property requires a comparison of the method, composition, or application to existing patents and patent applications, in addition to gaining an understanding of the published literature and other public-domain information. Ultimately, the timing and mechanisms employed to protect intellectual property can play a major role in the success of a product. In this article, specific examples from the medical device and regenerative medicine sectors are utilized to highlight strategic approaches that may be used to effectively understand and navigate the competitive landscape in the pursuit of product development.

[†] The author wishes to thank Rusty Kelley, Kelly Guthrie, and John Ludlow for their thoughtful review of the manuscript.

I. INTRODUCTION

In any research and development setting (university, small company, large company) discoveries are made that have potential value as products, enabling technologies, or improvements on processes that yield a superior product at a lower cost of goods. The value generated by these discoveries can be harvested ultimately as revenue, providing money to expand universities, create jobs, and fund new pipeline research projects. In an industrial setting, intellectual property (whether patent or trade secret) is the foundation for differentiation among products in the market, and constitutes the battlefield on which market positions are gained and lost based on filing dates and validity.[1]

The Bayh-Dohl Act of 1980 fundamentally changed the relationship between industry and academia by enabling non-profits, universities, and small businesses to retain ownership of innovations developed within federally-funded research programs.[2] While the government funding agencies retain "march-in" rights to technologies that they have funded, university-industry collaborations and licensing deals are commonplace, accompanied by a significant expansion in size and scope of the technology management offices that function to capture revenue streams through in-licensing and royalties arising from commercialization of valuable discoveries.[3] After thirty years, the number of patents filed annually in the U.S. has risen over four-fold, from 108,209 in 1979 to 482,871 in 2009,[4] resulting in greater access to federally-funded technologies for commercial application while also creating a more complex competitive landscape for any potentially novel technology.

Intellectual property can arise from pioneering discovery, whereby something new is created in a landscape with no precedent, potentially yielding a novel method to make a new product with an unanticipated application. However, it is more common for discoveries to be made on a foundation of existing knowledge,

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[1] *See generally* Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 1066-67 (1997) (arguing control of intellectual property can lead to greater market power).

[2] ROGER L. GEIGER & CRESO M. SÁ, TAPPING THE RICHES OF SCIENCE: UNIVERSITIES AND THE PROMISE OF ECONOMIC GROWTH 12, 149 (2008).

[3] *See, e.g.*, Council on Gov't Relations, *The Bayh-Dole Act: A Guide to the Law and Implementing Regulations*, U. CAL. OFF. TECH. TRANSFER (1999), *available at* http://www.ucop.edu/ott/faculty/bayh.html.

[4] Patent Tech. Monitoring Team, *U.S. Patent Statistics Chart: Calendar Years 1963-2010*, U.S. PAT. & TRADEMARK OFF., *available at* http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm.

methods, and products, generating improvements or filling known technological gaps as a routine component of the product development process.[5] Technology managers need sound and consistent strategies for identifying potential intellectual property that emerges from routine experimentation. Integrated management of the intellectual property relative to the competitive landscape and the commercial strategy is essential to ensure commercial success.

II. IDENTIFYING & MANAGING INTELLECTUAL PROPERTY

Build or Buy? Considering the economic realities of both academic and industrial research, the majority of experimentation that is undertaken is aimed at solving a specific problem or filling a known gap in the pursuit of a specific product or product concept.[6] For example, the pioneering use of radioactive seeds to treat prostate cancer (i.e., "brachytherapy") dates back to 1914-1915.[7] Although the first issued U.S. patent containing "brachytherapy" in the claims was granted in 1985,[8] since that date there have been 217 additional issued patents covering various aspects of brachytherapy, including specialized devices to enable precise delivery of the seeds,[9] methods for imaging the implanted seeds,[10] and improvements in the design of the seeds to provide directional specificity of the radiation delivered to the tissue.[11]

Intellectual Property Generation & Capture. Intellectual property is born of discovery and creativity—two processes that it is tempting to say should not be constrained. However, the practical realities of technology development often lead to discovery strategies that are focused toward solving a particular problem instead of open-ended exploration.[12] A truly effective intellectual property strategy

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[5] *Intellectual Property, Innovation and New Product Development*, WIPO MAG., July-Aug. 2005, at 9, *available at* http://www.wipo.int/sme/en/documents/wipo_magazine/7_2005.pdf.

[6] Peter Lee, *Toward a Distributive Commons in Patent Law*, 2009 WIS. L. REV. 917, 943 (2009) ("Responding to commercial pressures as well as scientific and legal developments, universities increasingly conduct research with clear practical applications.").

[7] H. H. Holm, *The History of Interstitial Brachytherapy of Prostatic Cancer*, 13 SEMINARS IN SURGICAL ONCOLOGY 431 (1997).

[8] U.S. Patent No. 4,510,924 (filed Jan. 13, 1983).

[9] *See*, *e.g.*, U.S. Patent No. 6,221,003 (filed Jul. 26, 1999).

[10] *E.g.* U.S. Patent No. 6,809,517 (filed Dec. 10, 2001).

[11] *E.g.* U.S. Patent No. 7,762,940 (filed May 17, 2005).

[12] *See generally* Timothy J. Ellis & Yair Levy, *Framework of Problem-Based Research: A Guide for Novice Researchers on the Development of a Research-Worthy Problem*, 11 INFORMING SCI.: THE INT'L J. EMERGING

lies in the intersection of the technical and business strategies,[13] which together should determine if and when a patent is filed. It can be both expensive and strategically unwise to file patents on concepts alone, because until a technology has been reduced to practice and has demonstrated utility towards its intended use,[14] patent applications tip off competitors[15] while simultaneously creating prior art that could potentially form the basis of rejection later on when the definitive methods and composition of matter are known and are potentially different than anticipated by the theoretical patent application.[16] There are four key steps in the strategic identification and management of intellectual property in the operational laboratory setting:

A. Observation

Frequently, work is initiated in the laboratory to develop a work-around for a particular method, to define a target composition-of-matter, or to develop a new tool where one did not exist before. In these cases, the generation of intellectual property is the driver of the effort and is, therefore, an expected outcome. However, what may appear to be routine work in the laboratory can often harbor hidden intellectual property, such as improvements in manufacturing processes that lower the cost of goods or enhance product performance.[17] Concerted efforts are required to scan, identify, and protect the intellectual property that emerges in the laboratory setting.[18] Witnessing and reviewing of laboratory notebooks, as well

TRANSDISCIPLINE 4 (2008), *available at* inform.nu/Articles/Vol11/ISJv11p017-033Ellis486.pdf.

[13] Christopher M. Arena & Eduardo M. Carreras, THE BUSINESS OF INTELLECTUAL PROPERTY 209 (Oxford University Press 2008); THE ROLE OF INTELLECTUAL PROPERTY RIGHTS IN BIOTECHNOLOGY INNOVATION 126-27 (David Castle ed., Edward Elgar Publishing, Inc., 2009); *see also* Figure 1.

[14] Rubber-Tip Pencil Co. v. Howard, 87 U.S. 498, 507 (1874) ("An idea of itself is not patentable but a new device by which it may be made practically useful is patentable.").

[15] 35 U.S.C. § 122 (2006) (providing that, in general, patent applications are published eighteen months from their filing date).

[16] 35 U.S.C. § 102(e) (2006) (stating that a published patent application that discloses, but does not claim the invention constitutes prior art as of its filing date).

[17] Robert A. Matthews, ANNOTATED PAT. DIG. § 1.18 (2011) ("There are three different species of utility patents [under 35 U.S.C. 101]: a patent on the device or apparatus (product patent); a patent on a process or method of creating something (process patent); and a patent on the product that is produced by a patented process (product-by-process patent).").

[18] William A. Eklund, *Intellectual Property Rights in Joint Research Ventures with the National Laboratories*, 17 HASTINGS COMMUN. & ENT L.J. 841, 850 (1995).

as dedicating time to review technical progress and outcomes, is essential for the technology manager charged with gleaning the intellectual property from ongoing work. In environments where key elements of technology development are managed across multiple parts of the organization, additional effort should be put forth to ensure that an integrated approach is taken in the identification and protection of all product-relevant intellectual property. Even at this early stage, it is often beneficial to do a rapid scan of the published literature and patent filings to assess potential novelty.[19] The time and resources spent confirming and reducing to practice non-novel art may be better expended elsewhere.

B. Confirmation

A small, upfront investment to confirm the initial concepts or observations is worthwhile, compared to the cumbersome practice of amending claims during prosecution to force-fit the technology into the assumptions made based upon initial concepts or preliminary data.[20] In addition to repeating initial experiments, it is advisable to examine the technology from multiple angles to provide an adequate understanding of the potential scope and value of the intellectual property.

C. Reduction to Practice

Robust enablement of patent claims involves an actual demonstration or a test showing utility in the intended application.[21] The date on which an invention is conceived is irrelevant unless coupled with the date of reduction to practice.[22] *Actual* reduction to

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[19] *See generally* 35 U.S.C. § 102 (2006) (stating that in order to be eligible for patent protection, patentable subject matter must be novel, useful, and non-obvious).

[20] *See generally* 4 PAT. L. FUNDAMENTALS § 15:23 (2d ed.) (indicating that the Patent and Trademark office will reject amended claims that contain new matter or are based on new matter under 35 U.S.C. § 112 for lack of written description).

[21] 35 U.S.C. § 112, para. 1 (2006) (setting forth the enablement requirement for patentability: "[t]he specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same . . . .").

[22] *See* 35 U.S.C. § 102(g)(2) (2006) (providing that, in a priority contest, the date of invention is the earlier of 1. actual reduction to practice, or 2. constructive reduction to practice).

practice can be accomplished by making a working model,[23] while *constructive* reduction to practice is accomplished by filing a patent application that is sufficiently disclosing that one of ordinary skill in the art can make and use the invention.[24] In either case, the refinement and repetition involved in reducing an invention to practice serve to ensure that the design, composition, and/or methods that are claimed are a reasonable approximation of the final process or product.[25]

Once a patent is filed around a specific method, subsequent changes or improvements may be deemed obvious in light of the previously-disclosed method, thus limiting the potential scope of obtainable patent protection.[26]

D. Formulate a Strategy in Context of Competitive Landscape

It is virtually impossible to formulate an intellectual property strategy without first considering how a particular method, composition, or utility fits into the competitive landscape.[27] It is essential to determine whether an element of intellectual property is best protected as a trade secret, or filed as a patent.[28] For example, in the case of a proprietary manufacturing process that produces a medical device of high quality at a cost well below competitors, it may be wiser to hold the manufacturing process as a trade secret, since the process cannot be revealed by examining or "reverse engineering" the

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[23] Slip Track Sys., Inc. v. Metal-Lite, Inc., 304 F.3d 1256, 1265 (Fed. Cir. 2002) ("In order to establish actual reduction to practice, the inventor must prove . . . that he determined that the invention would work for its intended purpose.") (citing Cooper v. Goldfarb, 154 F.3d 1321, 1327 (Fed. Cir. 1998)).

[24] *See* Travis v. Baker, 137 F.2d 109, 111 (C.C.P.A. 1943) (indicating that constructive reduction to practice requires a disclosure of the invention sufficiently adequate to enable one skilled in the art to practice the invention).

[25] *See* King Instrument Corp. v. Otari Corp., 767 F.2d 853, 861 (Fed. Cir. 1985).

[26] *See generally* 2-5 DONALD S. CHISUM, CHISUM ON PATENTS § 5.03[3][a][i][E] and accompanying notes.

[27] J. Jeffrey Hawley et al., *How to Maximize the Value of your IP Assets Globally*, 13TH ANN. INST. INTELL. PROP. L., at 411, 426 (PLI Patents, Copyrights, Trademarks, and Literary Prop. Course Handbook Ser. No. 10983, 2007).

[28] *See, e.g.*, Robert Graham Gibbons & Bryan J. Vogel, *The Increasing Importance of Trade Secret Protection in the Biotechnology, Pharmaceutical and Medical Device Fields*, 89 J. PAT. & TRADEMARK OFF. SOC'Y 261, 262 (2007) ("The importance of properly protecting intellectual property assets as trade secrets either in lieu of or prior to seeking patent protection is garnering the attention and support of audiences beyond in-house and outside counsel in the fields of biotechnology, pharmaceuticals and medical devices.").

device;[29] placing the manufacturing process in the public domain as a patent filing would teach competitors a proprietary process that they could easily infringe upon with low risk of being caught. However, the risks of disclosure in a patent application have to be balanced against the risks associated with protecting a trade secret—is it possible to contain the trade secret information within the company so that the proprietary methods are not disseminated? What is the likelihood a competitor would file a patent on the same proprietary process?[30] In the sections below, specific theoretical examples will be provided toward the use of comparative analysis tools for the assessment of an intellectual property landscape.

III. PUTTING INTELLECTUAL PROPERTY STRATEGY TO WORK

A. Example 1: Separating a Novel Observation from a Novel Asset

Each of the steps above (observation, confirmation, reduction to practice, and formulation of strategy) plays a role in intellectual property generation; while many observations may be novel, scientific value does not always translate directly into intellectual property value. For example, in 1990, two professors at Wake Forest University invented the VAC technology, which leveraged the observation that wounds or incisions heal better if negative pressure is applied to the wound in combination with a special foam dressing that facilitated wound closure.[31] While the observation that wounds heal faster under negative pressure did not constitute tangibly valuable intellectual property per se, the specific device and methodology that delivered the negative pressure was the subject matter of the patents

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[29] *See*, *e.g.,* Uniform Trade Secrets Act § 1.4 (defining a trade secret as "information, including a formula, pattern, compilation, program, device, method, technique, or process that: (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.").

[30] *See*, *e.g.*, Park & Sons, Co. v. Hartman, 153 F. 24, 29 (6th Cir. 1907) (suggesting that even if a trade secret is not generally known, a third party is free to discover it through its own efforts such as independent development or reverse engineering).

[31] L. C. Argenta & M.J. Morykwas, *Vacuum-Assisted Closure: A New Method for Wound Control and Treatment: Clinical Experience*, 38 ANNALS PLASTIC SURGERY 563, 577 (1997); *see also* M.J. Morykwas et al., *Vacuum-Assisted Closure: A New Method for Wound Control and Treatment: Animal Studies and Basic Foundation*, 38 ANNALS PLASTIC SURGERY 553-62 (1997).

filed in 1991[32] and subsequently licensed to Kinetic Concepts, Inc. ("KCI"), a prominent wound care company, in 1993.[33] While the patent estate has been periodically challenged by competitors,[34] the wound VAC remains on the market at the time of this writing and, according to KCI's 2010 Annual Report, their Advanced Healing Solutions ("AHS") business based on the negative pressure technology accounted for 70% of their annual $2 billion in revenue.[35]

In this case, the stage of discovery and development at which the patent was filed was a key component of the strategy. If the envisioned product that can be sold to generate commercial value is a device or instrument, it may be best to seek intellectual property protection for that device when the design is almost final and the technology as designed has been demonstrated to work in the application for which it is intended, thus providing: 1) the best chance of getting robust coverage of the actual commercial product; and 2) the longest post-commercial duration for protection of the product.[36] For example, if the scientist who made the novel observation (that accelerated wound healing can occur under negative pressure) had rushed to file a patent on theoretical designs that ultimately did not sufficiently represent the actual device put on the market several years later, the product would have lost several years of commercial patent protection based on the priority date of the original filing. This could have resulted in lost revenue, not only for KCI, but also for Wake Forest University in the form of lost royalties. Furthermore, early conceptual patents can often surface as prior art against subsequent inventions with real commercial potential impacting the ability of scientifically valuable intellectual property to garner tangible financial value.[37]

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[32] U.S. Patent No. 5,645,081 (filed Nov. 14, 1991); U.S. Patent No. 5,636,643 (filed Mar. 9, 1993).

[33] Matt Evans, *Judge Strikes Down Lucrative Wake Forest Patent*, BUS. J. (Nov. 5, 2010), *available at* http://www.bizjournals.com/triad/print-edition/2010/11/05/judge-strikes-down-lucrative-wake.html.

[34] *Id.; see also Jury Verdict may Lead to More Market Challenges for Locally Based KCI,* SAN ANTONIO BUS. J. (Aug. 4, 2006), *available at* http://www.bizjournals.com/sanantonio/stories/2006/07/31/daily36.html; David Saleh Rauf, *Local Firm KCI Wins as Justices Decline Case*, SAN ANTONIO EXPRESS-NEWS (Nov. 16, 2009), *available at* 2009 WLNR 23157551.

[35] Kinetic Concepts, Inc., Annual Report (Form 10-K) (Feb. 25, 2011).

[36] 35 U.S.C. § 154 (2006) (generally, the term of a patent is 20 years from the date of filing of the application).

[37] 35 U.S.C. § 102 (2006) (defining prior art as including the contents of published patent applications).

As the technology manager scans emerging technical progress for potential intellectual property, there are three key questions to ask. First, is it real? This requires an understanding of the experimental evidence that an observation is reproducible and not due to a phenomenological artifact, and also encompasses the observation and confirmation steps discussed above and can extend to include reduction to practice. The second question is, is it novel? The answer to this question requires an understanding of the discovery in the context of the competitive landscape surrounding the technology, which can be more complex than it may appear on the surface. Many aspects of a technology can be novel and considered intellectual property: the technology itself (a new drug-eluting stent, for example), the process by which something is made (a new process for manufacturing the stent that improves performance or reduces cost of goods), or a new application (taking an existing product and demonstrating utility for that product in an unexpected indication).[38]

If an initial survey of the competitive landscape indicates the putative intellectual property is novel, the third question materializes: is this invention relevant to the business? The answer to the third question may be 'yes' if: 1) the technology is pertinent to the methods of manufacture or the composition of a product; 2) the technology is relevant to the methods or performance of a platform that is used to generate products; or 3) the technology has the potential to impact future business strategy (beyond existing products and platforms). The first question is best answered by the technologists, the second question by the technologists and intellectual property lawyer, and the third question by the intellectual property lawyer and the business strategist. In the following example, a theoretical discovery will be taken through these serial questions, including preparation and analysis of an actual competitive landscape.

B. Example 2: Identifying and Vetting Potential Intellectual Property

Part 1: The Discovery (Theoretical)

Cardiovascular disease is the leading cause of death worldwide, accounting for over 17 million deaths in 2005.[39]

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[38] *See* Matthews, *supra* note 17; 1 CHISUM, *supra* note 26, at § 3.01 (2011) (discussing the novelty requirement).

[39] Matthew M. Cook, Katarina Kollar, Gary P. Brooke, & Kerry Atkinson, *Cellular Therapy for Repair of Cardiac Damage after Acute Myocardial Infarction*, INT'L J. CELL BIOLOGY 1 (2009), *available at* http://downloads.hindawi.com/journals/ijcb/2009/906507.pdf.

Consequently, with the emergence of the stem cell and regenerative medicine fields, much effort has been dedicated to the discovery and development of cell-based technologies to address this large unmet medical need and market.[40] For example, Ohio-based Athersys, Inc. and its partner Angiotech Pharmaceuticals plan to initiate Phase II human clinical trials in 2011, on the foundation of a Phase I clinical trial that demonstrated safety of the company's proprietary MultiStem® cell-based technology in patients with acute myocardial infarction.[41] Consider the following theoretical example, whereby scientists at a small biotech company focused on the development of cell-based therapeutics have made an unexpected discovery:

Observation: In a set of experiments, specific cells derived from the blood are delivered systemically to an animal model to test whether they will improve recovery and survival after acute exposure to a toxin that causes kidney failure. A significant improvement in kidney function was not detected. However, post-injury survival was better in animals that received the cells compared to those who received a placebo. Surprisingly, follow-up analyses revealed that the toxin also induced severe damage to the heart muscle, which was significantly reduced in the cell-treated group. Furthermore, the cells were found in the heart muscle in the damaged area, indicating they may have played a direct or indirect role in cardiac regeneration.

Confirmation: Two series of experiments were conducted; in the first set of experiments, *in vitro* cultured heart cells (herein "cardiomyocytes") were exposed to the toxin to induce cell death in the presence of the blood-derived cells or placebo. Cardiomyocyte cell death was reduced by 50% when the blood-derived cells were present. Furthermore, the response was dose-dependent, showing that an increase in the relative proportion of blood-derived cells translated into a further reduction of cardiomyocyte cell death. In a second set of experiments, delivery of the blood-derived cells in another animal model of acute cardiac damage reproduced the observation—the blood-derived cells improved post-injury survival and multiple measurable cardiac functions.

At this point, the first question posed above comes into play: is it real? Clear observations were reproduced in two animal models as well as a set of *in vitro* studies. Given the consistency and reproducibility, paired with the fact that the company is focused on the

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[40] *Id.*

[41] Gil Van Bokkelen**,** *Company Profile: Athersys*, 6 REGENERATIVE MED. 39, 40 (2011), *available at* http://www.futuremedicine.com/doi/pdf/10.2217/rme.10.90.

development of cell-based products, the technology warrants further analysis. In part 2 (below), the actual competitive landscape is considered for cell-based therapeutics intended for the treatment of cardiac injury.

Part 2: The Competitive Landscape

Conducting a preliminary assessment of the competitive landscape at this point in the process is time well spent. Assuming novelty and deploying resources toward reduction to practice and advancement of the technology without consideration of the landscape could result in the development of a great technology with no real path to commercialization. Existence of prior art, especially in high-interest fields such as heart failure and regenerative medicine, is almost guaranteed; there can often be a path, albeit complex, to steer a new technology through the myriad of existing methods, compositions, and uses.[42] Furthermore, it is important to consider that patents are often available for licensure, or may expire prior to the anticipated date of commercial launch for the new technology.[43] The competitive landscape is not a still snapshot, but is more akin to a dynamic moving picture into which it is often feasible to introduce an additional character or alter the backdrop. Once the initial landscape is created for a specific area, routine updating is essential to ensure that the product remains relevant within the context of the evolving landscape.

For the purpose of this example, the following search was initiated on the United States Patent & Trademark Office: ACLM/((cell or cells) and (heart or cardiac or cardiovascular) and (repair or regenerate or engineer)), which identified a total of 57 issued patents and 468 patent applications. Screening of the 57 issued patents identified 11 issued patents with independent claims involving the use of cell-based products for repair or regeneration of cardiac tissue.[44] The specific attributes of the blood-derived cells used in this example should be compared to any general or specific cell types identified in the "composition" column of Table 1, realizing that if overlap is suspected, a more detailed analysis of the claims, specification, and examples provided in the patent will be necessary. If intellectual

[42] *See* 1 CHISUM, *supra* note 26, at § 3.02 (discussing prior art and the anticipation standard).

[43] *See generally* 69 C.J.S. *Patents* § 342 (2011) (discussing patent licensing); *see generally* 35 U.S.C. § 154 (2006) (stating patent term length).

[44] USPTO PATENT FULL-TEXT AND IMAGE DATABASE, http://patft.uspto.gov/netahtml/PTO/search-adv.htm (in the field marked "Query," enter ACLM/((cell or cells) and (heart or cardiac or cardiovascular) and (repair or regenerate or engineer)); *see also* Table 1.

property protection is sought on the cells alone, independent of method or application, an additional search should be conducted based on the defining attributes of the cells.[45] For example, many issued patents in Table 1 name general or specific cell types that are not claimed as composition of matter in the listed patent; in some cases, the cell type is too general to warrant patent protection (the 'stem cells' of 7,548,780) and in others the cells are protected as composition of matter by another patent (the mesenchymal stem cells of 6,387,369 and the "spore-like cells" of 7,060,492).[46] In contrast, some patents define the cells very specifically with a set of genotypic or phenotypic markers (the "unrestricted somatic cells" of 7,556,801).[47] Independent of composition of matter, methods and use claims that are not dependent on a specific composition should also be considered. For example, patents 6,514,515, 6,671,558, 6,696,575, and 7,338,657 contain claims that involve the seeding of cells (specific or general) onto specific biomaterials or devices for delivery; thus, if the blood-derived cells that are the subject of this analysis are delivered by these methods, the specific claims may be relevant.[48]

Analysis of the pending patent applications (from 2002–2010) identified by the initial search is more cumbersome and speculative, because the patents are still under active prosecution where claim amendments and cancellations are commonplace.[49] However, any patent application, whether claims are ultimately granted or not, becomes a public-domain document six to eighteen months after filings, depending on whether or not a provisional patent was filed in advance of the utility patent.[50] Thus, patent applications can contain subject matter (in claims, specification, or examples) that can be used

[45] For a discussion of the patentability of stem cells, *see* Allen K. Yu, *Within Subject Matter Eligibility-A Disease and a Cure*, 84 S. CAL. L. REV. 387, 414-15 (2011) (defining the question of stem cell patentability as "[w]hen does the extraction, purification, and preparation of naturally occurring products render the resulting products different enough to be considered man-made?").

[46] U.S. Patent No. 7,548,780 (filed Feb. 22, 2005); U.S. Patent No. 6,387,369 (filed Mar. 27, 2000); U.S. Patent No. 7,060,492 (filed Mar. 3, 2004).

[47] U.S. Patent No. 7,556,801 (filed Jan. 15, 2004).

[48] U.S. Patent No. 6,514,515 (filed Mar. 3, 2000); U.S. Patent No. 6,671,558 (filed Nov. 3, 2000); U.S. Patent No. 6,696,575 (filed Mar. 27, 2002); U.S. Patent No. 7,338,657 (filed Mar. 15, 2001).

[49] *See generally* 37 C.F.R. § 1.121 (2010) (allowing patent owners to amend and cancel pending patents).

[50] *See* 35 U.S.C. § 122 (2006) (stating patent applications must be published promptly after the expiration of a period of eighteen months from the earliest filing date of the application with several exceptions).

as prior art in the prosecution of a subsequent patent.[51] It is often helpful to screen the patent applications at this stage of analysis to evaluate the total number of pending patents, the filing trends over time, and the general subject matter. Figure 2 highlights the 102 patent applications that contain independent claims around cells themselves (for cardiac indications), biomaterials or devices combined with cells (i.e., a product in which cells are a component), and broad claims that include cardiac regeneration in a long list of therapeutic indications.[52] Notable trends revealed by Figure 2 are a peak in filings in 2005, and resurgence in 2008-2010 of cell-specific filings. It is recommended to populate the competitive matrix (Table 1) with relevant patent applications as well and conduct regular updates to monitor prosecution of applications and identify new relevant art.

The competitive matrix tool facilitates the answering of the second question: is it novel? Multiple opportunities exist for novelty in this theoretical example. The cells themselves may be novel, or novel in the context of use in cardiac therapy.[53] If the cells are not novel alone as a composition, there may still be opportunity to seek compositional coverage with the cells as part of a more complex formulation or as a component of a device.[54] Methods related to delivering the cells to the heart or preventing toxin-induced cardiac damage may also be patentable.[55] Finally, because the cardiac results were unexpected, therapeutic use of the cells for cardiac injury may constitute a novel application, even if the base cellular composition is not novel.[56] If commercial application of the technology is feasible and aligned with business strategy, the investment of resources into reducing the invention to practice and optimizing the technology toward commercial development are justified.

In Example 2, the refinement that occurs naturally during the development process serves to solidify methods, composition, delivery strategy, and scope of therapeutic use. As the product and the competitive landscape evolve, it is advantageous to apply more

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[51] *See* 35 U.S.C. §§ 102, 103 (2006) (excepting from patentability inventions either anticipated or rendered obvious by prior art).

[52] *See* Figure 2.

[53] *See* 35 U.S.C. § 101 (2006) (defining compositions of matter as patentable subject matter).

[54] *See id.* (defining machines and articles of manufacture as patentable subject matter).

[55] *See id.* (defining processes as patentable subject matter).

[56] *See* MPEP § 2145 (8th ed. Rev. 8, July 2010) (discussing the use of evidence of unexpected results to rebut prima facie cases of obviousness under 35 U.S.C. § 103).

rigorous mapping of the technology against the competitive landscape; heatmapping strategies provide an information-rich and highly visual means for tracking the positioning of a product within the competitive landscape.[57] The near-commercial version of a product has typically undergone significant modification from its original form, which underscores the importance of formulating a strategy.

Part 3: Formulating a Strategy

The key elements of intellectual property strategy are mechanisms of protection and timing. In Example 2, assume that the cells (which are novel) are combined with a hydrogel (which is not a new invention), and efficacy in the cardiac application requires delivery of the cells + hydrogel to the heart using a new device that had to be developed specifically for the application. What is the product? Cells + hydrogel loaded into a device for delivery to the heart—that is what will be packaged, sold, and put into the hands of the clinician who will administer it to the patient. It is useful to consider: 1) each component separately (cells, hydrogel, device); 2) the methods of manufacturing each component; 3) the composite product; and 4) therapeutic use(s) of the product. Unless it is necessary to disclose methods of manufacture, for business or regulatory reasons, it may be beneficial to hold manufacturing methods as trade secrets.[58] However, if the manufacturing process can be deduced by analyzing the product ("reverse engineering") it may be preferable to file claims on the manufacturing methods as well.[59] Obtaining broad composition of matter claims on the individual novel components (cells, device) provides support for platform strategies, where the components are likely to serve multiple indications; this strategy also prevents competitors from making small changes to the final composite product and bringing forward a 'new' composition.[60] Robust (but narrow) patent protection of the final composite product

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[57] Keiichi Himeno, Masayuki Miyake & Yuji Mune, *Strategic Intellectual Property Portfolio Management: Technology Appraisal by Using the "Technology Heat Map"*, NOMURA RES. INST. (2004), http://www.nri.co.jp/english/opinion/papers/2004/pdf/np200483.pdf.

[58] For a comparison of patents to trade secrets, *see* 2 LOUIS ALTMAN & MALLA POLLACK, CALLMANN ON UNFAIR COMPETITION, TRADEMARKS & MONOPOLIES § 14:15 (4th ed. 2011).

[59] *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 476 (1974) (defining "reverse engineering" as "starting with the known product and working backward to divine the process which aided in its development or manufacture.").

[60] *See generally* Soonwoo Hong, *Claiming What Counts in Business: Drafting Patent Claims with a Clear Business Purpose*, WORLD INTELL. PROP. ORG., http://www.wipo.int/export/sites/www/sme/en/documents/pdf/drafting_patent_claims.pdf.

can provide additional insurance that the specific product is protected, along with the revenue that it may generate.

Establishing effective strategies to control the timing of patent filings can be challenging, especially in environments where public disclosure of intellectual property must occur for business or technical reasons. The competitive landscape matrix can provide some guidance. In Example 2, the landscape (including issued patents and patent applications) is extensive; applications involving cells are numerous. Thus, seeking coverage for the blood-derived cells and the delivery device as stand-alone compositions of matter is advisable. However, the methods used to make the cells and the device may be best kept trade secret, providing the methods will not appear in the public domain. While methods can be easy to work around, the methods used to deliver the cells + hydrogel and repair the heart will be exposed to the end-users, and therefore it may be advisable to seek coverage. In a crowded field such as the one in this example, the timing of filing patent applications must be weighed carefully. Filing as late in the development process as possible may provide the benefit of a long post-commercial patent life, but will carry the risk that a competitor files a blocking patent with an earlier priority date.[61] Likewise, filing early reduces competitive risks, but could shorten the post-commercial patent life and, if filed too early (before methods and designs are solidified), could actually compromise the ability to protect the actual product.[62] Patent prosecution can be time-consuming; among the examples provided in Table 1, the average time from priority date to issuance of claims in the patent was 5.3 years.[63] The gap of time between filing a patent and obtaining issued claims may be a factor in determining when to file, so that claims are issued or in later-stage prosecution when the product is released onto the market.

IV. SUMMARY

In summary, the role of a technology manager extends well beyond managing technical strategy and operations. Intellectual property, whether protected in the form of a patent or as trade secret, is the foundation for revenue streams captured by market position, licensing fees, and royalties. Strategic research and development is most effective when conducted with full knowledge and consideration

[61] *See generally* 35 U.S.C. § 119 (2006).

[62] *See* Christopher A. Cotropia, *The Folly of Early Filing in Patent Law*, 61 HASTINGS L.J. 65 (2009); 35 U.S.C. § 102 (2006) (defining losses of right to patent).

[63] *See* Table 1.

of the competitive landscape. Comparative analysis practices and tools are invaluable in the stewardship of technology from concept through commercialization. Finally, a close partnership between technical, legal, and business functions is critical in the execution of a sound intellectual property strategy.

FIGURE 1

FIGURE 2

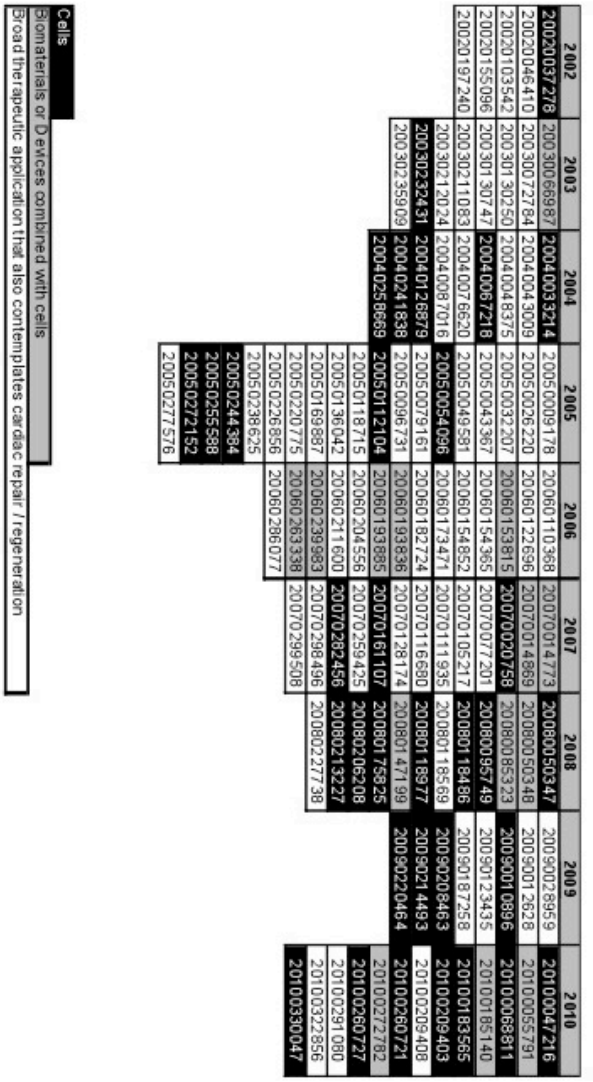
2002
2003
2004
2005
2006
2007
2008
2009
2010
Cells
Biomaterials or Devices combined with cells
Broad therapeutic application that also contemplates cardiac repair / regeneration

TABLE 1

Patent	Issue Date	Priority Date	Time to Issue	# of Claims	Ownership	Composition of Matter	Method / Process	Therapeutic Use(s)
6,087,552	7/11/2000	11/15/1994	5Y/8M	47	Sisters of Providence in Oregon	A composition-specific biomaterial, optionally seeded with cells (fibroblasts, endothelial, epithelial, or urothelial)	Method of making the biomaterial	Repair of: - heart valves - heart implants - dialysis equipment - oxygenator tubing for heart lung by-pass systems
6,387,369	5/14/2002	7/14/1998	3Y/10M	17	Osiris Therapeutics, Inc.	mesenchymal stem cells *	- Delivering mesenchymal stem cells directly to the heart - Delivering mesenchymal stem cells systemically	- Producing cardiac muscle cells in the heart - Reducing scar formation in infarcted heart tissue
6,514,515	2/4/03	3/4/99	3Y/11M	39	Tepha, Inc.	A polymer-based composition or device that possesses mechanical properties - optionally engineered to mimic - mechanical properties of specific tissue - optionally engineered to mimic - mechanical properties of cardiac tissue - optionally seeded with cells for implantation		
6,671,558	12/30/2003	11/07/1997	6Y/1M	51	MedTronic, Inc.	An implantable system comprising a cell repopulation source for damaged myocardial tissue (+/- genetic material) and an electrical stimulation device - Repopulating source comprising cells (cardiomyocytes, myoblbes, or muscle fiber cells) - Repopulating source as a protein - Repopulating source as a chemical or genetic material	Method of implanting cell repopulation source into or near damaged or diseased myocardial tissue and electrically stimulating the new tissue with an implanted electrical stimulation device - Delivery via catheter - Delivery via syringe	Repair of heart myocardium with the described implantable system - improve cardiace systolic function - improve cardiac diastolic function - improve cardiac muscle elasticity - improve cardiac muscle contractility - Increase left ventricular function - Treat or repair myocardial infarction - Improve heart function in coronary artery disease
6,696,575	2/24/2004	3/27/2001	2Y/11M	39	University of Texas System	Chemical compound for use in a biodegradable electrically-conducting polymer - the chemical compound delivered to the body in the form of sutures, sheets, films, and scaffolds for tissue engineering - the chemical compound mixed with any combination of bioactive compound, cell type, or polymer blend		Transplant engraftment, tissue regeneration, tissue repair, tissue reconstruction, tissue growth, tissue differentiation (including heart)
6,805,860	10/19/2004	9/30/2001	3Y/1M	19	Sciotec GmbH	Autologous cells derived from bone marrow, adipose tissue, or lipoaspirate *	Delivering stem cells to heart tissue damaged by myocardial disease though a blood vessel, occluding the vessel during delivery to increase concentration of the stem cells at site; - Delivery of cells to the heart via catheter - Use of balloon catheter for occlusion during delivery; - Process of harvesting autologous adult cells as the source to be delivered; - Process of harvesting cells from bone marrow, adipose tissue, or lipoaspirate	Repairing tissue in the heart

7,080,492	6/13/2006	10/30/2000	5Y/8M	27	University of Massachusetts	Spore-like cells *		- Method of isolating spore-like cells from a mammalian tissue or fluid - Method of culturing the spore-like cell population - Method of placing spore-like cells in a matrix - Method of implanting matrix into a tissue for repair, augmentation, or regeneration - Method of implanting the matrix into heart tissue	Repair, augment, or regenerate tissue (including heart)
7,338,657	3/04/2008	3/15/2001	7Y	25	Biosphere Medical, Inc.	Injectable composition for tissue generation comprising (a) polymer microspheres associated with stem cells and (b) a biocompatible carrier, injectable through 18G needles - Stem cell components of composition are mesenchymal stem cells isolated from bone marrow, muscle tissues, dermis, or combinations thereof		Administering a therapeutically effective amount of the composition - target tissues include heart	Vascularization effects, anti-vascularization effects, visualization properties, anti-inflammatory effects, anti-bacterial effects, antihistamine effects, or combinations thereof
7,452,532	11/18/2008	9/30/2001	7Y/2M	11	Sciotec GmbH	adult stem cells * adult multipotent cells *		Delivering adult stem cells to replace failing heart tissue - through blood vessel that leads to the site of repair - occluding blood vessel proximal to location of cell entry to increase concentration of cells delivered	Repairing tissue in the heart
7,548,780	6/06/2009	2/22/2005	4Y/4M	38	Cardiac Pacemakers, Inc.	stem cells *		Applying neural electrical stimulation via an implanted device to a cardiac region subjected to exogenous cell therapy, gene therapy, and/or cytokine therapy	- Modulating cardiac contractility - Reducing local inflammation - Reducing mechanical load - Sensing a physiologic parameter indicative of local cardiac contractility, inflammation, mechanical remodeling, or mechanical load - Modifying electrical stimulation based on sensed physiological parameter
7,556,801	7/07/2009	11/3/2000	8Y/9M	1	Kourion Therapeutics GmbH	unrestricted somatic stem cells from umbilical cord blood with a specific marker expression profile (CD14-, CD45-, CD13+, CD29+, CD44+, CD49e+, fibulin-2+, hyaluronan synthase-, fibromodulin-)		Treating cardiac muscle disease by administering unrestricted somatic stem cells	Regenerating cardiac muscle cells in the heart

* Cells are named, but specific cellular compositions are not covered by claims in the patent