Facilitating Open Innovation: Focusing on IP Management Rather Than IP Rights

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Author(s): Tony Williams

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Abstract

In a closed innovation company, intellectual property (IP) strategy is typically one of defense. In fact, some companies pursue trade secret approaches because even using patents is considered too risky of an exposure to their critical competitive advantage. In an open innovation company, traditional IP strategies hamper adoption and execution of innovation. Open innovation encourages sharing ideas and solutions with another company, not being closed and secretive.

What IP strategies, infrastructure, and processes need to be in place for open innovation to thrive? In this paper, a literature review is completed toward an attempt to consider the main methods of open innovation IP protection, valuation of that IP, IP marketing/brokering infrastructure, innovation enabling aspects of IP protection methods, and general obstacles to collaborating on IP usage and creation in an open innovation environment.

1. How Open Is Open?

The term open innovation is generally agreed to have been coined by Henry Chesbrough in a book publish in 2003 entitled Open Innovation: The New Imperative for Creating and Profiting from Technology, in which he said "open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough 2003a, p vii). Even though many realize that innovation has always been somewhat open (Dahlander, 2010), Chesbrough's work brought to light a recent trend of increases in collaborations due primarily to a maturing of intellectual property rights (IPR) markets,

an increase in venture capital firms, growth in technology standards (Dahlander & Gann, 2010), and the increase of the value of intangible assets to 83% of the value of firms, IP being the largest portion of that (Hagelin, 2002).

Open innovation is not public innovation or free innovation. Even though the term it bears some resemblance to, open source software, conveys something that is free under certain usage conditions and is certainly a fully collaborative effort, open innovation refers to not necessarily free collaboration to produce a marketable product or service.

The use of the term "open" is actually one of the more prevalent sources of confusion about the definition of the term open innovation because constructs such as open science, free culture, Free Software Foundation, and the Open Source Initiative, etc. are now so prevalent (Wikhamn, 2013). Eric von Hippel tried to define the terms open source and open science as referring to information that is not constrained by IPRs and Chesbrough's open innovation as referring to an organization's permeability to information related to product and service development (von Hippel, 2010). I will use this definition and distinction in this paper.

2. How Does an Increase in Openness Influence Business Strategy?

One way to look at open innovation and how it can be framed in a company's business strategy is to consider it two dimensions of inbound versus outbound information, and of pecuniary versus non-pecuniary information (Dahlander & Gann, 2010). These four modes are:

Selling – getting money for outbound information, products, services,

Revealing – giving away outbound information,

Sourcing – getting free information, and

Acquiring – paying for inbound information.

In the context of open innovation, companies sell their IP to other companies to fuel their innovation and the recipient becomes the focal firm in the open innovation discussion. Revealing is freely disclosing IP, which IBM did in 2005 when they released 500 patents to the open source community to signal that they were interested in collaborating. Sourcing is receiving the information freely revealed by another firm or person, through spillovers or through something like open source software. Acquiring is paying for IP and information, such as ideas or patent licenses, from other companies or individuals. One can look at these four dimensions and explore how open innovation impacts a firm's strategy for developing products and services.

All things being equal, companies would prefer to not collaborate, but often they are in situations where they have to get help. In the selling and acquiring dimensions, IPR becomes the "currency of innovation" (Alexy, Criscuolo, & Salter, 2009, p 73). We will discuss many logistical issues with the selling and acquiring dimensions later in this paper. However, these types of transactions are frequently difficult because of high partnering uncertainty, high costs of establishing or coordinating, or an unwillingness to collaborate on either side (Alexy, George, & Salter, 2013).

As a solution, a focal firm can use revealing and sourcing dimensions to illicit collaborative behavior from another firm without them even being aware. Outgoing spillovers can evolve along the path of many actors and eventually return to the focal firm to their advantage (Agarwal, Audretsch, & Sarkar 2010). And, once the relationship

is established, more common approaches to open innovation, such as acquiring and selling IPR, can begin between the firms.

Within the revealing dimension, we can talk about revealing a problem or a solution (Alexy, George, & Salter, 2013). Revealing a problem invites other firms to submit ideas or implementations of solutions to the focal firm. Revealing a solution markets a firm as having a solution to some other firm's problems. Both of these "induce isomorphism" (Alexy, George, & Salter, 2013, p 272) in the production of shared knowledge. Alexy et al further considers these two modes of revealing along with two types of a company's strategic goals: path creation and path extension. The product of the intersection of these four motifs of "selective revealing" (Henkel, 2006, p 954) can be defined as four tactical paths: issue spreading, agenda shaping, product enhancing, and niche creating.

Selective Revealing Tactical Paths (Alexy, George, & Salter, 2013)

	Problem Revealing Mode	Solution Revealing Mode
Path Extension Goal	Issue Spreading (broadcast search, ala Greentouch Initiative)	Product Enhancing (open source software, al a Eclipse)
Path Creation Goal	Agenda Shaping (open research calls, al a DARPA)	Niche Creating (academic publishing, al a Arup fire elevators)

The above discussion talks about open innovation versus closed innovation as if they were a black and white operational dichotomy. The reality is most firms practicing open innovation "operate in a grey zone, where due to specific reasons they choose to adopt certain open innovation activities over another" (Parida et al, 2010, p 5).

3. How Does IPR Fit In Open Innovation?

Although there is much in the literature about selective revealing, when and how to use it, how it is related to open source software and standards, etc., it is a mostly uncontrolled transfer of knowledge, which Wilkamn calls "Libre Openness" (2013, p 276), as opposed to "Controlled Openness". In his mind, IPR is a mechanism to regulate openness between organizations participating in "Controlled Openness". The use of IPR and contracts (Joint Development Agreements (JDAs)) that define 'background IP' (what firms bring before the alliance) and 'foreground IP' (what firms create together during the alliance) and the rights of the actors to benefit from the foreground IP are "crucial building blocks for regulating [and encouraging] participation" (Wilkamn 2013, p 380) in open innovation.

Hagedoorn and Zobel (2015) studied fifteen companies considering themselves open innovation practitioners, and determined that 95% of them use formal contracts and IPR that govern their relationships. In fact, they found strong positive correlations between the use of strong IPR and the degree of openness, the strength of R&D capabilities, and the levels of competitive dynamics.

Chesbrough agrees that strong IPR is a facilitator of the open innovation that he is describing in his work. He complains that IPR decisions are still being made by lawyers as a carryover from the closed innovation days, instead of being used as a strategic management tool to implement open innovation (Chesbrough & Ghafele, 2014). He says that strong IPR appropriability regimes "foster revenues for those pursuing an inside-out open innovation approach" (p 194), and promotes specialization within an industry. This then creates a rich economy of ideas and implementation competencies.

When we talk about IPR in the context of open innovation, we are talking primarily about patents. Even though in a letter to Isaac McPherson on August 13, 1813, Thomas Jefferson considered the exclusivity rights given by many patents to be "monopolies [that] produce more embarrassment than advantage to society" (Liscomb, 1904, p. 334), since 1982 the Court of Appeals for the Federal Circuit (CAFC) confirmed the validity of 89% of the patent challenges brought to it. Because of this and because of the emerging fields of biotechnology and software, there has been a broadening of patented subject matter since the 1980s (Mazzoleni & Nelson, 1998).

Historically, the broad reasons for having patents have been to 1) motivate useful invention, 2) induce the investment needed to develop and commercialize inventions, 3) reward the disclosure to society, and 4) enable the orderly exploration of broad prospects. However, patents can also discourage invention in areas close to an existing patent. They can cause extra effort to learn how to design around them. If multiple firms are patenting in the same area, their combined patents can create a 'patent thicket' that brings the industry to its knees. This happened in the aircraft, sewing machine, and radio industries and only government intervention allowed the industries to continue to innovate (Mazzoleni & Nelson, 1998).

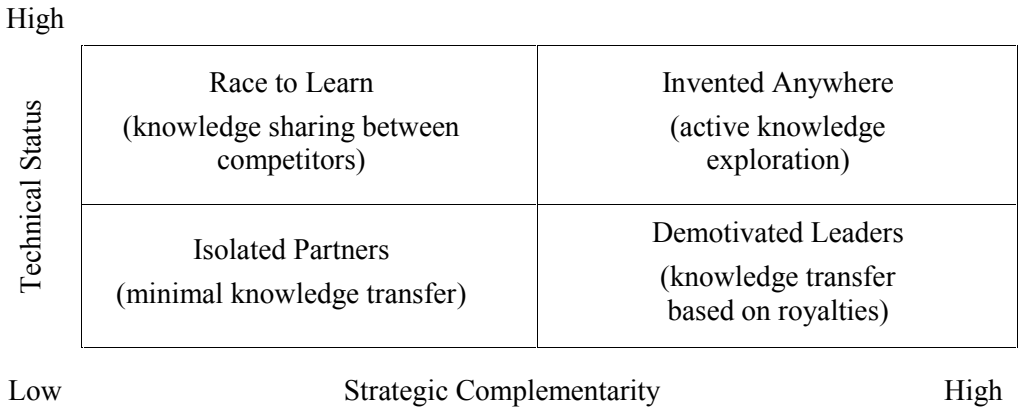
A patent decribes a technology, not a business model that will make money. As Chesbrough says, "technology itself has no inherent value; …value only arises when it is commercialized through a business model" (2003c, p 40). Put another way, the value of a patent asset "resides entirely in the value of the tangible assets which incorporate them" (Hagelin, 2002, p 1138). Open innovation does not occur if IP is "transformed from a means of capturing value of innovation to an end in itself" (Alexy, Criscuolo, & Salter,

2009, p 72). It only occurs when companies use IP strategically to enable the creation or extension of products and services. And, because there is a plethora of situations companies find themselves in, a single simple approach to IPR cannot work, especially if it is focused only on protecting the IP. Companies must become expert in using IPR to further their open innovation goals. IPR management needs to become a company's core competency (Shih et al, 2013). Firms need to shift their concerns from protecting their IP to maximizing its commercial value in the most efficient manner (Hurmelinna, Kylaheiko, & Jauhiainen, 2007).

4. How Do We Efficiently Use Patents To Innovate Openly?

The presence and quality of patents can be an effective way to evaluate and select innovation partners. Cho & Lee define high "strategic complementarity" (2016, p 19) as the extent to which technical capabilities and product or service markets do not overlap. Their proposal is to use the inverse of the overlap in standard industrial classification (SIC) codes multiplied by the overlap in international patent classification (IPC) codes to indicate strategic complementarity. In other words, companies with compatible technology but differing markets have higher strategic complementarity. In addition, they promote the idea of analyzing patent citation counts as an indication of both the number and quality of patents (i.e. technical status), when compared to other alliance candidates. These measures, coupled with the strength of market share should stand out during a partner selection process. They define a matrix like that below (Cho & Lee, 2016):

R&D Alliances



In their model, only the Invented Anywhere quadrant represents healthy, vibrant alliances which have a high potential for synergy and commitment for open innovation. Nevertheless, the Race to Learn and Demotivated Leaders quadrants provide some useful scenarios.

Great improvements in control and efficiency in open innovation can be realized in proper management of the alignment of IPR with product and service architecture modularity. A focal firm must appropriate for itself enough economic benefit of an architecture to make the development worthwhile. But, that doesn't mean it needs to have it all. Joel West considers how three famous companies (Apple, IBM, and Sun Microsystems) made a choice between proprietary and open source paths to their software architecture to try and address the major competition from Microsoft (West, 2003). Apple created an open source operating system (OS) based on BSD Unix, but kept its graphics, multimedia, GIU, Mac OS 9/X APIs, NextStep APIs, and Java APIs proprietary. This allowed Apple to benefit from efforts of the BSD community for improvements in web and mail services, as well as hardware device drivers, while keeping its differentiation in its iconic user centered designs. IBM fully adopted Linux,

including for the S/390 and DB2 platforms. IBM spent $1B on Linux in 2001 and created the highly adopted Eclipse IDE in open source under the Common Public License (not GPL). Their strategy resulted in the maximum damage to Microsoft, yet allowed them the freedom to make proprietary enhancements and focus on applications for real differentiation. Sun Microsystems had less success. It focused on making Java open source, but Microsoft customized it and muddied their waters. Later they published the Solaris OS under an SCSL license and released their MS Office look-alike StarOffice under a Lesser GPL license. They ended up making Linux servers and being bought by Oracle.

These stories exemplify the high sophistication of IP and open innovation strategy. By designing their architectures to allow for portions to be provided or enhanced by partners and the other portions strongly protected by IPR, an open innovation firm can efficiently manage their IP and product development. In fact, one could say that architecture modularity enables open innovation (Baldwin & Henkel, 2012). Furthermore, modularity aids and enhances IP protection by hiding portions of IP that are difficult to protect by patent or agreements. If external IP is used in a focal firm's design, modularity can enable encapsulation to reduce the cost of integrating the external IP into the product.

In the words of Henkel, Baldwin, and Shih (2013), "boundaries of parts with different IP status coincide with the technical boundaries of modules" (p 68) in an IP modular system architecture. Their discussion goes beyond encouraging open innovation with modularity. They suggest techniques of protecting IP by using the modularity to limit access to contiguous modules within a single supplier or employee group that has

access to IP (to control knowledge transfer), of coupling weakly protected IP inside a strongly protected module to limit visibility, and of encapsulating uncertain or fast moving technology into modules for the possibility of changing the IP status of that module as needed in the future.

Designing products and architectures for 'IP modularity' requires that the designers have at least a basic understanding of IP rights and mechanisms. This is part of building an open innovation firm's core competency, and I will mention this again below in the section on employee training for open innovation.

The potential problem of 'patent thickets' discouraging industry growth was mentioned above. These can be prevalent in areas that require a systems approach. Patents can also make it difficult to collaborate with other firms in developing new technology, especially in the areas of systems interfaces in software. If patents are given in a fragmented manner, they create an "anticommons" (Heller & Eisenberg, 1998, p.280) economic resource that is covered by a large number of "individual exclusionary rights" (Merges, 1999, p.6) which makes it practically impossible to create a common good for society. A good example of this is when patents are granted to individual gene fragments that can preclude development of downstream products that require use of several fragments (Merges, 1999).

One solution to such situations is to create a patent pool. A patent pool is an organization or firm created to own at least a portion of the IPR of several related patents, whereby each member of the organization has rights to use some or all of those patents. This type of solution is used by firms such as ASCAP in the copyrights IPR arena. There have been several examples of patent pools being used to eliminate patent failures in oil

field technologies, early shoe machinery industry, automobile industry, as well as in several cases, the digital media industries such as MPEG-2 and DVD (Merges, 1999). Another example is the Taiwan TFT-LCD (thin film transistor – liquid crystal display) Association, a patent pool containing 232 patents (Lee, Kim, Oh, & Park, 2013). Yet another is the Open Invention Network, a patent pool set up to protect Linux (Chesbrough & Ghafele, 2014).

Another difficult situation occurs when a very broad patent is issued for a new technology, yet the firm does not have enough resources to fully exploit the patent quickly (Mazzoleni & Nelson, 1998). To solve such challenges, and many others, there has been a vast increase in the numbers and types of intermediaries in the IP marketplace.

Of these practitioners, the following have implications for open innovation (Millien & Laurie, 2007):

IP/Technology Development Companies – These are companies that usually don't develop their own products, but develop IP and sell/license it to companies that design/make/sell products.

Licensing Agents – Assist patent owners in finding companies to license their IP.

Patent Brokers – Assist patent owners in finding companies to buy their IP.

On-Line IP/Technology Exchanges/Clearinghouse – These are online facilitators for buyers and sellers of IP rights, somewhat like a Craig's List for IP.

IP-Backed Financiers - These companies bridge lending companies and IP owners, using the IP as collateral.

Royalty Stream Securitization Firms – Companies that use a Bankrupt Remote Entity (BRE) to buy a firm's patents and then license rights back to them. The BRE issues notes (i.e. bonds) to investors that benefit from future royalties and pays the original patent owner an agreed upon purchase price.

Patent Rating Software and Services – Software companies sell individual patent analysis tools.

University Technology Transfer Intermediaries - IP/Technology Development Companies, Licensing Agents, and Patent Brokers that focus on university technology transfer market.

In addition, the following are emerging business models:

Live Patent Auction House – Auctions are one good way to establish the true real time value of a patent. Because of the desire to "make IP a liquid asset class" (Millien & Laurie, 2007, p.1) companies such as Ocean Tomo, LLC and IP Auctions GmbH have held live patent auctions.

IP Transaction Exchanges/Trading Platforms – Similar to NYSE or NASDAQ, these platforms have been proposed to list and trade "IP-based financial instruments….much like stocks are traded today" (Millien & Laurie, 2007, p.4)

Defensive Patent Pools – These are set up by firms that want to share existing patents that they fear some predator will acquire and keep them from doing business. See discussion about patent pools above (Chesbrough & Ghafele, 2014 and Millien & Laurie, 2007).

Technology/IP Spinout Financing – These are venture capital or private equity firms that specialize "[in] spinning out promising non-core IP which has become 'stranded' within larger technology companies, or [in] creating joint ventures between large technology companies to commercialize [their] technology" (Millien & Laurie, 2007, p.4).

Patent-Based Public Stock Indexes – These are an evolution of Patent Rating Software and Services (above) that publishes indexes of public companies based on the value of the patents they hold (Millien & Laurie, 2007).

As can be seen above, the "IP marketplace itself is not immune to innovation!" (Millien & Laurie, 2007, p.4).

5. Developing a Strong IPR Core Competence

Perhaps because the mechanisms of strong IPR have been around for some time, there is much literature from experts in that field chiming in on the open innovation theatre. Several good papers put an open innovation spin on how firms should become expert in strong IPR (Mehlman et al, 2010, Parida et al, 2010, and Slowinski, 2006 & 2008). Perhaps it is best to explore these based on the phases of involvement in the

innovation (i.e. exploration phase, joint development phase, and commercialization phase). After that, we will touch on employee training issues.

5.1. IPR Issues During the Exploration Phase:

Alliances most often fail because managers don't consider that the alliance is not only between the two companies, but also between all the alliances within each company (i.e. internal departments, third party companies, etc.) (Slowinski, 2008 and Mehlman et al, 2010). Therefore, it is crucial to approach the exploration phase of open innovation implementation as a cross functional endeavor, not just involving the product development and legal departments of the focal firm.

One of the factors during the evaluation of potential partners is the size of the partner. Small partners are typically inherently more challenging and risky for a focal firm. In many industries, the joint development can be long-lasting (3-5 years) and this can be unsure when the partner is small and struggling. If the focal firm is much larger and a small partner is being considered, the end result is often acquisition, since it can be easier than dealing with all the difficulties mentioned above (high partnering uncertainty, high costs of establishing or coordinating) (Parida et al, 2010 and Alexy, Criscuolo, & Salter, 2009).

Scouting for technology must become a core competency. Already mentioned were some ways to use patent mining to search for firms with strategic complementarity (Cho & Lee, 2016). To evaluate a potential partner, the firms must be exposed to each other's technology, which is a delicate issue mainly because neither firm has confidence that there will be a definitive agreement in the end. The first step should be to avoid

intellectual asset (IA) pollution by accessing only public information and disclosing only non-proprietary information in meetings (Mehlman et al, 2010). Trade secrets and know-how are especially intangible and are "easily shared, travel effortlessly in people's minds, and resist being categorized into neat little piles labeled proprietary and non-proprietary knowledge" (Slowinski 2006, p 38).

Of course, an NDA is a valuable tool during this exploratory phase. However, there are many misconceptions and subtleties of NDAs. NDAs serve two main functions: first, they raise awareness in the parties of the proprietary nature of the information about to be discussed, and secondly they protect the patent rights of the party disclosing. When the disclosure takes place under established confidentiality, the patent *filing* rights are preserved. In other words, an invention is not considered disclosed for patent purposes when it is done so through an NDA (Slowinski, 2006). Another related subtlety is that the common clause to document any disclosure of confidential information and provide the documentation to the other side within a specific period of time can create a dangerous double-edged sword. Even though the seemingly innocent concept lets each side know which disclosures must be treated carefully, any disclosures *not* identified as such within the time period are considered a public disclosure (Mehlman et al, 2010).

A firm still must be careful after executing an NDA, but before a JDA is established. If it starts to discuss technologies and an invention happens to be created during discussions, that invention is considered a joint invention. This means joint ownership and both firms can monetize the invention, including licensing or selling it to another firm (Slowinski, 2006). It is only in Joint Development Agreements (JDA) that firms typically address ownership and rights of joint inventions (i.e. foreground IP).

Regarding protecting their know-how in university relationships, a firm must clearly and early define the university's right to disclose the results of the collaboration, such as during conferences and in academic journals. As in all partnerships involving IP, all members of the partnering company or institution working on the project must understand the terms of the agreements (Slowinski, 2006).

Other business processes impacted by the exploratory phase of open innovation include a firm's strategic technology planning process and their customer involvement process (Parida et al, 2010). Often these need to be overhauled in order to accommodate the increased complexity of involving outside partners.

5.2. IPR Issues During the Joint Development Phase:

The Joint Development Agreement (JDA) is the most important agreement that guides project activities in the joint development phase. The three most important goals of the JDA are to establish a technical plan, to allow each firm to have the necessary background information and rights, and to establish the allocation of foreground patent rights. Prior to entering negotiation of a JDA, it is best for each firm to prepare and exchange a simply summary statement of the firm's IP strategy and its needs for the JDA (Mehlman et al, 2010).

The technical plan includes the roles of each firm, the resources being committed to on both sides, the metrics of performance, the deliverables, and the decision making process that will be used throughout the collaboration. The worst case scenario is at the end of joint development the results are lacking even when both firms have carried out

their responsibilities specified in the agreement. This is avoided by carefully setting the expectations, outcomes, and verification plans (Slowinski, 2006).

Each partner needs access to any background IP from the other and from any third parties (Slowinski, 2006). If this work requires disclosure of know-how or trade secrets, the JDA should spell out how the partners will protect each other after disclosure (Mehlman et al, 2010). Of particular concern is any exclusively licensed background IP in either partner that might constrain future foreground IP. Slowinski advises conducting three separate asset checks to detect this problem: one early on in negotiations, one midway through negotiations, and another before signing (2006).

The goal of the joint development phase of open innovation is the creation of protectable intellectual assets (foreground IP) (Mehlman et al, 2010). In the absence of a JDA to the contrary, any invention is jointly owned and exploitable. Typically, the relationship of inventorship and the rights to use (RTU) the invention are defined in one of two ways (Slowinski, 2008):

> Sole Option – Inventorship and RTU are equal. This means that only the firm that invents the IP can exploit the IP.
>
> Joint Option – Inventorship and RTU are independent. Each firm will have the right to use the IP, regardless of whose employees did the inventing.

As always, make sure the NDA has clear walk-away provisions. It is usually more productive to focus attention first on RTU then on ownership (Mehlman et al, 2010). Since inventors and scientists are motivated by being the listed inventor in the

patent, you can motivate these employees to invent and still get the market benefits of the Sole Option if the NDA allocates exclusive rights to each partner. The RTU are defined along three domains: field of use, geography, and time. The JDA should outline the foreground rights each firm has under the boundaries of the collaboration, outside of those boundaries, and upon agreement termination (Slowinski, 2006 and 2008).

If possible, carefully consider *when* to finalize the details of the commercial agreement. This is because the negotiating power moves around depending on the phase of the project and the goals of the firms. For example, if the commercial details are negotiated early, a market-facing firm has power because the technology is not proven. When the technology is proven, the technology producing firm has power. The allocation of RTU between them is important to establish early because they may not be able to come to a detailed commercial agreement. The details of the commercial agreement may best be delayed, depending on the circumstances (Mehlman et al, 2010).

A best practice involving patent filing during the joint development phase of open innovation is make sure each partner reviews any patents prior to filing and/or publication. This will insure that "inventors are correctly identified, the patent claims cover all areas of both firm's business interests, and no confidential information belonging to the other party is included without consent" (Slowinski 2008, p 64).

Other business processes impacted by the joint development phase of open innovation include an employee driven innovation process, any out-sourcing process, and network centric innovation processes. Also, a firm about to embark on open innovation should seriously consider the suitability of their design tools, such as web portals, audio/video communication tools, project rooms, communication security, technological

system standards, virtual prototyping, and simulation and modeling for product development (Parida et al, 2010).

5.3. IPR Issues During the Commercialization Phase:

As mentioned above, the timing of establishing the details of the commercialization agreement can be strategic. The two critical issues for commercialization include the business plan and a financial model that includes and shares both risks and rewards. The financial models must not only capture the value and the assets required to create the value, it must include a forecast of cash and IP flows. The overall goal of the financial model is to show that each firm's contributions and benefits are equitable (Mehlman et al, 2010).

5.4. Employee Training Issues:

Along with the NIH cultural obstacle to open innovation, there is an 'I do not *know how* to work outside' obstacle. Dealing with this requires technical people to learn a new skill around protecting IP. In order for employees to learn there must be an open discussion about risks. There needs to be an understood link between the agreements and the marketplace, the technical intent of each party, and the work processes used within the firms (Slowinski, 2008).

A member of each key group in the company needs to be part of the planning and negotiation of agreements. In addition, the portfolio of agreements needs to be tracked (Slowinski, 2006).

The exploratory phase is the most dangerous. Prior to any meetings with a potential partner, the legal department of a firm should give an intellectual asset

protection lesson to the entire team. Each exploratory meeting should be carefully documented, including the list of attendees. Prior to the engagement, the participants should have a good understanding of the candidate firm's publically disclosed products and IP (i.e. their patents) (Mehlman et al, 2010).

During the joint development phase of the collaborative project, each employee involved needs to focus on knowing the firm's obligations under the agreement. All work and especially interactions with the partnering firm must be fully documented. To prove inventorship and to confirm confidential information disclosed orally, each employee needs to know how important it is to label all confidential information. (Slowinski, 2008).

All the legal agreements mentioned above are necessary but not sufficient to protect intellectual assets. It is also important that members of both firm's technical staff understand how IP creates value for their firm and knows how and when or when not to share.

6. What are Some Gaps in the Literature and Ideas for Future Research?

Management skills that serve to combine internal and external development are different from those of internal-only R&D. This is true for the technical, product, marketing, and financial sections of the company. This suggests research is needed to identify and confirm those changes in skills being sought after and/or being demonstrated in successful open innovation companies.

Open innovation practices must be creating tensions within the focal company beyond R&D. For example, the shear bandwidth increase in contracts, legal, and finance are obvious. According to Dahlander and Gann, this is worthy of research (2010).

There is a serious lack of literature on the various costs associated with the open innovation approach, especially including the risks associated with this approach. Dahlander & Gann would like to see a study on the costs of open innovation (2010).

There appears to be much less research available on the underlying decision processes used in open innovation companies. Perhaps a Hierarchical Decision Model for typical open innovation decisions would be a useful thing to do.

Although there is probably a significant amount of literature on open innovation's effects on stage gate and agile product development processes, this could be a useful separate literature review project.

What is next after open innovation? Maybe 'networked innovation' or 'innovation networks'. These are networks of external developers that form with little regard to organizational boundaries. I would expect to see something like this already going on in collaborations between companies allocating resources to work on specific open source software initiatives (i.e. like Intel, IBM, and maybe Apple or Qualcomm all working on a single open source project). The interactions between those company members would be interesting to study. In a more commercial endeavor, high IPR would be required, but perhaps with Business Process Management (BPM) tools integrated into the network, perhaps with IT tools and cloud services. It could be remarkably like military aerospace companies in their level of IPR control, but orders of magnitude more efficient at maintaining that level of control.

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