Patent and Non Patent Strategies in R&D Based Entrepreneurship: A 4 Step Test

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Abstract. In this paper we challenge a common view that patenting is always a ‘good thing’ for R&D based entrepreneurs to do. We note that in an attempt to provide some simple generic advice to all entrepreneurs that government agencies (e.g. patent offices) often ‘dumb down’ the business and economics complexity inherent in patents. Unfortunately, this causes R&D based entrepreneurs to think that they should always patent innovation. This has the effect of exaggerating the legal costs and commercial benefits of patents with the result that entrepreneurs and investors (1) are often deterred from engaging in R&D based ventures, (2) overspend on patenting and (3) overestimate the asset value created by the patents. We offer a 4 step test to help entrepreneurs decide how much patenting they need to undertake and how much value it will create for their business. The first 3 steps of the test define the ability of patents to generate value. This benefit is then weighed up against the 4th step which assesses the cost of patenting.

Keywords: patents, scientist entrepreneurs, R&D entrepreneurship, strategy.

1. Introduction

Patent filing is widely promoted as “a good thing”. In the US, Microsoft’s Bill Gates is reported as having advocated “patenting as much as we can” (Warshofsky, 1994) while Saluja and Rawat (2009) have argued that companies must “patent or perish”. Patent office straplines such as “For Creativity and Innovation” and statements that “Patents … let inventors profit from their inventions” \(^1\) do nothing to discourage this impression. Indeed, Kingston (2004) suggests that efforts by national patent offices to increase awareness of the patent system by SMEs is simply an attempt by those offices to survive, arguing that large companies have had little need for the national patent offices since the European Patent Office (EPO) opened in 1973. However, it is notable that even the World Intellectual Property Organisation (WIPO) has a strapline “Encouraging creativity and innovation” at the top of its website homepage.

\(^{1}\) UK Intellectual Property Office.
To be fair to patent offices, the nature of the patent system runs counter to a nuanced approach: in Europe at least, it is not possible to obtain a valid patent to an invention if the invention was made public before the application for patent was filed. Accordingly, the patent offices promote patent filing on the basis of “better safe than sorry”.

However, even the case studies produced by patent offices for more sophisticated readers convey conflicting messages. For example, a case study prepared the UK Intellectual Property Office and published by the EPO (2008) variously notes that “IP protection has been costlier than expected” but that “at least filing patents more broadly has provided him [with] some security” while concluding that any success has been attributable to “first to market and persistence”.

It is the authors’ contention that entrepreneurial businesses and their investors need a more sophisticated view of IP in business. This paper challenges the view that, for R&D based entrepreneurial start-ups, more patents necessarily means more value. Not only can this view mislead entrepreneurs about the market power and hence value of their patents, the same emphasis on patents may also deter startups by exaggerating the scale of market entry barriers. This occurs because the cost of creating patents is expensive; thereby raising the amount of finance and risk which entrepreneurs need to take prior to startup. Seed or pre-startup finance is the most difficult and expensive form of finance to secure due to the high risks associated with very early stage investment. So seeking external finance to finance a patent strategy is extremely expensive. Entrepreneurs who adopt a patent intensive strategy can suffer extensive dilution and so become demotivated.

These forms of barriers to startup raise the question of whether a message promoting patenting may actually retard rather than promote R&D based entrepreneurship. Furthermore, they raise the question of whether less patent-intensive, strategic approaches to startups ought to be promoted more strongly as a means to reduce finance constraints, de-risk the venture and provide a more evolutionary approach to new venture creation. In this paper we investigate these propositions.

The fundamental “bargain” underlying patents is the grant to the patentee of a legal monopoly to an invention (“market power”) in return for full disclosure of that invention to society. For the patentee, this can limit imitation and raise the financial returns from investment in R&D through the subsequent commercialization process. Society gains from knowledge of the invention, which in turn fosters further innovation.

The paper investigates each component of this path from patenting to value creation. We offer a 4 step test to help entrepreneurs decide how much patenting to undertake and in the process gauge how much value for their business is created.

2. See, for example, Knight (1996), p 2.
by patents. The first 3 steps define the ability of patents to generate value. This is then weighed up against the 4th step which assesses the cost of patenting.

**Step 1: Does the commercialization of R&D require a patent to create market power?**

One of the laws of economics is that the profitability of a single patent and product firm is that it is non decreasing in the market power of its patent. In other words, more market power in the patent either raises the value of the venture or at worst leaves it unchanged. In this scenario patenting is an easy managerial choice to make as it involves simply weighing up the value added created by a patent through enhanced market power compared to the costs of the patent. But if one relaxes either assumption then a more realistic and complex situation emerges regarding the optimality of patenting.

Take, for example, an innovation based on a knowledge platform comprising a portfolio of patentable innovation. If a sub set of the total number of potential patents is sufficient to maximize profits then it is not optimal to patent all patentable innovation. The complexity, particularly for university technology transfer, is that one needs to know the commercial application and hence the main competitive threat before one can ascertain which innovation to patent and which to leave open to imitation (see Box 1 below).

There is also the issue of product complementarity. Most products are not sold in isolation and their appeal depends on available complementary products. In this instance, it can be necessary for ventures to actually encourage imitation of a proportion of their knowledge platform. For example, when Philips launched the tape cassette it made the technology freely available to other firms in the market on the grounds that this would lead to many more products on the tape cassette format and hence help it oust its main rival, the 8 track cartridge. The strategy proved to be a success as blank tape producers, the major record labels and audio hardware manufacturers opted to use the ‘free’ technology. Philips gained too as it had other patents and a knowledge lead that enabled it maintain a competitive advantage in the tape cassette audio hardware market. Another example is electronics manufacturing components which have ‘male’ and ‘female’ connection designs. In this instance a component’s manufacturer may only patent the male version incentivising the hardware companies to (freely) include the female fitting device in their machines. The more machines sold with this particular connection type the more ‘male’ components that will be sold. In general, the greater the extent to which industries are subject to network effects (Shapiro and Varian, 1998), customer lock-in (Arthur, 1989) and business shakeouts (Day, 1997) the greater the incentive to encourage imitation by leaving some of the knowledge platform unprotected in the public domain. Of course, these are the conditions that typically face R&D based entrepreneurs as the
technology in the patent usually faces technological diffusion and format standardization challenges.

**Box 1: Which Innovation to Patent? – The example of the Workmate™ workbench**

The Workmate™ portable workbench has been a major commercial success, with over 65 million units sold as of 2005. As acknowledged by inventor and his patent attorney (Hickman and Roos 1982), the inventor was better placed financially than many individual inventors and thus able to file early UK patent applications to four innovative aspects of the Workmate™ product. These patent applications variously addressed the workbench’s stability, ease with which items might be sown, lower storage space and ability to clamp irregular shapes. Corresponding patent applications were subsequently filed - at significant cost - in other countries including the US, Canada, Germany, France, Italy, Denmark, Sweden, Japan, Australia and South Africa.

The subsequent commercial success of the Workmate™ workbench resulted in the launch of many competing portable workbenches, necessitating infringement proceedings in a number of countries. Exact details of many of these proceedings are not readily available; however, the proceedings in the UK against Andrews suggest that only the early patent relating to the “clamping of irregular shapes” was actually infringed. The remaining three early patents were not applied: the competitor was able to bypass the patent to a space-saving collapsible base mechanism by simply providing the competing workbench with removable legs. As regards the patents offering stability and ease of sawing, the competitor simply did not feel the need to offer these advantages at all.

Moreover, several models of the Workmate™ workbench on sale today seem to be closer to these competitor designs than to the designs that were the subject of the early patent applications. In spite of this, Workmate™ workbenches seem to be the market leader. Question: had inventor Hickman known that this would turn out to be the case, would he have spent so much money on filing patents all those years ago or would he have spent it on some other aspect of the business such as marketing or product development?

Similar effects occur with multi product firms where these types of spillover effects can be internalized. For example, dot.com companies such as Mp3.com made their operating system open source for a significant swathe of their suppliers in order to boost the innovation base underlying their website (Burke and Montgomery, 2002). Such an approach can also have benefits in terms of raising goodwill for the company among consumers and suppliers.

In summary, the lesson here is that maximizing profits does not necessarily require maximizing the number of patents. We have presented examples where a sub set of patents is sufficient to prevent imitation while in others profit maximization requires firms to encourage rather than restrict imitation of their innovation. Therefore, a business/economics analysis is required before a venture can decide which and how many technological innovations to patent in order to maximize profits.
Step 2. How much market power and value is created by patenting?

In his discussion of the value of a patent, Knight (1996) notes that the most important issue is the degree of legal monopoly that can be obtained. As illustrated in the example of box 1, the existence of alternative means of achieving the same technological end can severely impact the value of that patent, particularly if the alternative means are not themselves patented but free for use by anyone (as was the case with the competitor’s “detachable legs” in the example of box 1).

In addition, as illustrated in box 2, patents are also vulnerable to invalidation, both before and after grant, leaving the invention of the patent free for use by all (for an overview of the grounds on which a patent can be invalidated and data on the relative occurrence of the various grounds see Hartwell, 2002). This is in spite of the patent applicant having paid the price of the patent “bargain”, namely disclosure of the invention to the public and the possible signaling of a solution to other innovators in the “patent race”.

Box 2: Patent Invalidation – The example of the Dyson™ vacuum cleaner

James Dyson’s victory over Hoover for patent infringement in October 2000 made the national headlines, the Independent on Sunday noting that “At the centre of the dispute was the Dual British Cyclone – a bagless cleaner that operates by using centrifugal force to separate dirt from air. Based on an idea that Mr Dyson originally came up with in 1979, the cleaner was chosen as one of the Design Council’s products of the millennium”.

What the reports did not mention was that Dyson’s first patent application to the broad concept of a vacuum cleaner utilizing a cyclonic dust extractor had actually been invalidated during prosecution before the European Patent Office (EPO) some sixteen years earlier: searches carried out by the EPO had revealed that the concept had already been disclosed in another patent document published decades before the filing date of Dyson’s first application.

As a result, other manufacturers were free to offer vacuum cleaners incorporating cyclonic dust extractors and indeed, at the time Dyson launched his litigation against Hoover, competing cyclonic vacuum cleaners were being sold by Sharp and Electrolux. Dyson was only able to sue Hoover on the grounds that they infringed a further Dyson patent relating to a combination of two cyclones offering improved cleaning efficiency.

Certain other types of intellectual property do not suffer from the above vulnerabilities. For example, trade secrets by their very nature avoid disclosing information to other innovators / competitors. Copyright, e.g. in code or databases, typically comes into existence when information is recorded and, as long as the information is original, is not vulnerable to invalidation. Where such

3. Under the patent statutes of most countries of the World, the right to a patent to an invention belongs to the first person to file a patent application to that invention. The major exception is the US, where a patent may be granted to the first person to invent, even if that person’s subsequent patent application is not the first to be filed for that invention.
types of IP are present in an R&D based entrepreneurial start-ups it is not unreasonable to question how much value added patenting provides when these intellectual property rights (IPRs) are already acting as impediments to imitation. Is patent market power creation exaggerated in such situations?

One conclusion might be that cost and design alternatives, as well as ability and need to create market power, ought to be considered first; i.e. strategy before patenting. This is arguably an inherent flaw in university tech transfer strategy where the primary knowledge-generation role of a university typically means that inventions are made and patents filed before attempts to commercialize. From a commercial perspective, it is desirable to engage commercialization and understand the possible business models much earlier in the process.

Step 3. Regulation and the public good: how much market power in the patent can be used?

While a patent can enable market power, the law places limitations on the extent to which this can be used. By consequence, the ability of a patent to add value to a venture hinges on the extent to which market power in the patent can be utilized. Patents have a finite life span. Usually after 20-25 years⁴ the patent expires and with it so too does market power. This is of course motivated by the public objectives underlying patent law. The law is created to solve a market failure associated with imitation undermining the incentive for firms to innovate. But in order to benefit from innovation the public also needs to gain access to it. For example, if patents motivate entrepreneurs to invent a cure for a serious illness then the scale of the public benefit will depend on how many people can actually get access to the medicine – hence a balancing act of providing enough financial incentive to bring the medicine to market while simultaneously trying to ensure that the price charged for the medicine does not make it inaccessible to too many consumers. If the venture maximizes the market power of the patent it will seek to charge a monopolistic price which unfortunately may make the medicine too expensive for some of the public to buy.

Therefore, the public benefit depends on both the innovation taking place and the price of the resulting products being affordable for as many people as possible. Scientists reading this paper will recognize this as a form of constrained optimization which is exactly how it is modeled in economics (for example, see Deardorff 1992 and Burke, 2000). This means that using the monopoly power in a patent is permissible as long as that use is not excessive. In most circumstances use is considered excessive if two conditions hold. Firstly, that the financial return on the commercialization of the patent is more than enough to

⁴ Most if not all patent systems specify a term of protection of twenty years from the patent application filing date. However, this term may be extended in certain technical areas, particularly pharmaceuticals.
give an incentive to invest in R&D to invent the patentable technology in the first place i.e. compensate for (usually high) risk of failure and financial outlay. Second, that reducing the price or providing more easy access to the technology would encourage more use and hence greater public benefit. When both of these conditions hold then there is likely to be an excessive use of the market power in a patent. Put differently, limiting the use of market power in the patent in this range will still provide an adequate financial incentive for similar types of (investment and risk in) innovation to occur in the future.

Factors that might limit the amount of market power bestowed on an innovator by a patent may include compulsory licensing, access to code (as in the decision of the European Commission’s against Microsoft (2004)), fair use, price regulation, tie-in arrangements, and price discrimination with downstream effects.

Box 3: Limitation of Patent Remedies – Paice Corporation and the Toyota Prius

Paice is VC-backed US corporation which, according to its website, “is in the business of developing hybrid electric power train technology that enables lower emissions, superior driving performance and fuel efficient operation of internal combustion engines. Paice is pursuing arrangements with automakers and automotive suppliers to accelerate the adoption of its technology in automobiles, light trucks and commercial vehicles”.

In 2004, Paice filed a suit in the Texas courts alleging that the Toyota Prius infringed three Paice patents relating to hybrid drivetrain technology. Finding in Paice’s favour, the courts ordered Toyota to pay $4.3m damages plus an ongoing royalty of $25 per vehicle. However, the court refused to grant Paice the usual injunction that would otherwise have allowed Paice to prevent sales of the Prius until such time as Toyota had agreed to a licence on Paice’s terms.

In an appeal, Paice argued that the absence of an injunction would have an adverse effect on its ability to license its patented technology, citing in evidence the failure of licence negotiations with Chrysler. The appeal court rejected this argument, referring to Supreme Court guidelines that an injunction should only be granted, inter alia, if “monetary damages are inadequate to compensate” and if “the public interest would not be disserved by a permanent injunction”. Question: had the VC investors known that Paice’s licence terms would be restricted in this way, would they have financed the technical development, patent prosecution and litigation costs?

Box 3 gives an example of what is effectively a compulsory license in the area of “green” technology. The likelihood that compulsory licensing may become more of an issue for entrepreneurial businesses in the “green” field is highlighted by the US Chamber of Commerce’s Global IP Centre (2009) which has formed the Innovation, Development and Employment Alliance (IDEA) to counter attempts by developing countries to issue compulsory licenses in the area of green technologies. All these factors limit the value of the patent – the less costly/risky the innovation and the smaller the innovative step the less market power regulators typically will allow. Again, as with the patenting process discussed in section 2 above, there is arguably a need for an economics audit of
the impact of the innovation on the public good, prior to spending precious resources on patenting.

**Step 4. Given the benefits, is the cost of the patent justifiable?**

A final aspect to consider with regard to patents is the cost of applying for and then maintaining a patent right. These include official patent office fees, attorney fees and sometimes translation costs. Since there is at present no single global patent, these costs arise to a greater or lesser degree for each country in which patent protection is sought. Moreover, these costs are difficult to predict with any accuracy, varying as they do from country to country, with the length of the patent application document and with the complexity of the invention to be protected. A study carried out by Roland Berger Market Research (2004) on behalf of the European Patent Office suggests a total typical cost over ten years of Euro 47,000 for a patent application of 26 pages length, granted in 8 European states and prosecuted via the Patent Cooperation Treaty (PCT) and European patent systems.

The above figure excludes in-house preparation costs for the patentee and also overlooks the annual renewal fees payable in each European state if the patent is to be kept in force longer than ten years, as may well be necessary if initial investment is to be recouped. It also does not include the cost of protection in countries outside of Europe where, again, high profile speakers such as Ian Harvey (1992), ex CEO of British Technology Group, have exhorted technology-based companies to “file for patents far and wide”. This is in spite of Harvey’s own admission that a patent filing programme in the main OECD countries for a single technology of moderate complexity will have a lifetime cost of about $270,000 at 1992 prices.

For the resource-limited entrepreneurial start-up, there is a stark contrast to be drawn with copyright where, depending on territory, there are little or no registration costs. Similarly, there are no registration costs associated with trade secrets, although the measures required to keep such secrets confidential and within the company (and including, in their widest sense, non compete clauses, equity and Non-Disclosure Agreements) will not be without cost. The question faced by entrepreneurs is how much resource to invest in these various sources of potential competitive advantage, bearing in mind that this will inevitably divert resources from other aspects of the business which may be equally – if not more – important to value creation.
2. Conclusions

In this paper we challenge a common view that patenting is always a ‘good thing’ for R&D based entrepreneurs to do. We note that, in an attempt to provide some simple generic advice to all entrepreneurs, government agencies (e.g. patent offices) often ‘dumb down’ the business and economics complexity inherent in patents. Unfortunately, this often causes R&D based entrepreneurs to think that they should always patent innovation. This has the effect of exaggerating the legal costs and commercial benefits of patents with the result that entrepreneurs and investors (1) are often deterred from engaging in R&D based ventures, (2) overspend on patenting and (3) overestimate the asset value created by the patents.

We offer a 4 step test to help entrepreneurs decide how much patenting they need to undertake and how much value it will create for their business. The first 3 steps of the test define the ability of patents to generate value. This benefit is then weighed up against the 4th step which assesses the cost of patenting.

Step 1 asks entrepreneurs to check whether their business strategy requires exclusive rights over an innovation. We show that maximizing profits does not necessarily require maximizing the number of patents. We illustrate that a sub set of potential patents is usually sufficient to prevent imitation while in others profit maximization requires firms to encourage rather than restrict imitation of their innovation. If the patent fails the first step then none of the next steps are needed. Assuming that market power is required, step 2 ascertains if the patent can deliver this. We note a considerable number of cases where this does not hold; particularly where patents can be circumnavigated, invalidated and at worst trigger increased innovation in competitors. Again, unless the patent can create market power and clear test 2 the next steps are unnecessary. Step 3 assumes that the patent can create market power and then assesses the extent to which regulation limits its use and hence places a ceiling on the commercial value generated by the patent. We note that many entrepreneurs are unaware that the objective of patent law is to enhance the public good and that this objective can not only reduce but sometimes completely eliminate the commercial value in a patent. If a patent clears tests 1 to 3 then it generates a commercial value and hence the last (4th) step of the test is to ascertain whether this exceeds the costs of the patent. The 4th test highlights that patenting is expensive and also points out that some of the market power objectives of patents can be achieved through cheaper forms of IPRs such as copyright and trade secrets. If a patent clears steps 1 to 4 then it is an optimal commercial activity; otherwise not.

The 4 step test requires entrepreneurs to undertake a commercial analysis of their innovation before rather than after a patent has been created. This determines how much patenting is needed and how much value it will create for their business. From a public policy perspective, our analysis indicates that there is a need to redress the excessive ‘dumbing down’ of patent advice for entrepreneurs.
References:


Paice LLC v Toyota Motors Corp. Court of Appeals for the Federal Circuit 06-1610.


