It's all in the game

R&D games theory has led to a better understanding of how IP is leveraged in various industries. It is also a useful tool for those interested in exploring how patent issues impact on open innovation timeframes

By **Paul Germeraad**

Open innovation as a method of conducting new business development has benefits and risks. The primary benefits are speed and access to a wider variety of technical and business solutions as open innovation is a faster way to introduce ever more diverse innovative products and services to the market. The risks associated with open innovation are potentially losing intellectual property and/or allowing conflicts from derivative intellectual property (IP created by follow-on post-contract innovation efforts) to preclude a company from obtaining a sustained advantageous position. In order to utilise open innovation effectively, a company must adopt tools and methods appropriate to its needs.

Early adopters of open innovation quickly recognised the need for a model or tool to make faster, higher-quality, sticky R&D and licensing decisions. Historically, in the 1990s individuals involved in licensing reported in surveys that the average time to do a licensing deal was between 12 and 15 months. They were done in as short as a month and as long as 30 months. This timeline is unacceptable for today's R&D processes in most industries. Consumer products companies in particular require in-licensing programmes that can deliver a negotiated settlement in two to four weeks. This is because the overall project timeline is on the order of a year or two and to spend any more time than a month on the initial access to technology would be damaging to the project's chance of success.

It is a roadblock associated with intellectual property that often slows a project team's ability to close a licensing deal in these timeframes. The roadblock is often related to uncertainty surrounding the strategic and fair value that a company would wish to pay for the intellectual property and know-how it is receiving. Frequently, the delays in negotiation are caused by participants striving to sign only a perfect deal. A key learning from experienced open innovation adopters is that it is better to get it about-right fast rather than to do a perfect deal later. The goal should be a business rate of success similar to the 80/20 rule. This means that for 20% of the effort the right decision is made 80% of the time. This is contrary to the training of most legal professionals. Companies that have retrained their legal and technical professionals to make decisions consistent with this 80/20 metric have significantly reduced product development cycle times.

R&D game theory organises types of innovation

The R&D game theory was developed as part of the Industrial Research Institute's Research-on-Research Subcommittee on innovation. That group was supported by Dr Roger Miller at the Polytechnic University of Montréal. His team surveyed over 700 companies to find patterns in the way their innovative processes were related. After studying how these companies went about innovation, the subcommittee and Dr Miller's team were able to show that there were 11 types of R&D method utilised. The 11 methods (game types) of R&D were

Figure 1. **R&D game types**

Innovation game matrix (by industry)			**Factors affecting time to prototype**			
			Longest time	**Medium time**	**Shortest time**	
			Knowledge-creation dynamism			
			High	**Average**	**Low**	
Factors affecting time to market			(strong scientific influx) [basic research science]	(important intra-sector advances) [basic science & engineering]	(marginal advances and influx of artifacts from other sectors) [application science & engineering]	
Longest time	Structuring logic	**High** (government rules and regulations)	**Technology races** (biotech, fuel cells, nanotechnologies)	**Safety journeys** (chemical drugs, medical equipment, aerospace)	**Asset-based problem solving** (power, gas, petrochemicals, mining, regulated telecom)	
Medium time		**Average** (industry standards)	**RD&E tools and services** (drug research and discovery tools, specialty cosmetic research tools, engineering test equipment)	**Battles for architectures** (mass software, computers, Internet and telecom services, networking equipment, semiconductors)	**Innovating in packs** (chemical products & polymers, industrial gas products, packaging materials, building materials, pharmaceutical carriers)	**Consumer research & marketing** (automobiles, snowmobiles, mass consumer products)
Shortest time		**Low** (customer expectations)	**Unique gadgets** (Specialty consumer products, toys)	**System design & consulting services** (MIS, specialised telecom systems, enterprise solutions)	**High-technology craft** (specialty food, ingredients,specialty chemicals, electronic equipment, industrial controls)	**News, clothing, food** (newspapers, news programmes, clothing, food)

related to industry sectors that compete in similar environments and typically focus their innovation methods on one class of innovation. Figure 1 is an adaptation of the original grid.

The key elements of this grid are in the segmentations along the two axes. The columns relate to the time it takes to create a working prototype of the new product or service from a technical standpoint. Where it takes a long time to develop a prototype, R&D is resourced, managed and leveraged for the scientific insight it is creating. This often includes the use of a government laboratory or a university partner. On the other end of this scale, where it takes a short time to create prototypes, because they exist in other industries or are straightforward from a science and engineering standpoint to conceive, R&D is managed and leveraged more like typical technical service organisations.

For the rows of this matrix, the segmentation is based on the factors that affect time to market once a prototype has been created. These vary from long timeframes, because of government requirements for lengthy approval processes, to shorter times wherein it is just a matter of being sure that the product prototype is refined to be something a customer quickly recognises as desirable. Again, R&D is resourced, managed and leveraged differently depending on what timescale is needed. For industries that require government approval, R&D must contain individuals familiar with submitting the required documentation and test results. For industries that are driven by specification standards, R&D must have individuals capable of advocating their solution as the most appropriate. The R&D funding must be consistent with these various activities and timelines for bringing products to market.

R&D game theory also organises IP strategy and open innovation options

Because best practices to manage innovation and create IP vary by time to prototype and time to commercialise, the management and leverage of results of innovation and intellectual property also vary along the same segmentation axes. Figure 2 highlights proposed attributes of an IP landscape best suited for each theoretical R&D game type.

The boxed areas of Figure 2 contain the 11 R&D game types of Figure 1. The rows of Figure 2 contain attributes a company would

wish to find, or create for itself, in the ideal or desired IP environment in order to obtain the most value from its investment in invention and innovation. There are 15 such attributes that typically affect open innovation planning, negotiation and return on investment (ROI). Most importantly for companies wishing to engage in open innovation activities, the Figure 2 elements describe the ideal position a licensor can provide (portfolio attribute elements), the most advantageous IP environment a licensee can typically find (desired IP landscape elements), and the areas both parties can work together on afterwards to sustain the IP's value (behaviour elements) in each sector.

The elements of a few rows of the table require some definition. The first row is the overall patent density in a field. A patent desert is defined as a field in which there are tens of patent families present. A patent forest, on the other hand, is defined as a field in which many hundreds of patent families are present. Patent jungles are areas in which lots of activity has produced tens of thousands of documents. Not all fields benefit from having the same IP density. Brand-new areas of scientific inquiry are ideally devoid of previous IP, allowing the first movers to capture grandfather IP positions that can later be leveraged. This is typically an area for government, university and high-risk venture funding of R&D initiatives that are then protected by small numbers of key patents.

In the middle row called "competitor citation position", the characterisation of an IP predator is used to describe an entity that has over 10% of the citing art. Sharks in this context are used to describe entities that have over 30% of the citing art.

The last row refers to intellectual property aggregators, sometimes called trolls. Because of the ROI required for this business model to succeed, there has been only one R&D game type which so far has proven to be attractive to trolls. This is in the area of battles for architecture found in the centre of Figure 2.

The first Behaviour row characterises IP holders' posture versus that of infringers. The term aggressive in this context refers to a company's proactive search for other entities that may offer products or services that infringe the claims of their IP. Don't look, on the other hand, refers to a very passive approach on the intellectual property owner's part, whereby the time and expense required to look for infringers do not have a business chance of success in generating an ROI that meets the company's hurdle rate or target internal rate of return.

Having defined the attributes used in Figure 2, key elements in each of the 11 R&D game types from a patent standpoint will now be discussed. It is understood that for each of these R&D game types, the attributes of the patent landscape are generalisations. They simplify the patent landscape found in these areas for quick, high-quality decisions, though by no means is each and every industry segment represented by exactly these descriptions. It should also be noted that these landscapes are for patents; trademark and copyright landscapes will differ.

Extension of individual R&D game types

To guide intellectual asset management, licensing and open innovation strategies and practices in a useful way, and to allow reduction to software modelling, it is useful to consider R&D models as applied to specific IP environments and IP licensing negotiations. These models help companies to determine the value of patents to open innovation projects and therefore speed the negotiations and new business development programmes. The characteristics of selected models of Figure 2 are described in the context of their application to open innovation negotiations.

Game one

In the upper left-hand quadrant of Figure 2 the first R&D game to be discussed is that of Technology Races. For Technology Races, at the time when the companies are first negotiating, the patent density that will benefit all parties will be a desert. The field needs to be wide open for grandfather patents to be established and dominate the few other patents in an early landscape that will act as prior art for the work that follows. The patent growth rate should be very high, reflecting the incremental and next-generation work that is building on the breakthrough work of this grandfather art.

The reason it is desirable to have a large number of IP holders is that it represents large-scale investment by many universities and government funding agencies, with no one entity holding a large position. Such diversity of non-commercial entities in an early phase speaks well for the potential commercial value that will accrue to the first commercial entities in years to come.

Parties to the negotiation must plan to fund and file patents on derivative and follow-on work in their agreements with one another. There may be potential competitors to the company working in the field, so it will be important that no other company has more than a 10% position at the time of the

Figure 2. **R&D games and the IP landscape**

		IP environment	Technology races (biotech, fuel cells, petrochemicals)	Safety journeys (chemical drugs, medical equipment, aerospace)	Asset-based problem solving (power, gas, petrochemicals, mining, regulated telecom)
Desired IP landscape		Patent density	Desert	Light Forest	Forest
		Innovation & patent growth rate	High	Moderate	Low
		Typical number of IP holders	Many	Many	Many
		Competitors' citation position	Present but no predators	Present but no predators	Weakly represented
		Non-competitors' citations	Many with predators but no sharks	Modest but no predators and no sharks	Modest but no predators and no sharks
		IP aggregators' presence	Few present	Few present	None present
Desired licensor	Portfolio attributes	Size of portfolio	Largest portfolio	Sole holder	Within 20% of average
		New patent velocity	Faster than average first non-self cite time	At average first non-self cite time	Slower than average first non-self cite time
		Self-citation position	Multi-generation fences	Multi generation fences	No fences
		Portfolio management posture	Building	Holding	Pruning
		Claim quantity	High	High	Low
		Claim scope for technology and uses	Broad	Moderate	Moderate
		Geog coverage	Broad	Specific	Specific
	Behaviour	IP holders' posture versus infringers'	Aggressive	Aggressive	Don't look
		IP holders' posture when challenged	Proactively defend challenge	Proactively defend challenge	Settle or cross-license

initial open innovation negotiations between the parties. Also during the open innovation negotiations it is important that the understanding between the parties be that they will proactively file and defend the patents. They must be vigilant in looking for infringers, and when infringers appear, challenge them aggressively.

Game two

The next game type is that of Safety Journeys. Industries and companies utilising this R&D game methodology typically include those operating in the pharmaceutical drugs, medical equipment and aerospace industries. Although the technical challenges to create prototype products are still formidable, they are moderated as the underlying science has become more broadly available. Once a product prototype has been made in the laboratory, it still takes a long time for commercialisation, however.

As with Technology Races, government approvals and regulations are often hurdles that slow the commercialisation process. The typical IP environment that open innovation explorers find is usually a light forest. This is because in addition to academic entities, commercial ventures around the world have often done their first exploration of this new field. Mostly because of the increased amount of activity and the more programmatic approaches that exist, patent growth rates tend to be moderate. There are still many participants creating IP in the field so the advantaged position the licensor would like to obtain is to be the sole owner of the chokepoint or grandfather patent that holds the low-cost, high-performance position versus other technical and manufacturing approaches that may exist.

This chokepoint patent should be protected by multi-generation patent fences. As before, both competitors and non-competitors that are citing the key chokepoint art should have positions well under 10% of the total citations present. If an entity has a large position – for example, that of a shark with over 30% of the follow-on citations – there is a good chance that entity has blocked some of the high-value commercial routes that a licensee might have wished to have available. It still remains important that both the licensee and licensor in open innovation negotiations in this area understand that aggressive, proactive defence against challenging infringers be provided for. Their relative roles and funding contributions

Figure 2. **R&D games and the IP landscape (continued)**

		IP environment	RD&E tools	Battles for architectures	Innovating in packs	Consumer research & marketing
			(drug research and discovery tools, specialty cosmetic research tools, engineering test equipment)	(mass software, computers, Internet and telecom services, networking equipment, semiconductors)	(chemical products & polymers, industrial gas products, packaging materials, building materials, pharmaceutical carriers)	(automobiles, snowmobiles, mass consumer products)
Desired IP landscape		Patent density	Forest	Jungle	Forest	Jungle
		Innovation & patent growth rate	Moderate	High	Moderate	Low
		Typical number of IP holders	Few	Many	Few	Few key top competitors
		Competitors' citation position	Present but no predators	Present but no predators	Present but no predators	Moderately represented
		Non-competitors' citations	Modest but no predators and no sharks	Many with trolls and predators but no sharks	Many but no predators and no sharks	Many but no predators and no sharks
		IP aggregators' presence	None present	Trolls present	None present	None present
Desired licensor	Portfolio attributes	Size of portfolio	Largest or within 20% of largest; with knock-out patent	Within 20% of average; participating portfolio for standards control	Within 50% of average	Within 50% of average; participating portfolio for cross-license if necessary
		New patent velocity	Faster than average first non-self cite time	Faster than average first non-self cite time	At average first non-self cite time	At average first non-self cite time
		Self-citation position	Patent fences	Patent fences	Patent fences	No fences
		Portfolio management posture	Building	Building	Pruned	Pruned
		Claim quantity	High	High	Low	Low
		Claim scope for technology and uses	Broad	Broad	Broad	Narrow
		Geog coverage	Specific	Broad	Specific	Specific
	Behaviour	IP holders' posture versus infringers'	Aggressive	Aggressive	Aggressive	Don't look
		IP holders' posture when challenged	Proactively defend challenge	Proactively defend challenge	Proactively defend challenge	Settle or cross-license

for these activities must be carefully defined in the open innovation agreements.

Second row innovation games

We now move to a selected set of the second row of innovation games that are shown in the middle of Figure 2. These R&D games have a medium time to commercialisation once prototypes have been created. The rate limiting step for commercialisation is usually the adoption of industry standards. These can be formal industry standards that are required by a government or, more typically, required by consumer preferences. Underwriter laboratories (UL) ratings are examples of such standardisation.

Game one

The first R&D game type of this section has the longest time to prototype. The name of the game is RD&E Tools and Services. The typical industries using this innovation game are drug research and discovery tools, speciality cosmetic research tools and engineering test equipment. The long time to prototype comes from needing to discover basic scientific principles as a prelude to development of products and services.

In this field, when looking for opportunities for open innovation it is best to find specific areas in which the intellectual property density is that of a forest. This is because there are academic and government entities funding breakthrough research in these areas. For any specific commercial opportunity, however, the typical number of patent holders in the field is few. This is because development cycle times require significant investments on the part of the entity seeking to bring a product to commercial fruition. Potential competitors may be present, but there should be no company with over 10% of the citations of key art in the field.

Figure 2. **R&D games and the IP landscape (continued)**

		IP environment	Unique gadgets (specialty consumer products, toys)	System design & consulting (MIS, specialised telecom systems, enterprise solutions)	High-technology craft (specialty food ingredients, specialty chemicals, electronic equipment, industrial controls)	News, clothing, food (newspapers, news programmes, clothing, food)
Desired IP landscape		Patent density	Forest	Forest	Forest	Light forest
		Innovation & patent growth rate	High burst	Low with high business method bursts	High bursts	Low
		Typical number of IP holders	Sole	Many	Modest	Few
		Competitors' citation position	Weak with no predators and no sharks	Modest but no predators and no sharks	Many with predators and with sharks	Weak with no predators and no sharks
		Non-competitors' citations	Few with no predators and no sharks	Many but no predators and no sharks	Moderate but no predators and no sharks	Many but no predators and no sharks
		IP aggregators' presence	None present	Few present	Few present	None present
Desired licensor	Portfolio attributes	Size of portfolio	Dominating	Within 50% of average	Largest or within 20% of largest	Within 50% of average
		New patent velocity	Episodic	At average first non-self cite time	Faster than average first non-self cite time	Slower than average first non-self cite time
		Self-citation position	Focused patent fence	No fences	Patent fences	No fences
		Portfolio management posture	Pruned	Pruned	Building	Pruned
		Claim quantity	Low	Moderate	High	Low
		Claim scope for technology and uses	Broad	Narrow	Broad	Narrow
		Geog coverage	Specific	Specific	Broad	Specific
	Behaviour	IP holders' posture versus infringers	Aggressive	Don't look	Agressive	Don't look
		IP holders' posture when challenged	Settle or cross-license	Proactively defend challenge	Defend or settle	Settle

To protect the significant return on investment in open innovation that is being made, it is important that both the licensee and licensor agree to an aggressive enforcement of the patents. They need to defend challenges proactively and ascertain whether there are entities experimenting with aggregating IP in these areas.

Game two

The next R&D or innovation game in this sequence is called Battles for Architectures. Organisations utilising this are typically involved in industries such as mass software, computers, internet and telecom services, networking equipment and semi conductors.

Characteristics of this particular R&D game type are a moderate time to prototype and a moderate time to market. This unique blend of characteristics generates high commercial returns on technology investments. The science needed for innovation has already been done so, relatively speaking, it is simply a matter of applying engineering principles to create rapid prototype products and services. Likewise, once prototypes are available it is relatively quick to make sure that they meet evolving industry standards to meet customer expectations as opposed to the longer timeframes typical of government standards.

Because of these timeframes and lucrative markets, many companies invest in innovation. They thoughtfully cover their inventions and innovations with intellectual property and with patents in particular. This creates a jungle environment in many of the industries that utilise the Battles for Architectures game. Patent growth rates are very high, increasing exponentially in the newer areas. Entities around the world actively research market trends that are then reported and published in market research reports. This information provokes participation by large numbers of competitors, each with high innovation intensity; often there are trolls, predators and sharks present too. Thus, before engaging in

open innovation negotiations it is important to detect the presence of such threats.

With respect to infringing art, patent holders need to be aggressive and proactively defend against challenges to their position. As trolls are sometimes present, it is also important for IP holders to consider belonging to patent pools to help ward off some of these threats. The Battles for Architectures game type has been the one in which open innovation has been most prevalent. In fact open sourcing, in which the derivative work is also shared freely among participants, has its genesis in this particular R&D game. This environment has most richly rewarded companies' sharing of information and licensing of patents.

Game three

The third innovation game in this row is Innovating in Packs. It covers sectors such as chemical products and polymers, industrial gas products, packaging materials, building materials and pharmaceutical carriers. The time required to create a technical laboratory prototype in these fields is faster than in the previous two. With the underpinning science and engineering known, most work in this area has been reduced to next-generation and incremental innovation. On the commercialisation side, industry standards still govern the introduction of products, providing a moderate time to market.

Companies exploring open innovation opportunities in this area will typically find a forest environment. Patent portfolios are growing at a moderate rate and because of the speciality of the individual industries involved, there are usually very few patent holders in any one of them. There are usually a big three or big 10 worldwide that have invested continuously in next-generation innovation. Competitors are often present but not of concern, unless one of them has a position of over 10% of the follow-on citations of the key art.

Because most patents cover incremental innovations that create a small price premium for a few companies, this has not been an R&D game area in which IP aggregators or trolls have found value. From an open innovation standpoint, it has been a particularly good area for exploring opportunities because the base technologies developed in these fields have such broad applicability.

The final row

The last row of Figure 2 contains four R&D games that have the shortest time to commercialisation once a prototype is developed. These games are distinct from those of the previous two rows in that there is no formal review process required for a company to bring a product to market. There are no government regulations *per se* and no industry standards. The only requirement is that the product hopefully matches the customer's expectations.

The first R&D game on the left-hand side of in the bottom row relates to Unique Gadgets. These can be speciality consumer products such as the Gillette Mach 5 razor, Procter & Gamble's SpinBrush toothbrush or the Fisher-Price Talking Elmo doll. What is unique about these products is the high scientific content embedded in them. Often they incorporate technologies that come straight from the science laboratory. Examples are new battery technologies, new manufacturing methodologies and a new computer chip applied to a toy.

The patent landscape associated with this game is usually a forest. The growth rate of investment and patent filing is usually a high burst (extremely rapid even compared to exponential growth) to protect the new product application, followed by a lull and very little follow-on and activity as other competitors choose not to enter the market. Because of the rapid movement in this industry there is typically no patent predator or shark present. If an infringer does appear, the parties to the open innovation negotiations must plan for a very aggressive follow-up. Companies then usually quickly settle or cross-license.

A model to speed open innovation negotiations

The elements of an IP landscape in Figure 2 were selected because of their typical impact on open innovation licensing negotiations. Others could clearly also be listed for completeness, but these are a good starting point when preparing for open innovation carrot licensing discussions. For example, having IP predators, sharks, companies citing over 10% of another entity's art and companies citing over 30% of another entity's art is not desirable in open innovation environments.

Just as with traditional licensing negotiations, the most important element associated with intellectual property negotiations for open innovation is strategic alignment between each party and the patents under discussion. All value or pricing is dominated by the licensing context or business model. The saying "beauty is in the eyes of the beholder" is never more true than when applied to open innovation.

To make the fast, sticky, 80/20 business-quality decisions, the simplified view of the

desired IP landscapes found in Figure 2 can be contrasted to the actual IP landscapes present. Where the IP under negotiation is going to be supportive of the desired IP position found in Figure 2, its value should rise to the top of the customary royalty rates for that field. Where the IP is going into an area where its contribution is weak compared to the desired position, or where IP in general is not highly leveraged, its value should be at the bottom of the customary royalty rates for that field.

When the IP environment position of both the licensee and licensor will be enhanced by the open innovation endeavour, a good deal is likely. When there are conflicts in the resulting IP patterns, it is the resultant licensee's patent position that should dominate the IP portion of the negotiation process.

In closing, Figure 2 can be used in multiple additional ways. Metrics derived from these IP attributes can be used for any given industry segment as a high-level screening tool to determine whether the overall IP landscape is conducive to having technical know-how and IP of value. It is the first step in valuation. Some industries do not rely on patents as a real basis for protecting competitively advantaged positions. There are areas where know-how, copyrights or trademarks are what is most important. Using this matrix to understand and honour the R&D game and corresponding IP strategy of each party to a standard or open innovation licensing negotiation can significantly improve the rapport and speed of that negotiation. This is particularly true when the parties are playing different R&D games.

R&D game theory has led to a better understanding of how IP is leveraged in various industries today. This is a hypothesis currently being tested around the world. The work is not finished. It requires additional research and insight. As such, the models cannot be used blindly. But they do serve as a starting point for thoughtful discussions and negotiations. *iam*

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