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Pulling Back the Curtain:

Calculating Return on Investment of Patent Portfolios

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Return on Investment (ROI) is a widely used measure of efficiency or profitability of an investment.

ROI measures the return on a particular investment relative to its cost and has been applied across virtually every area of business from R&D, brand, marketing and information technology. Although ROI is routinely used to identify ways to enhance the performance of investments, it has not been applied to patent portfolios.

With more questions being asked about the value of patents, this article sets out a methodology for calculating your Portfolio ROI. It is important to note this emphasis, as Portfolio ROI is a measure of the value of your patent portfolio to your organization. Value and price are two different things, so this is not a methodology for calculating the price at which you could sell your patents.

There are many benefits of calculating Portfolio ROI. First, it enables investment in patents to be measured and compared in the same way as all other investments by the business. Second, it is a forcing function that requires clear articulation of your patent strategy, and measurement of ROI against that strategy. Third, it supports a holistic approach to patent strategy and contravenes organizational silos, where separate budgets are allocated to portfolio development, licensing and litigation, and each budget owner measures their performance in isolation.

We have included an economic model for calculating the cost and benefit of patent portfolios and walk through a hypothetical example. It also provides a downloadable copy of the full model and a spreadsheet that will enable readers to calculate their own Portfolio ROI.

While there is some inherent complexity in calculating Portfolio ROI, the message in this article is both simple and direct. Portfolio ROI identifies which parts of your portfolio are delivering value to your organization and which are not. The steps in the process will be enlightening, and the destination delivers clarity about what needs to change and why.

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Contents

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Dorothy's story

The doorbell rings and Dorothy opens the door. It's Oswald, her financial advisor. He walks Dorothy through all of the assets in her portfolio – real estate properties, stocks, bonds, mutual funds, a college savings plan for her daughter, and her retirement plan. Dorothy is concerned about the low 3% yield from her college savings plan, while the market has been performing at 10%. Not only is Oswald unaware of the market's performance, he has not been tracking Dorothy's ongoing contributions to the plan. He assures Dorothy that a 3% return is better than 0%, but Dorothy is worried that the plan won't be able to cover her daughter's future college tuition at the current growth rate. Dorothy asks about her other investments, and Oswald simply points to the positive income generated by the investments without any mention of Dorothy's previous contributions or market performance. When Dorothy finally asks Oswald how he evaluates his investment decisions, he shrugs his shoulders and says, "That's a difficult question to answer because it's very complicated behind the curtain. Nobody knows what the market will do, so you can't predict the expected return on any of your investments. I've been doing this for 20 years, and every financial advisor that I know takes the same approach. We make the best choices for our clients and hope for the best." Dorothy says to Oswald, "I'm sorry, but I need to understand the return on my investment."

Return on investment (ROI) is a metric that is widely used to evaluate past investment decisions (by comparing the gain or loss from the investment to its cost) and future investment opportunities (by measuring the probability of earning a return from the investment). Individuals like Dorothy are not the only ones who look to ROI to evaluate their investment decisions. Companies have a fiduciary duty to their shareholders to exercise care in how they spend the company's money, and they evaluate ROI to make responsible decisions on their investments. Contrary to Oswald's thinking, the standard of excellence for ROI is not just any positive yield that covers the cost of the investment. Most investors expect to see a rate of return that outperforms the market. If the cost of the investment could have produced a higher yield through another financial instrument, the company may have missed an opportunity to realize a greater return on its investment. The purpose of ROI is to scrutinize the investment and ensure that the cost is worth the return.

For some reason, companies have not applied ROI to one of their most significant corporate assets – patent portfolios. While companies that monetize their patents often have Patent Departments with their own profit and loss statements, most companies are not in the business of generating revenue from patent licensing or litigation campaigns. Industry surveys show that companies spend more than $40B annually on growing and maintaining their patent portfolios without applying any type of ROI analysis.

For many corporate legal departments, the cost of the patent portfolio is one of the most expensive line items in the total legal budget; but despite its material cost, the vast majority of patent departments have dodged the ROI question entirely. Like Oswald, they reference the status quo as best practice and claim that Portfolio ROI is too complicated to measure. The problem is that the traditional approach does not provide any transparency or accountability on the part of the portfolio manager. The truth is that portfolio ROI is not too complicated, and the value that a patent portfolio delivers to the company can (and should) be quantified and measured.

This article describes the importance of measuring the ROI of patent portfolios, the building blocks for an ROI calculation and some of the challenges that it presents.

Why is it important to measure ROI?

Over the last 20 years there has been a seismic shift in patent strategy. Gone are the days when patent budgets can be justified by reference to broad stroke platitudes such as the protection of innovation. While this may be philosophy, it is not a strategy. Some portfolio managers argue that their strategy is to preserve optionality for the company (i.e., claiming to have no idea how the company will use the patent portfolio), but this often leads to undisciplined spending. With no clear targets for optimization, optionality inevitably translates into a practice of amassing patents on numerous features of the company's own products without a concrete vision of how these patents will be used by the company or deliver value to the business.

This topic was explored in *How Many Patents are Enough?*[1]. The article exposed a staggering array of views, all accumulated through experience, but rarely substantiated with data. Some teams argued that their budget should be directly proportional to the growing size of their engineering teams, with the premise that more is simply better. Others relied on comparing their spend to companies of similar size, arguing that they should spend the same amount to compete. The end result is that only 19% of patent owners report that their portfolio is perfect, and 66% indicate that their portfolio is too big, too small or both (in different areas). This data and the accompany survey are reported fully in *Beyond Portfolio Optimization*[2].

The response to this chaos was the development of optimization models that place evidence-based decisions at the heart of patent strategy. These models guide resource allocation to areas where there is the greatest need (where the portfolio is understocked) and away from areas where the organization is already well placed (where the portfolio is overstocked).

While these models are helpful, they do not respond to the foundational question of how much value the patent portfolio delivers. Going through the exercise of calculating a Portfolio ROI is a forcing function that requires patent departments to articulate a reasonable patent strategy and quantify the answers to the chief questions that every patent portfolio manager should be able to answer: How big should the patent portfolio be? In what areas do I need to grow or shrink the portfolio to increase its value to the company? How much should be invested in licenses and patent acquisitions to offset the need for organic growth?

Measuring Portfolio ROI is applying mainstream accounting and financial modelling to patents. The good news is that it will be well received by many parts of the business that have been applying this approach to their expenditure for decades. The challenge is that the probabilistic models required do not always sit comfortably with some strongly held views that every patent is special, and its validity and enforceability should be considered on its own merits.

Transparency and actionability are central to the premise that patent owners should calculate the ROI of their investment in patents. Transparency includes the ability to share the analysis with the business and financial teams responsible for managing costs across the company. Because ROI is used in many other areas of the business, this means that investment in patents can be assessed side by side with ROI in other areas to make decisions. This brings us to actionability. It is the essence of capitalism that a business should maximize its ROI. In a world of scarce resources, this means constantly adjusting investment from areas of lower to higher ROI. For this reason, patent teams must be willing not only to communicate the current Portfolio ROI, but also to share their strategies for increasing that ROI over time.

[1] *How Many Patents are Enough?* Nigel Swycher and Steve Harris (IAM, Autumn 2019)
[2] *Beyond Portfolio Optimisation: understanding the connection between patent cost and value*, Nigel Swycher, Steve Harris and Niall McMahon (IAM September 2020)

Is Portfolio ROI too difficult to measure?

ROI is calculated as follows:

$$ROI = \frac{Net\ Return\ on\ Investment}{Cost\ of\ investment} \times 100\%$$

There are a number of reasons why patent teams have not widely adopted ROI as a core business metric, including the lack of available resources and reliable data. Thanks to advances in machine learning, the ability to identify relevant patents and access requisite revenue and royalty data is no longer insurmountable. The historical perception of patents is another obstacle that has stood in the way. For the longest time, patents have been regarded as a cost, wholly disconnected from the benefits they deliver. By calculating Portfolio ROI, the approach described here will not only quantify the benefits delivered by the portfolio, it will also help correct the long-held view that patents only deliver value when they are sold or monetized.

The building blocks of ROI analysis

The following sections focus on organizations that primarily utilize their patents to defend their business against potential patent aggressors (referred to as "third party threats" and collectively as a "threat list"). 62% of organizations report that this is their primary strategy (*Cipher/IAM Report on Portfolio Optimization* [3]). These companies use patents to address the risk of potential conflict with third party threats, and 75% of patent owners agree that a well-balanced portfolio mitigates the risk of patent litigation. This understanding is foundational, because it means that simply mapping your patents to your own products is insufficient to establish that your portfolio is mitigating the risk of assertion from others.

It is now widely accepted that the starting point for calculating your exposure to an identified third party threat requires both patent and revenue data. The logic was explained in *The role of AI in evidence-based strategic IP decisions* [4] and the formula is set out in Figure 1.

Figure 1: Calculating the balancing payment for a single technology

The fundamental calculation for an average cross-licence between two companies for a given technology area is:

$$balancing\ payment = s\ \frac{r_b p_a - r_a p_b}{p}$$

Where

- s is the royalty rate
- r_a is the revenue of Company A
- r_b is the revenue of the Company B
- p the total number of families reading onto a specific technology (the denominator)
- p_a is Company A's portfolio reading onto that technology
- p_b is Company B's portfolio reading onto that technology

Positive balancing payments indicate a net payment to Company A, negative indicates a payment to Company B.

In the context of a defensive strategy, the return is the degree to which all known threats can be neutralized. That is to say, in the ideal situation, the sum of all balancing payments for all technologies and all companies on your threat list is zero. Against this backdrop, the following sections set out the mechanics and considerations in calculating Portfolio Investment and Portfolio Return.

[3] *Cipher/IAM Report on Portfolio Optimisation*, March 2020 available for download from: https://cipher.ai/insights/beyond-portfolio-optimisation-iam-issue-100-article/
[4] *The role of AI in evidence-based strategic IP decisions*, Nigel Swycher and Steve Harris (IAM, December 2018)

Calculating Investment

The investment in your portfolio is the total of all costs in getting to the current portfolio, including patents filed (organic growth) and patents acquired. A different approach can be taken in each area.

Organic investment: If filing rate and pruning rates are relatively constant then it is reasonable to use the prior year's preparation and prosecution costs as the basis for investment. However, if the budget has fluctuated significantly as the portfolio has grown and shrunk, then a more sophisticated calculation can be performed at the family level. For example, if we have a family with a grant date of 2011, and an expected expiry date of 2023, which will cost $120k over its lifetime, then we can account for the cost at $10k per year.

It would be possible to perform this calculation exhaustively for every live family in 2020, but for most cases it will be sufficient to calculate the mean cost and lifetime per family, and apportion that amount to each family-year. Analytics platforms which provide cost data can facilitate these calculations.

It is also necessary to make an adjustment for abandoned or rejected patent applications. They form part of the investment, even though they ultimately delivered no benefit. These could either be accounted for explicitly, or the per-family cost described above can be multiplied by the inverse of the acceptance rate (e.g., where there is a 50% acceptance rate in a technology area, then double the per-family cost to account for that).

Acquisition investment: The treatment of acquired patents should be different depending on the circumstances:

Corporate Finance – there are some strategic M&A deals where patents play little or no part in the motivation for the deal. In these circumstances it is reasonable to treat the cost as zero. Patent costs incurred from the date of acquisition should be included.

IP-centric M&A – in certain deals, the patents are very important. This can be reflected by treating the acquired patents as if they were organically developed and should be included as the cost of obtaining and maintaining these assets.

Patent specific deals – where patents are all or a material part of the transaction, then the cost of acquisition, and future prosecution and maintenance costs should all be included. For example, Google representatives said that it acquired Motorola to "level the playing field in patent attacks against Android", and so in that case, Google would attribute a substantial portion of the deal cost to the acquired patents.

If this adds an unwarranted level of complexity, it will generally be acceptable to treat the entire portfolio as organic investment.

Backward-looking Benefit

Calculating the return for a prior year is more straightforward as many of the licensing and litigation outcomes are already known. The return for a backward-looking ROI model is the difference between what was paid out in litigation settlements and license fees, and what you would have paid with no portfolio.

This can be calculated by deriving the effective royalty rate *(s)* for licences active in the year, and then calculating the position where p_a is zero, for each technology. Figure 2 is that calculation for a single licence. This can be repeated for every licence signed (and in force) during that year, to come up with a total return for the defensive function of the portfolio.

Figure 2: Calculating the return of a licence or cross-licence

Our company has a portfolio of 50 families (p_a), the other party has 100 (p_b), we have a revenue of $75M ($r_a$), the other party had $100M ($r_b$), and the denominator is 500 families (p), the agreed balancing payment to the other party was $200k (-$0.2M). We would like to calculate s, the effective royalty rate for this licence:

$$balancing\ payment = s\ \frac{r_b p_a - r_a p_b}{p}$$

$$s = \frac{balancing\ payment \times p}{r_b p_a - r_a p_b}$$

$$s = \frac{-0.2 \times 500}{100 \times 50 - 75 \times 100}$$

$s = 0.04$ (4%)

From that we can deduce that the payment had there been no portfolio would have been:

$$balancing\ payment = s\ \frac{-r_a p_b}{p - p_a}$$

$$= 0.04\ \frac{-75 \times 100}{450} = -16.7\ (-\$16.7M)$$

Note that the expression for the hypothetical balancing payment for this case is the normal balancing payment model, with p_a in the numerator set to zero, and p_a subtracted from the denominator. The denominator expression represents the idea that the total number of families in the technology would be decreased by the number of our company's patents in that technology since we are assuming our company has no portfolio in that area. However, an alternative viewpoint is that there was a scramble to get patents in the area, and if we had not applied for and received those patents someone else would have. If that model is preferred then the $p - p_a$ term can be replaced with p. This applies to the following past, deterrent, and future benefit expressions as well.

So the return for that licence is the difference between what we did pay, and what we would have paid without the portfolio to cross-licence:
-$0.2M – -$16.7M = $16.5M

Bringing this all together we have:

$$past\ benefit = s\ \left(\frac{r_b p_a - r_a p_b}{p} - \frac{-r_a p_b}{p - p_a} \right)$$

In addition to these known events, it is also necessary to ascribe benefit to the deterrent value of the portfolio by looking at the expected balancing payment for third party threats that would have sought a licence in the event that we had zero patents in the technology area, scaled by the expected probability (a_0) that they would have asserted the portfolio to seek a licence:

$$deterrent\ benefit = a_0\ s\ \left(\frac{r_b p_a - r_a p_b}{p} - \frac{r_a p_b}{p - p_a} \right)$$

This captures the difference between the expected payment in the case where our company holds no patents in this area, and the expected payment at that date, which quantifies the risk removed in monetary terms.

Note that in the case of most major players, absent other protections, the a_0 probability term will be close to 1.0 (100%), as a company in a competitive space, with zero patents is more likely to attract assertions.

The *past benefit* applies to (historical) third party threats where there is now a cross licence in place, and the *deterrent benefit* applies to threats where there is no licence in place. Applying one or the other to your entire threat list delivers a model that covers that part of the industry.

Forward-looking Benefit

For calculating forward looking ROI, the return is the same as backward looking for all licences currently in effect, plus the difference between:

- the expected cost of a cross-licence in the case with zero patents, multiplied by the probability of an assertion if there was no portfolio (a_0); and
- the expected cost of a cross-licence in the current situation, multiplied by the probability of an assertion (a_1).

$$future\ benefit = s\ \left(a_1\ \frac{r_b p_a - r_a p_b}{p} - a_0\ \frac{-r_a p_b}{p - pa} \right)$$

This is modelling the difference between the likely outcome of a licensing negotiation in the situation where we had no portfolio, and the improved situation which can be expected.

Not all outcomes are equal – accounting for your overall strategy

The basic version of this model assumes that the benefit of achieving $1M of licensing revenue is equivalent to reducing the licensing spend by $1M, but this is only the case if the company has a strategy that is perfectly balanced between monetization and defense. This is not true for many defensive companies that place a higher value in reducing licensing spend than monetization. Thus with a defensive-minded strategy, a function to the net balancing payment should be applied (not the balancing payment for each technology) for each third party threat that downweights the royalty figure if it is positive (e.g. by a factor of 10), and uses it unmodified if it is negative, i.e. if the portfolio just reduces/removes balance of trade payments:

$$adjusted\ royalty = \begin{cases} royalty \times 0.1 & \text{If } royalty > 0 \\ royalty & \text{otherwise} \end{cases}$$

Note that the benefit is not removed entirely, as there is some residual benefit from the larger-than-necessary portfolio. Because no model will predict the exact portfolio size required, it is designed to account for some variability. Conversely, these adjustments should be reversed for a strategy driven primarily by monetization.

Estimating assertion probability

One of the more complex tasks is estimating the probability that a third party threat will assert its portfolio in the year being analyzed. We highly recommend *Return on investment for your patent portfolio: the strategic counter-assertion model* [5], which describes techniques for estimation. This works on a balanced scorecard approach where certain factors will increase the likelihood of conflict and others will decrease it. Table 1 lists some of these.

Table 1 | Scorecard for estimating assertion probability

Factor	Increase risk	Decrease risk
Supply chain	Competitor	Major supplier or customer
Technology area	Declining	Emerging
Economic conditions	Company in trouble	Company doing well
Propensity to litigate	High litigation intensity	Low litigation intensity

So if your analysis reaches the view that there is a 60% chance that a given company will assert in the next 5 years, this enables an annual probability to be calculated:

$$annual\ probability = 1 - (1-p)^{1/t}$$

Where

p is the multi-year probability
t is the selected time period

In the example above, the single year probability is approximately $1-(1-0.6)^{1/5} = 0.167$ (or 16.7%).

[5] Return on investment for your patent portfolio: the strategic counter-assertion model, Kent Richardson and Erik Oliver (IAM, July 2015)

While outside the scope of this article, some of the scorecard factors lend themselves to reliance on other external sources of data analysis – specifically litigation history where there is a correlation between prior litigation history and propensity to litigate in the future.

Quality weights

There are situations where strict adherence to size does not do justice to the quality of your portfolio, or inflates the third party threat. In these situations, it is acceptable to cautiously apply weightings that effectively increase the return on investment of your portfolio. Examples of this include where you have strong reason to believe that your portfolio (or parts of it) is foundational, where you have evidence of use (EOU) prepared against competitor products, or where your portfolio is further optimized for assertions using targeted prosecution or acquisition strategies.

These weights are applied to effectively scale the number of patents held by each party, treating each family as if it were worth more or less than a typical patent in negotiations, from a base of 1.0. Including the weights, the full balancing payment expression becomes:

$$balancing\ payment = s\ \frac{r_b w_a p_a - r_a w_b p_b}{p}$$

Where w_a is the weighting for your company, and w_b is the weighting for the third party threat. These terms can be applied to all the expressions in the model, but have been omitted for brevity. They are present in the Excel spreadsheet which is available for download[6].

While there is nothing wrong with the introduction of subjective weightings of this sort, be sensitive to the introduction of bias, recognizing that most patent owners believe their patents are stronger than a third party's patents. This danger is especially acute where you have no or limited knowledge about whether third parties also have EOUs against your company's products. If you feel that you must resort to weighting adjustments, try to anchor on objective data that can be applied to both parties' patents, like relative priority dates, forward and backward citations or composite quality metrics such as PVIX.

Bringing it all together – the ROI calculation

The ROI for a set of technologies is the sum of all returns (R) for each technology, divided by the sum of all costs (C) for each technology:

$$\frac{\sum_t R_t}{\sum_t C_t}$$

Technology	Return	Investment	ROI (Technology)	ROI (Company)
X	$101M	$97M	4%	80%
Y	$273M	$103M	165%	
Z	$911M	$512M	78%	

Note that this could be calculated for a whole company, or a single technology; however, the ROI for the company (80%) is not the average of the ROIs for each technology (82%).

Example of applying the ROI calculation to a hypothetical company

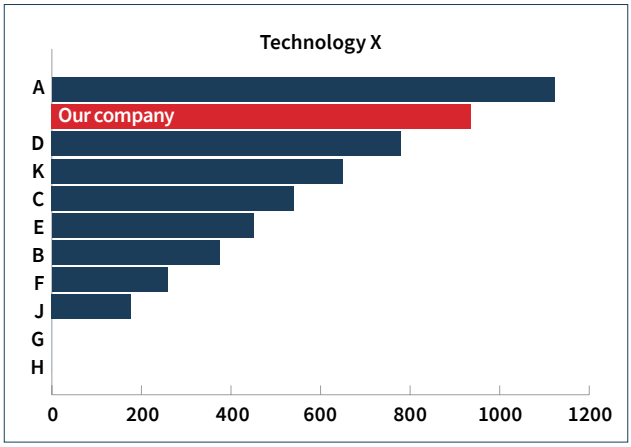
This is an application of the technique for a hypothetical company, their threat list (third party threats A-K), and existing cross-licences. It considers two technologies X and Y. Some factors have been removed, in order to make the table of results more compact. An Excel sheet with the complete calculation is available here, and a blank one for completion for your own company or client is also available here. Table 2 represents a Cipher strategic patent intelligence dashboard from which certain of the key data points can be readily extracted. Table 3 is the ROI calculation for a hypothetical company.

[6] https://cipher.ai/pulling-back-the-curtain-calculating-return-on-investment-of-patent-portfolios

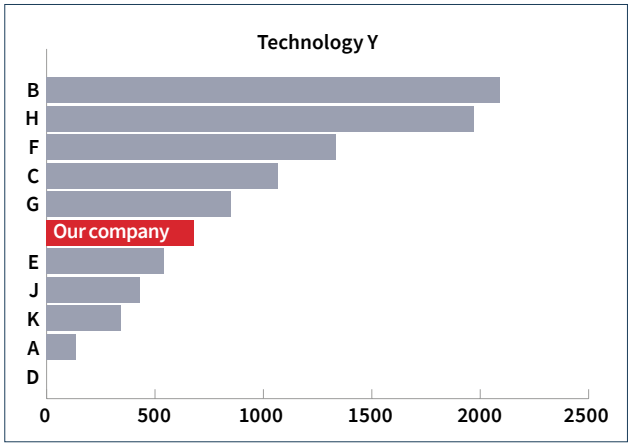
Table 2: | Cipher strategic patent intelligence dashboard

Source: Cipher dashboard. The first three charts represent data from the example and the final three charts illustrate other benchmarking metrics.

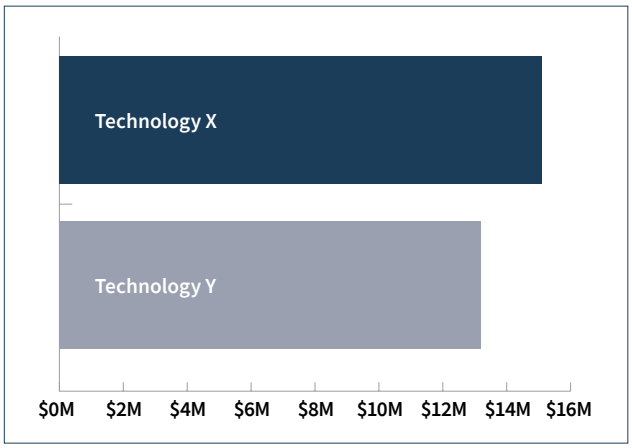
Portfolio Size | Companies A to K



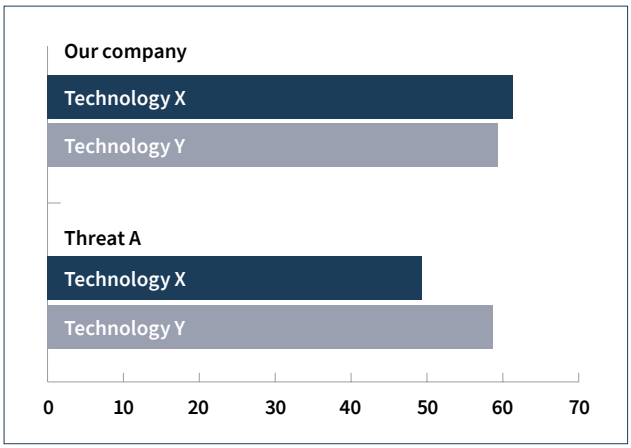
Portfolio Size | Companies A to K



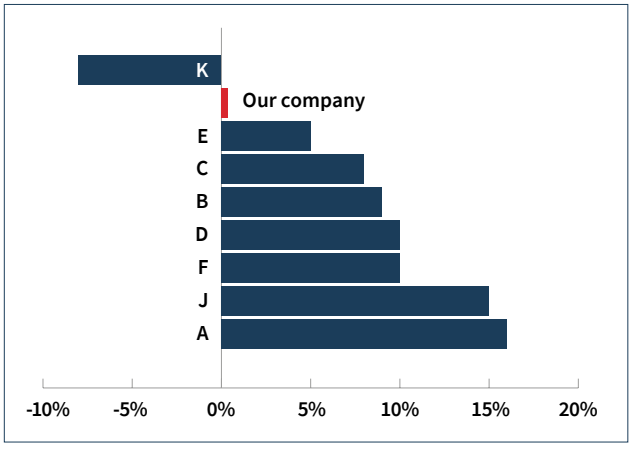
Patent Cost | Our Company



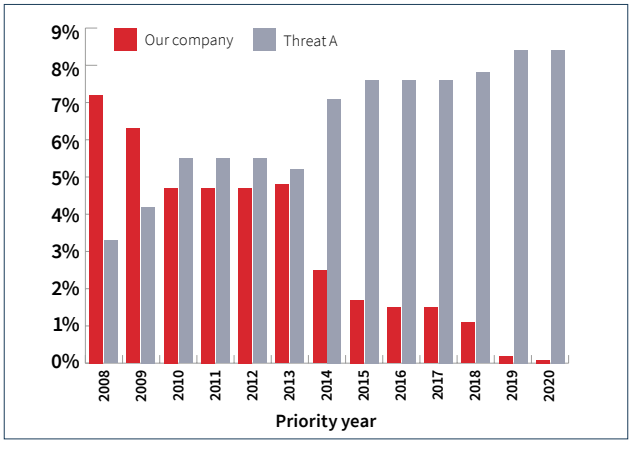
PVIX | Our Company vs. Threat A



Pace of Invention (CAGR) | Companies A to K



Age, Technology X | Our Company vs. Threat A



We are working from the following figures for each technology:

Technology	X	Y
Royalty rate	3.50%	5.50%
Average family cost per year ($1000)	14	17

The cost per year is the average cost of a family in that technology – it includes preparation, prosecution, and annuity costs, and also factors in the cost of abandoned applications. This can be calculated by working out the average full life-time cost of each family, and dividing it by the mean number of years between grant and expiry, and multiplied by the inverse of the acceptance rate. It could also be calculated on a family-by-family basis, rather than using means.

For example if our families in technology X typically cost $67,000 over their lifetime, they typically grant in year 4, and we let them expire in year 12, and we have a 60% acceptance (grant) rate, then the average annualized cost is:

$$\frac{\$67{,}000}{12-4} \times \frac{1}{60\%} = \$13{,}958$$

Table 3 | ROI calculation for a hypothetical company

	Licencing		Technology X					Technology Y					Overall	
Company	Licence	Assert prob.	Portfolio	Revenue	Royalty	Zero case	Benefit	Portfolio	Revenue	Royalty	Zero case	Benefit	Adjusted royalty	Adjusted benefit
Our company			936	$655M				679	$539M					
A	No	1%	1,123	$1,423M	$0.0M	-$4.5M	$4.6M	173	$197M	$0.0M	-$0.5M	$0.5M	$0.0M	$5.1M
B	Yes	0%	374	$451M	$0.9M	-$1.5M	$2.5M	2,093	$1,503M	-$0.6M	-$6.5M	$5.9M	$0.1M	$8.1M
C	Yes	0%	541	$608M	$1.1M	-$2.2M	$3.3M	1,066	$597M	-$0.9M	-$3.3M	$2.4M	$0.1M	$5.5M
D	No	13%	780	$1,245M	$0.5M	-$3.2M	$3.6M	0	$0M	$0.0M	$0.0M	$0.0M	$0.1M	$3.3M
E	No	17%	450	$422M	$0.1M	-$1.8M	$1.9M	542	$397M	$0.0M	-$1.7M	$1.7M	$0.0M	$3.5M
F	Yes	0%	258	$283M	$0.5M	-$1.0M	$1.6M	1,335	$812M	-$0.9M	-$4.1M	$3.2M	-$0.4M	$4.8M
G	No	17%	0	$0M	$0.0M	$0.0M	$0.0M	851	$932M	$0.2M	-$2.6M	$2.8M	$0.0M	$2.7M
H	No	5%	0	$0M	$0.0M	$0.0M	$0.0M	1,672	$659M	-$0.1M	-$5.2M	$5.0M	-$0.1M	$5.0M
J	No	5%	177	$215M	$0.0M	-$0.7M	$0.7M	432	$342M	$0.0M	-$1.3M	$1.3M	$0.0M	$2.1M
K	No	32%	650	$464M	$0.0M	-$2.6M	$2.6M	344	$228M	-$0.1M	-$1.1M	$1.0M	$0.0M	$3.6M
Denominator			6,611					10,299						

Description of columns:

- **Licence:** whether a licence, or cross-licence is in place, i.e. whether we are calculating the return from a past benefit, or deterrent benefit.
- **Assert prob. :** the probability of assertion in the year – a_1 from the equations. a_0 is taken to be 100% in all cases for simplicity. This is a reasonable assumption given the revenue.
- **Portfolio:** the number of granted families reading onto the technology.
- **Revenue:** the predicted annual revenue associated with each technology.
- **Royalty:** the known/predicted licencing fee with each threat list/licensee company. Positive numbers indicate a balancing payment to our company, negative numbers indicate a payment away.
- **Zero case:** the expected cost of a licence, in the case where we had zero patents reading onto that technology.
- **Benefit:** the net economic benefit of the portfolio in this area, with respect to the third party threat. N.B. this is not adjusted to take into account our particular patent strategy.
- **Adjusted royalty:** the combined royalties for both technologies, adjusted for strategy. In this case we're taking a factor of 5 downweighting on positive returns, representing a strategy which is largely defensive.
- **Adjusted benefit:** Adjusted royalty minus the sum of Zero case.

The Denominator row indicates the total number of granted families for the respective technologies *(p)*.

Bringing this together, we have the final ROI calculation:

Technology	X	Y	Overall	Notes
Benefit	$20.8M	$23.8M	$43.6M	The sum of the Benefit or Adjusted benefit columns
Cost	$13.1M	$11.5M	$24.6M	Annualized cost of building, maintaining the portfolio
Overheads	$2.0M	$1.7M	$3.7M	Salary, outside counsel fees etc.
ROI	38%	80%	54%	ROI = (Benefit - Cost - Overheads) / (Cost + Overheads)

It is important to note that for companies with multiple technology areas, the overall portfolio ROI is not equal to the sum of the individual ROIs for each of their respective technology areas. This is due to third party threats that traverse multiple technology areas. For example, consider the hypothetical example of ACME company as a threat to Facebook in its messaging and infrastructure technologies. Assume that Facebook is overstocked in its messaging portfolio (with a return of $XM) but understocked in its infrastructure portfolio (with a return of -$YM), the overall portfolio would not simply be X-Y because Facebook's messaging-related patents can be used to mitigate risk from ACME in messaging and infrastructure.

Looking at Table 3, these are some other observations. By most metrics this company is overweight in technology X, as they have a positive balancing payment against all known threats. By contrast, the balancing payments in technology Y are roughly in balance with a mixture of small negative and positive payments. This explains the differences in ROI between the two technologies.

Embracing the limitations of the ROI calculation

Many of the limitations of Portfolio ROI calculations are familiar to those encountered by the early adopters of Portfolio Optimization. These include:

- **"All models are wrong, but some are useful":** this aphorism generally applies to statistical and scientific models. While economic models are relatively new in the patent world, they deliver structure, consistency and transparency for those wanting to understand the relationship between the cost and benefit of patents.
- **Counting doesn't count:** the foundational assumption that risk and royalties depend on *n/d*, where n is a count of patents you own relating to a technology. This does not sit well with patent litigators whose belief system is built on claims charts. Comfort here can be found in the widespread adoption of probabilistic models, in the absence of any other practical way to model risk in densely populated patent landscapes. The approach

has also been validated by courts, arbitrations, and, perhaps most importantly, real-world negotiations.
- **Doesn't differentiate by sector:** in certain sectors like pharmaceutical, a single patent for a proprietary drug could protect billions of dollars of revenue. While the inputs would naturally be different, the ROI in patents, licensing and litigation is in fact much easier when these are the dynamics.

Other challenges that are specific to the ROI calculation are:
- **Establishing the likelihood of licensing or litigation:** this is how insurance companies have operated for years. The fact that those building the model can adjust the risk depending on industry or sector dynamics provides the flexibility to evolve and stress test the model over time.
- **Patent lifecycles are long:** Your patent portfolio today is the culmination of investment made over decades. It reflects patents applications and grants that have come and gone, businesses bought and sold, and licenses and litigation past and present. Patents take 3 to 5 years to grant and protect investment in technologies that will take even more time to be widely adopted. Some never find favour. This reality is accommodated by treating all costs as investment, and calculating return at specific point in time.
- **Organizational "silos":** there are some IP departments that allocate budget separately for portfolio development, licensing and litigation. The ROI calculation is designed for holistic strategy and budget management. While there is often a need for autonomy, this is not the same as living with inefficiency. If budget would be better deployed for a patent acquisition than organic filing, then the structure should permit the reallocation of funds from one category to another. In this way, ROI acts as a North Star for the entire team, providing incentives to align.

There are also the challenges highlighted by the recent IAM/Cipher survey and report on *Dispelling the benchmarking myth* [7]. In that report, 53% of respondents highlighted time and cost as an obstacle, with absence of objective and reliable data (48%) and no accepted industry standard (43%) coming closely behind. Prior to automated approaches to strategic patent intelligence, it could take a team of analysts countless hours to generate the patent analysis required for even a rough estimate of Portfolio ROI. With advances in AI and machine learning for automated patent-to-technology mapping, these roadblocks have been removed with the availability of repeatable results and minimal bias.

Finally, it needs to be acknowledged that there are those who remain sceptical of AI and machine learning, and the use of economic models to inform million-dollar decisions that have been reserved for patent professionals. To this we would say that the risk merits the reward. ROI allows patent teams to communicate using financial metrics that business executives can understand. Some may argue that quantification of risk and value encourages an unnecessary level of scrutiny. We disagree. If patent owners can communicate the investment and the benefit, then they will create a level playing field with other assets of strategic importance. While this will lead to more discussion and debate, it will also facilitate resource optimization.

Other applications of ROI analysis

The approach to Portfolio ROI calculations also enables assessment of individual strategic decisions. This provides a useful metric for comparing say investment in more patent filings with a potential patent acquisition or cross-license. Each option has its own ROI:

Patent acquisition: This is the simplest case where the target portfolio will have both an acquisition and a carrying cost. The rights will bolster your position against companies on your threat list. The ROI is that benefit (specifically the risk mitigated against one or more companies on your threat list) over the aggregate cost.

Cross licensing: Applying the foundational calculation across your entire portfolio (Figure 1) provides a balanced view of how dominance in one technology area compensates for apparent weakness in another. The requirement to integrate revenue data also deals with the natural tendency to focus on overall size. The fact that this approach has been adopted by many companies involved in cross licensing provides confidence that Portfolio ROI is a natural extension of what is already delivering value in that context.

[7] *Dispelling the benchmarking myth: how machine learning increases efficiency and reduces costs* (March 2021)

This approach is also capable of being applied to allocation of supply chain risk which is often a hot-bed for contention. A typical situation is where a customer requires an indemnity for patent infringement risk relating to goods supplied. There is a calculable cost to providing indemnities of this sort, which is often not factored *ex ante* into pricing or the bill of materials.

While outside the scope of this article, we recognize that operating companies are not the only source of risk. The largest other contributors consist of non-practising entities (NPEs), where your own portfolio does nothing to deter or neutralize their patent aggression. Mitigation strategies for that risk lie in the domain of insurance companies and defensive aggregators such as RPX and LOT Network. ROI calculations can also be applied to these decisions [8].

Pulling back the curtain

The doorbell rings and Dorothy opens the door. It's Glinda, her new financial advisor. She walks Dorothy through all of the assets in her portfolio and shows her how each of her investments has performed relative to the market. It turns out that Dorothy's portfolio has experienced significant growth, and the return on her investment is on track to satisfy all of her future income needs according to her desired timeline. Glinda has maximized the ROI from Dorothy's portfolio with the right balance of risk and reward across her investments. Dorothy's portfolio ROI will allow her to retire on schedule and provide for her family. When Dorothy asks Glinda how she evaluates her investment decisions, she responds by saying, "I'm glad you asked because you should have a clear understanding of how I'm managing your portfolio. The first step is to understand your retirement strategy so I can make investment decisions that are in line with your goals. I have access to lots of data about the market which enables me to make forecasts with a high degree of confidence and evaluate the ROI for every single investment in your portfolio. By making data-driven decisions, we can build a portfolio that accomplishes your objectives."

As more and more portfolio managers adopt Glinda's approach, clients like Dorothy demand greater transparency into their financial management. Oswald had no understanding of Dorothy's retirement strategy or her portfolio ROI; and he did not provide her with any insight into his management of her assets. The only thing clear was that he was building a portfolio that was misaligned with Dorothy's objectives.

Patent portfolio managers find themselves in the same predicament. Most companies report that they do not have the right portfolio, and most patent departments have not made any attempt to measure the ROI of their company's patent portfolio. This means that they don't know if the value of their company's patent portfolio has been worth the investment; and they are also not certain whether their current efforts to build and maintain the portfolio will deliver value to the business. How much longer will portfolio managers simply hope for the best? When will their company's leaders start asking basic questions about the patent portfolio's ROI (if they haven't started already)?

Adam Grant (American psychologist and author) asked, "Why do we laugh at people using computers that are ten years old, but yet still cling to opinions we formed ten years ago?" Will portfolio managers cling to the status quo as long as they can, or will they begin to hold themselves accountable to deliver value on one of the company's most expensive assets? The data, the tools and the model are all ready to be used. Perhaps it's time to pull back the curtain.

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The views expressed in this article are those of the authors alone.

[8] *Join a defensive aggregator and what is your financial return?* Kent Richardson and Erik Oliver (IAM, August 2017).