

The quality conundrum

It has always been easy to measure the size of a patent portfolio. More complicated has been the task of working out its quality. Now, however, new statistical benchmarking methods are emerging which could make things a whole lot simpler

By **Jonathan A Barney**

One of the foundational tenets of modern management theory is that you cannot effectively manage that which you cannot measure. Performance benchmarking (organising and driving managed resources against goal-specific objectives) is a particularly effective tool for exerting management control over desired performance objectives. However, identifying and maintaining accurate performance metrics appropriate to goal-specific objectives can present its own challenges.

The frequently encountered conundrum is that not all things that should be measured can be measured and, conversely, not all things that can be measured should be measured. In the context of patent portfolio management, this conundrum typically presents itself in the fact that patents are often and easily counted, but they can only be valued or appraised rarely and with great difficulty and expense.

The difficulty of measuring desired aspects of patent performance leads to the natural inclination to focus attention on what is more easily and readily measured. Typically, this involves counting the number of patents in a portfolio or applicable portfolio segment. But focusing too much attention on patent counts and similar raw metrics (such as claim counts, citation counts and the like) can result in a myopic management process that tends to proliferate and maintain large quantities of patents (or claims, or citations), but without effective controls in place to manage the overall quality or effectiveness of those patents within each desired target market.

Fortunately, the advent of powerful computers and the widespread availability of vast quantities of relevant patent information have led to the recent development of several sophisticated statistical models and predictive analytics tools for objectively benchmarking and assessing patent performance. This article describes one such approach for comparatively rating and benchmarking patent performance using statistical modelling based on an analysis of reported abandonment rates of patents sharing statistically similar attributes.

Patent survival analysis

Patents derive unique value from the legal rights they secure, namely the right to exclude competition in the patented technology. This value (if any) usually manifests itself as a net increase in operating revenues resulting from either premium pricing of patented products or services; or royalty payments or other valuable consideration paid by third parties for use of the patented technology.

But not all patents have value. In fact, in the United States, for example, most patents (about 57%) are actually abandoned before they reach the end of their full statutory term. As in most countries US patent owners are required to pay a periodic tax or maintenance fee during the term of a patent if they wish to maintain the patent in force. In the US maintenance fees are paid every four years and escalate progressively from US\$900 to maintain a patent in force beyond the fourth year, to US\$2,300 to maintain a patent in force beyond the eighth year, to US\$3,800 to maintain a patent in force beyond the 12th year.

The relatively substantial and escalating

nature of the required maintenance fees has the natural (and arguably beneficial) effect of discouraging the maintenance of less valuable patents. This trend is borne out by Figure 1, which indicates average patent maintenance rates for a study population of about 70,000 patents issued in 1986.

As the graph illustrates, approximately 83.5% of all patents issued in 1986 were maintained beyond the fourth year, approximately 61.9% of the patents were maintained beyond the eighth year and only approximately 42.5% of the patents were maintained beyond the 12th year. In other words, all but about 42.5% of the original sample population was eventually abandoned before the full statutory patent term.

This data simply reports observed patent maintenance rates for patents in a study population according to records maintained by the USPTO. The more interesting question is: why are some patents abandoned and others maintained?

The patent value assumption

In most cases, it would be fair to assume that individual patent decision-makers will (on average) choose to pay maintenance fees only when the perceived value of the expected remaining economic benefit secured by the patent exceeds the amount of the maintenance fee, taking into account a number of issues, such as appropriate risk factors and anticipated rates of returns.

Generally accepted economic theory holds that individuals and companies will invest in asset(s) only when the perceived value of the expected economic benefits sought to be secured by the asset(s) exceed the anticipated investment required to obtain and/or maintain the asset(s), taking into account issues such as appropriate risk factors and anticipated rates of return. Of course, that is not to say that all relevant decision makers will behave rationally in all cases or at all times. For a variety of reasons, individual decision makers may choose non-optimal investments in some or even many cases. It is enough to assume that on average decision makers will behave rationally. Thus, for example, a rational economic decision maker would choose to make additional incremental investments in a patent asset (ie, payment of maintenance fees) only if he or she believes that the patent will produce expected future economic benefits sufficient to justify the further investment.

Patent holders are uniquely knowledgeable and well qualified to make

internal patent value assessments of their own patent holdings, and they are economically and financially motivated to make accurate value judgments and corresponding maintenance decisions. One caveat is that the fundamental context of the maintenance decision process is one of internal asset management; not external market-based transactions between willing buyers and sellers. As a consequence, it cannot necessarily be assumed that the internally calculated maintenance value of a patent (the imputed value of the patent as perceived by our hypothetical rational patent holder) would necessarily be equivalent to what a willing buyer would pay for the asset in an arm's length negotiated transaction.

Objectively measuring patent quality/value

By examining patent maintenance/abandonment records, it is possible to identify certain patent metrics or characteristics that are statistically correlated to higher maintenance rates (higher value).

In fact, it turns out that a wealth of useful information can be derived from USPTO maintenance records by determining and exploiting statistical correlations between patent maintenance rates and certain objective attributes or metrics revealed by the patent, its file history and/or other associated public records. For example, Table 1 summarises observed maintenance rates for patents categorized by the PTO in several different technology classes:

As Table 1 illustrates, patents classified in Class 482 (exercise equipment) had an average maintenance rate of 21% (79% of patents abandoned prior to full term), while patents classified in Class 935 (genetic engineering) had an average maintenance rate of 56% (44% of patents abandoned) and patents classified in Class 935 (computers) had an average maintenance rate of 55% (45% of patents abandoned).

Since higher maintenance rates correspond to higher imputed maintenance values, the above data provides a simple, objective basis on which to rate or rank individual patent assets comparatively. All other things being equal, patents relating to genetic engineering and computers appear to be statistically more valuable (more likely to be maintained) than patents relating to golf and exercise equipment.

Figures 2 to 6 illustrate similar statistical correlations observed between patent maintenance rates and various other selected patent metrics. The reported statistics are based on fourth year

Figure 1: Patent maintenance rates (1986)

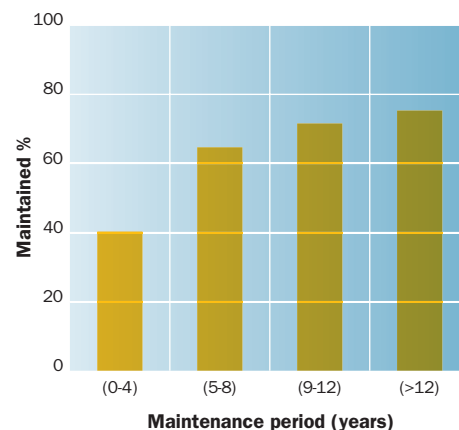


Table 1: Patent maintenance rates in selected classes

Class	Description	Maint. Rate
482	Exercise equipment	21%
473	Golf clubs/equipment	26%
446	Toys and amusement devices	30%
206/250	Packaging	43%
365/364	Computers	55%
935	Genetic engineering	56%

Figure 2: Fourth year maintenance rate v # independent claims

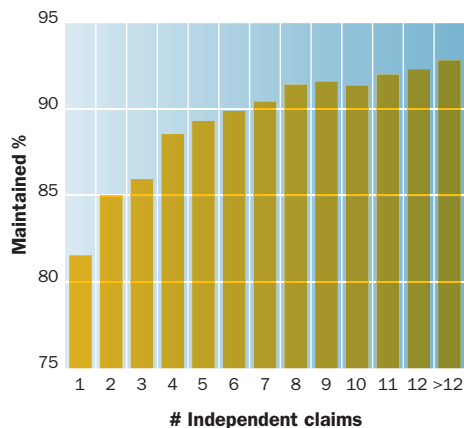


Figure 4: Fourth year maintenance rate v length of patent specification

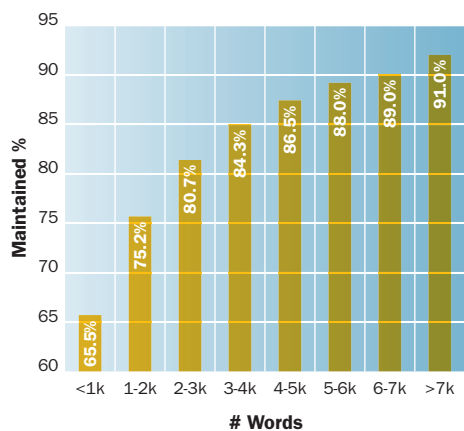


Figure 3: Fourth year maintenance rate v claim length

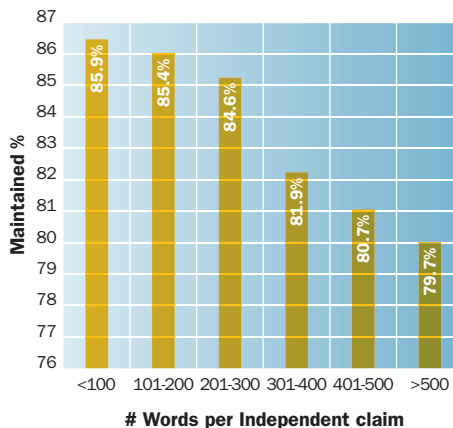
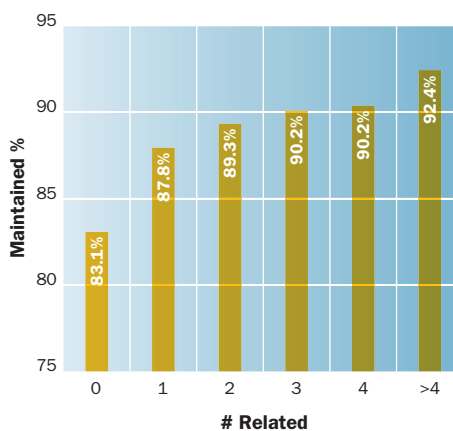


Figure 5: Fourth year maintenance rate v number of related cases



compared to 79.7% for patents having an average word count of 500 or more. The data suggests patents having shorter claims are more valuable. Again, this makes intuitive sense – less words means less limitations and, thus, a broader scope of protection.

Figure 4 shows patent maintenance rates generally increase with the length of written specification. Patents in the sample population having written specifications less than 1,000 words had an observed fourth year maintenance rate of 65.5%, compared to 91% for patents having written specifications longer than 7,000 words. The data suggests patents having longer written specifications are more valuable. Intuitively, a longer specification provides better support for patent claims and strengthens the patent against certain types of validity attacks. A longer specification may also indicate a higher initial investment in the original patent document (possibly implying a higher initial value expectation on the part of the patent owner/applicant).

Figure 5 shows that patent maintenance rates generally increase with the number of recorded priority claims to related cases. Patents in the sample population which made no priority claim to an earlier-filed related case had an observed fourth year maintenance rate of 83.1%, compared to 92.4% for patents claiming priority to five or more related cases. The data suggests that patents having more priority claims (more related cases) are more valuable. Intuitively, more priority claims probably means a patent is entitled to an earlier filing date, which can be beneficial in fending off art-based validity attacks. It could also indicate a greater level of overall interest and investment by the patentee.

Many studies over the years have suggested that the number of citations or references made to an issued patent by other subsequently issued patents (so-called forward citation rate) may have a positive correlation with patent impact or economic value. This correlation appears to be consistent with the reported data, as illustrated by Figure 6.

Figure 6 shows that patent maintenance rates generally increase with the forward citation rate. Patents in the sample population that received no forward citations in the first four years had an observed fourth year maintenance rate of 79.3%, compared to 93.5% for patents having 14 or more citations. The data suggests that patents receiving more citations are more valuable. Intuitively, a high forward citation rate could

maintenance rates for a sample population of about 100,000 patents issued in 1996.

Figure 2 shows that patent maintenance rates generally increase with the number of claims. Patents in the sample population having only one independent claim had an observed fourth year maintenance rate of 81.3%, compared to 92.6% for patents having 12 or more independent claims. The data suggests that patents having more independent claims are more valuable. Intuitively this makes sense – the more claims, the broader the likely scope of protection and the better the likelihood of surviving a validity attack.

Figure 3 shows patent maintenance rates generally decrease with claim length (number of words per independent claim). Patents in the sample population having an average word count less than 100 had an observed fourth year maintenance rate of 85.9%,

indicate a high level of commercial interest or activity in the patented technology.

Tying it all together

Each of the individual patent metrics identified above was determined to have a statistically significant correlation ($\alpha < 0.001$) with observed patent maintenance rates. While such correlations are interesting and informative, individually they provide only limited guidance. It would be much more useful to distill all of the relevant statistical data and derive from it a single statistically correlated parameter or rating. Such a rating could then be used to forecast or estimate directly the probability or likelihood of a patent being either maintained or abandoned and, thus, its relative potential value.

For example, most people are familiar with FICO® risk scores which rank consumers according to the likelihood that their credit obligations will be paid as expected. FICO scores play a pivotal role in billions of business decisions each year. Key advantages include speed, objectivity, repeatability and statistical accuracy. FICO scores are calculated using a sophisticated multivariate regression technique optimised to predict loan default events and drawing from a rich body of data collected for each rated consumer over many years.

To calculate an analogous score for patents, a computer regression model was constructed and optimised to predict patent maintenance/abandonment events. The model comparatively scored individual patent assets based upon all of the identified patent metrics (predictor variables) determined to have a statistically significant correlation to observed patent maintenance rates. Some of the more pertinent metrics included PTO classification, number of independent and dependent claims, average claim length, shortest independent claim, number of different words per claim, length of written specification, forward citation rate, number and age of cited prior art references, length of prosecution, number and country of origin of related family members, and the presence or absence of specific limiting claim language (eg "means" clauses and the like). The P-value for the fitted regression model was less than 0.001, indicating a statistically significant relationship at the 99.9% confidence level.

The regression model is then used to calculate a raw numerical score for each patent according to the extracted metrics for that patent. Raw scores represent the simple probability that each patent would be

Figure 6: Fourth year maintenance rate v forward citation rate

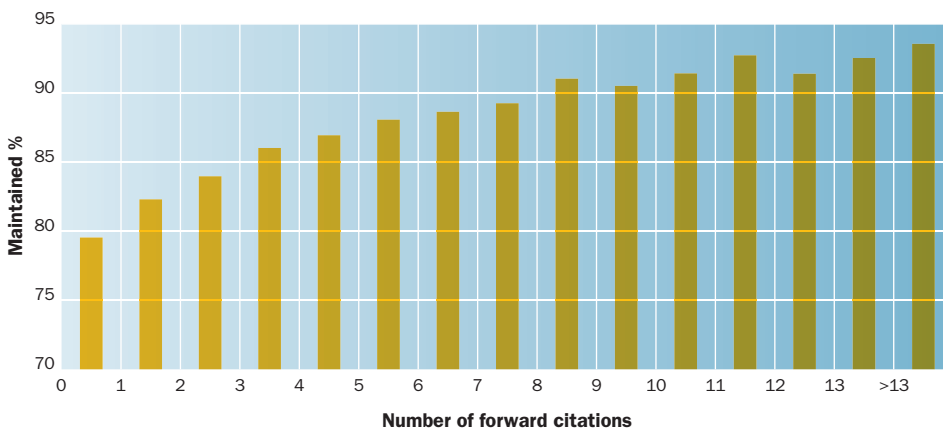
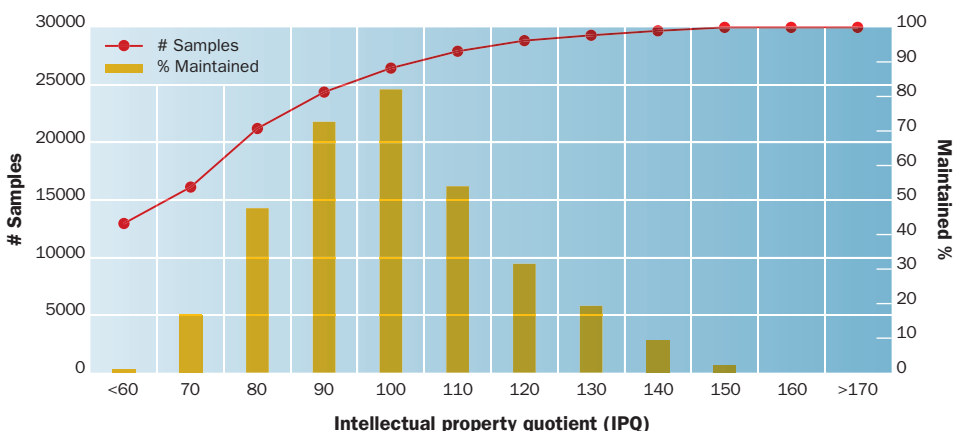


Figure 7a: Maintenance rates and IPQ

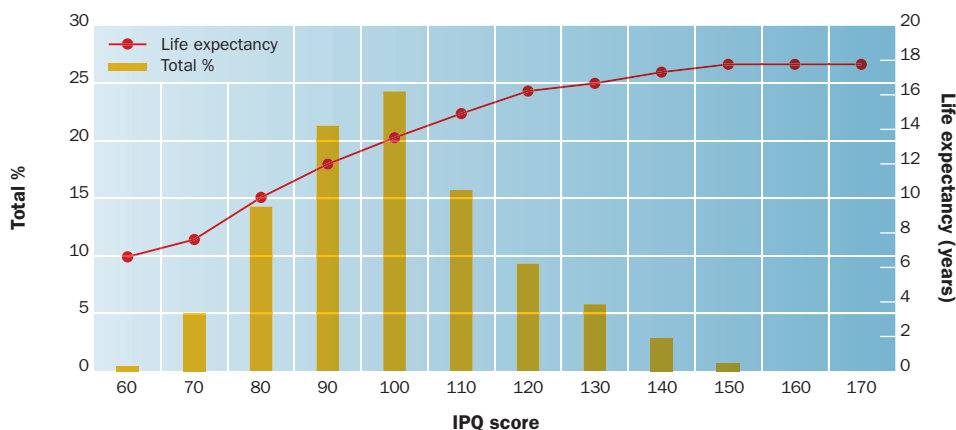


maintained for the full statutory term.

For convenience, raw scores are mathematically adjusted to provide a normalised mean or nominal expected score of 100. This adjusted score, dubbed the intellectual property quotient or IPQ is akin to the familiar intelligence quotient or IQ used to score human intelligence. Thus, a score of 100 on the IPQ scale generally corresponds to an expected normal or median quality (average expected maintenance rate). An IPQ higher than 100 indicates above-average quality (higher expected maintenance rate) while an IPQ lower than 100 indicates below-average quality (lower expected maintenance rate). Of course, as with IQ, the IPQ score provides only part of the equation for determining patent quality/value. Thus, a high IPQ does not guarantee high quality/value and *vice versa*. It only establishes a statistical correlation based on the body of available data.

Figure 7a shows how observed fourth

Figure 7b: IPQ v life expectancy



may hold the highest value and licensing potential. Study results are summarised by the graph in Figure 7c.

Objective baseline

Statistically derived patent performance benchmarks can provide additional objective measures of comparative patent quality and/or value. Statistical performance benchmarks cannot replace traditional legal analysis or valuation analysis. But, they can provide an objective baseline to help guide and support overall portfolio-level analysis as well as decision-making on individual patents.

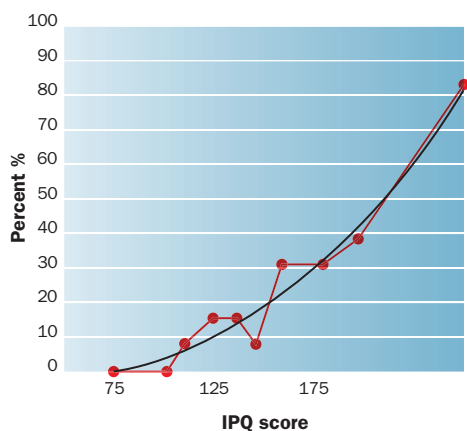
year maintenance rates generally increase with increasing IPQ. Patents scoring 60 or less on the IPQ scale had an observed fourth year maintenance rate of 43.7%, compared with observed maintenance rates of 100% for patents scoring 150 or higher. The average 4th year maintenance rate for all patents in the sample population was 85.2%.

Similarly, scores can be used to forecast average patent life expectancies for patents in the study population, as illustrated by Figure 7b. This shows that patent life expectancy generally increases with increasing IPQ. Patents scoring 60 or less on the IPQ scale were predicted to have an estimated life expectancy of 6.7 years, compared with a predicted life expectancy of 17.9 years (full term) for patents scoring 150 or higher. The average predicted life expectancy for all patents in the sample population was 13.3 years.

A double-blind study conducted in cooperation with a major Fortune 100 company demonstrated that IPQ scores were also predictive of patent commercialisation rates. A sample of approximately 200 patents was provided, roughly half of which had produced significant economic benefit (licensed or commercialised) and roughly half of which had produced no known economic benefit (non-licensed, non-commercialised). All of the patents were rated according to the statistical regression model described above and scores were ranked by decile from highest to lowest. Of the patents ranked in the top decile, roughly 83% were from the licensed/commercialised group. Of the patents ranked in the two lowest deciles 0% were from the licensed/commercialised group.

These results suggest that statistical patent benchmarking may be especially useful to help identify top tier patents that

Figure 7c: IPQ score v percent of patents licensed or commercialised



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