

## TRADE SECRETS REMAINING USEFUL LIFE ANALYSIS

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### INTRODUCTION

Trade secrets are one of the four types of intellectual properties. The other three types of intellectual properties, of course, are: trademarks, copyrights, and patents. *Black's Law Dictionary* (7th ed.) parallels the language of the Uniform Trade Secrets Act when it defines trade secrets as follows:

A formula, process, device, or other business information that is kept confidential to maintain an advantage over competitors; information—including a formula, pattern, compilation, program device, method, technique, or process—that (1) derives independent economic value, actual or potential, from not being generally known or readily ascertainable by others who can obtain economic value from its disclosure or use, and (2) is the subject of reasonable efforts, under the circumstances, to maintain its secrecy.

Like all intellectual properties, trade secrets are subject to three common types of economic analyses: (1) valuation, (2) lost profits/economic damages, and (3) transfer price.

A valuation analysis estimates a defined standard (or type) of value for the use or exchange of (1) a trade secret, (2) a collection of trade secrets, or (3) certain specified legal rights in a trade secret. An economic damages analysis quantifies (1) historical lost profits and/or (2) a prospective decrease in value suffered by a trade secret. And, a transfer price analysis estimates the fair, arm's-length license fee or royalty rate for the license of specified rights in a trade secret.

These types of intellectual property economic analyses are often performed for purposes of:

1. transaction pricing and structuring—of a sale, license, or other transfer;
2. financing collateralization—for a secured loan or sale/lease-back transaction;

3. taxation planning and compliance—including gift, estate, income, transfer, and property taxes;
4. commercial exploitation—for use, development, exploitation, commercialization, and other licenses;
5. litigation and controversy—related to infringement, breach of contract, bankruptcy, lender liability, family law, and other claims; and
6. management information—including intellectual property development and protection.

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All of these types of intellectual property analyses involve some procedures for estimating the remaining useful life (RUL) of the subject trade of intellectual property value, value decrement, lost historical/future income, transfer price, or royalty rate.

Because of their legal registration and overt commercial use, it is relatively straightforward to estimate the RUL of a patent, copyright, or trademark. It is often a more challenging task to estimate the RUL of a trade secret. Unlike other intellectual properties, trade secrets are not registered with a government agency. And, unlike other intellectual properties, the owner/operator's use of a trade secret is (by definition) confidential.

This discussion will present a methodology for estimating the RUL of trade secrets. The suggested methodology is properly referred to in the professional literature as the analytical method. However, it is frequently called the survivor curve method in the analyst's vernacular. Using the analytical method, the RUL of a trade secret is estimated indirectly, by examining the history of the creation and retirement of the tangible documentation related to the subject trade secret.

The analytical method can be used to estimate (1) the expected total life of a new trade secret, (2) the expected average RUL of an in-use trade secret, and (3) the expected RUL of an individual trade secret functioning within a group of commercial trade secrets.

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## TRADE SECRET DOCUMENTATION

This application of the analytical method works particularly well with regard to trade secret documentation. While trade secrets are confidential, owner/operators typically document their trade secrets for various commercial purposes. Such purposes include product production management/scheduling, product/service quality control, employee training, and so on. While this documentation is often maintained in secrecy, it typically does exist.

Examples of product/process trade secret documentation include: food product recipes, product chemical formulations, product engineering drawings, production process schematics, process flow charts, plant layouts and designs, distribution system drawings/mylars, computer software programs, clothing and other product patterns, blueprints, laboratory notebooks, system flowcharts and diagrams, employee manuals, user/procedure manuals, customer file contents, and so on.

Each of these types of documentation are the tangible embodiment of the owner/operator's trade secret. And, each of these types of trade secret documents has intellectual property content.

## TRADE SECRET DOCUMENT PLACEMENT AND RETIREMENT

Each of these types of product/process/procedure documentation are created at a specific point in time. For purposes of the analytical method, we will call that document creation date a "placement." And, each of these types of product/process/procedure documentation can be retired or replaced at a specific point in time. Whether the seasoned document is (1) simply no longer used or (2) permanently replaced with a new document, we will call that event a "retirement."

The basis of the analytical method is the statistical analysis of trade secret document placements and retirements. A document placement represents an event when a particular trade secret came into use by the owner/operator. A document retirement represents an event when the owner/operator discontinued the current use of a particular trade secret. By analyzing the historical placements and retirements of trade secret documentation, we can estimate the expected RUL of the related trade secret intellectual property.

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By analyzing the placements and retirements of supporting documentation, we can assess the owner/operator's actual use of the underlying trade secret. When the owner/operator retires the document, the trade secret is no longer in use. (For this reason, a retirement should represent a discontinuation of that document and not simply an update or minor modification.) When the trade secret is retired, it is no longer generating economic income for the owner/operator.

The analytical method is indifferent as to why the trade secret document is retired. That is, it is not important whether the trade secret became functionally or technologically obsolete, fell out of consumer favor, was declared illegal, and so on. The only consideration in the analytical method is that the trade secret document is either in use or it is not in use (retired).

Accordingly, the analytical method is a very objective methodology for estimating intellectual property RUL. In addition, it is an unbiased methodology. It is unbiased in that it equally considers all reasons why the intellectual property documentation was retired.

## THE ANALYTICAL METHOD

The theory of survivor curves was developed at Iowa State University in the early 1900s. Survivor curves are used to predict the mortality or decay of a group of similar assets (e.g., intellectual properties) as the assets age. Survivor curve theory is similar to the mortality table theory used by actuaries to estimate the human life span.

The analytical method is the process of predicting the behavior of a group of assets by fitting a "test group" of the actual asset placements/retirements to various survivor curves. Thus, by selecting the survivor curve that best "describes" the past actual decay of the test group of assets, the future behavior of each asset in the group can be estimated.

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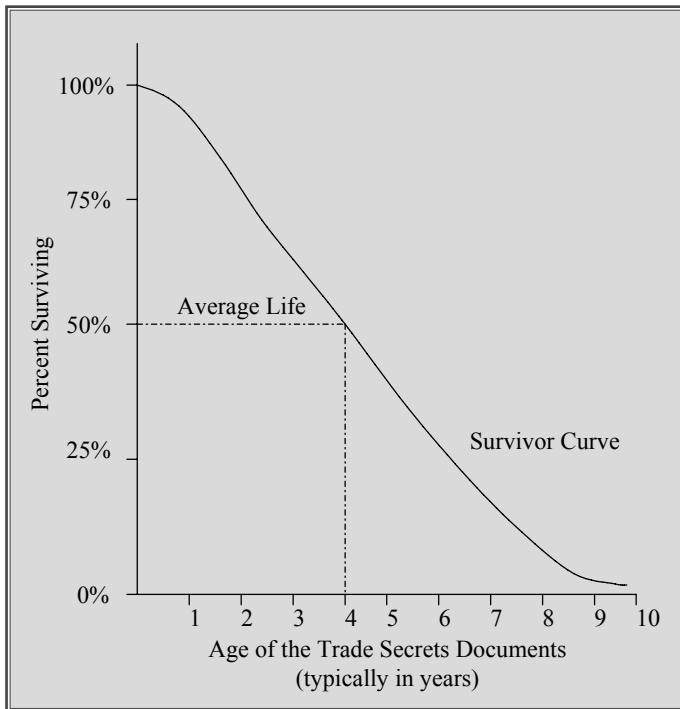
## THE SURVIVOR CURVE

Graph 1 presents a typical survivor curve. The x-axis represents the age of the assets and the y-axis represents the percentage of the original group of assets that are still surviving at a given age. For example, at age equal to zero years, 100 percent of the group is surviving.

As time passes, the assets within the group retire. Therefore, the percentage of the group still surviving

decreases. This creates the downward sloping characteristic of the survivor curve. A survivor curve can be any mathematical function of age which can accurately (and logically) depict the asset group's mortality.

**Graph 1**  
**Trade Secrets RUL Analysis**  
**Analytical Method**  
**A Typical Survivor Curve**



The age at which 50 percent of the original group still survives is defined as the group's "average life." That is, a new asset (i.e., an asset that is created at any given time) would have an expected life of the average life of the group. In reality, assets are "active" (i.e., assets are in current use) across a wide range of possible time units. However, the expected life (i.e., the mean time that the asset is in current use) is the average life for the group.

There are three basic types of survivor curves: left mode, symmetric, and right mode.

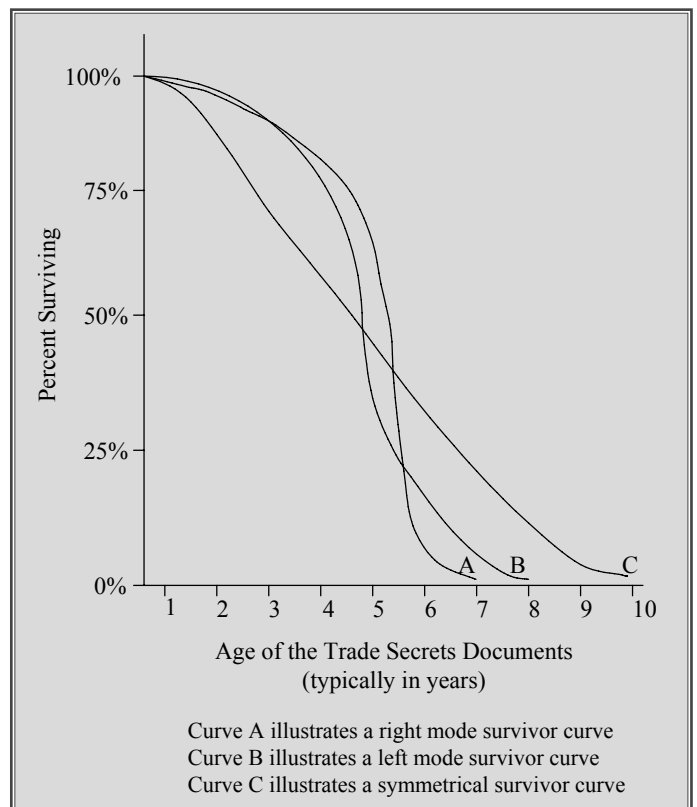
A left mode survivor curve depicts a group that retires (1) at a faster rate before the average life is reached and (2) at a slower rate after the average life is reached. In other words, if a left mode survivor curve accurately predicts a group's behavior, it could be interpreted as "the group's older assets will continue to operate longer than its newer assets and will tend to have a longer relative life."

A symmetrical survivor curve predicts that the assets within a group will retire at a similar rate at any given relative age on either side of the group's average life.

A right mode survivor curve is the opposite of the left mode survivor curve. An asset that has reached the group's average life tends to decay faster than an asset that has yet to reach the average life. In other words, if a right mode survivor curve accurately predicts a group's behavior, it could be interpreted that "the group's newer assets will continue to operate longer than its older assets and will tend to have a longer relative expected life."

Graph 2 illustrates the "curve structure" of a left mode, symmetrical, and right mode survivors plotted on the same graph.

**Graph 2**  
**Trade Secrets RUL Analysis**  
**Analytical Method**  
**Three Basic Types of Survivor Curves**



The ultimate purpose of an RUL analysis is to assign a specific "remaining life" to each asset (e.g., each trade secret document) within the group. RUL is defined as the amount of time before an asset will retire. An asset is "retired" when (1) it is no longer in active use and (2) no further economic benefit is expected from it. An example of how RUL could be interpreted would be to state that, "document number 123456 is expected to remain in active use for two and a half more years." In that case, two and a half years is the RUL of document number 123456.

**THE PROBABLE LIFE CURVE**

An important procedure in estimating RUL is to calculate the “probable life” for each asset within the group. Probable life is the age at which an asset would retire, given that it has already reached its current age. By subtracting the current age of an asset from its probable life, the asset RUL can be estimated. That is,

$$RUL = \text{Probable life} \textit{ minus} \textit{ Current age}$$

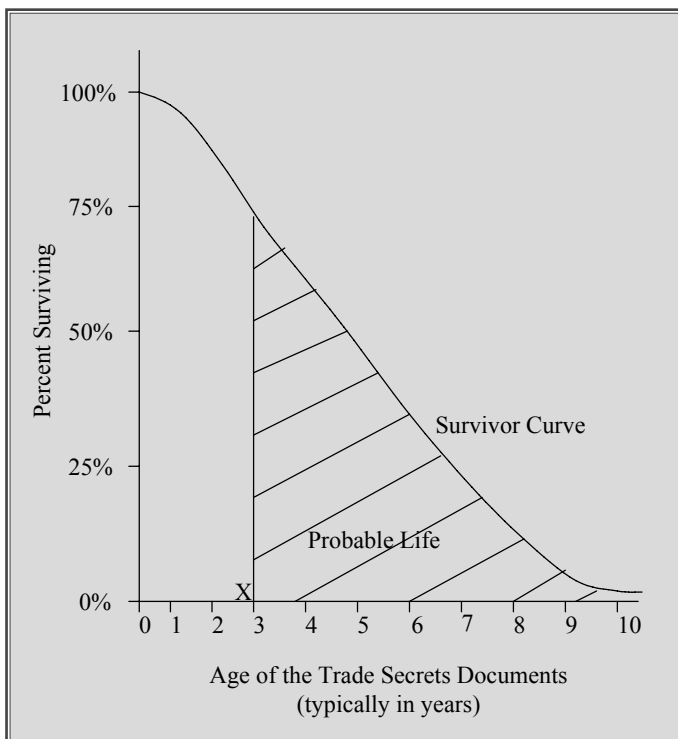
The mathematical definition of the probable lie of a given asset is the area under the survivor curve (i.e., using calculus, the integral) to the right of the current age of that asset. Every survivor curve has a corresponding probable life curve.

For any asset (e.g., a trade secret document) that is already *x* years old, this relationship can be summarized in the form:

$$\text{Probable life of the Trade secrets document} = \int_x^{\infty} \text{Survivor curve}$$

Graph 3 illustrates the relationship between (1) percent surviving and (2) probable life. The probable life of an asset at age *x* years is the area under the curve that is inside the shaded area (i.e., to the right of *x* years).

**Graph 3**  
**Trade Secrets RUL Analysis**  
**Analytical Method**  
**The Probable Life Integral**

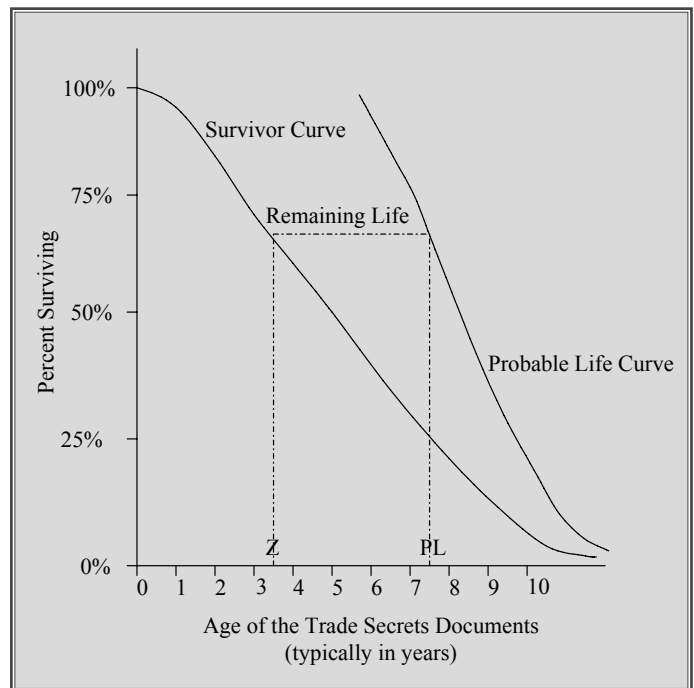


By solving for the probable life in the equation above for all possible asset ages, a probable life curve can be constructed. A typical survivor curve and its corresponding probable life curve are illustrated on Graph 4.

To determine the probable life of an asset that is already *z* years old using Graph 4, first locate *z* years on the x-axis and find the corresponding point on the survivor curve. Then, draw a line parallel to the x-axis to the point of intersection with the probable life curve. The probable life is obtained by moving down the y-axis to the number of years on the x-axis.

Graph 4 illustrates the probable life (point PL) of an asset that is already *z* years old.

**Graph 4**  
**Trade Secrets RUL Analysis**  
**Analytical Method**  
**A Typical Probable Life Curve**



The RUL of the particular asset (e.g., the particular trade secret document) can then be estimated by using the formula presented above.

There are several sets (or series) of survivor curve mathematical functions that are generally used in the analytical method. These survivor curve mathematical functions include: (1) Iowa State University modified Pearson-type frequency functions, (2) Weibull distribution functions, (3) Gompertz-Makeham distribution functions, (4) H-curves (a single parametric series of curves derived by truncating a normal probability distribution), and (5) polynomial (least squares regression fitting) functions. All of these mathematical functions should be considered when selecting the best fitting survivor curve relative to a specific set of assets.

In summary, by selecting a survivor curve that best explains the past decay performance of a group of assets, the future decay of the asset group can be predicted. From the predicted decay curve, the RUL of each individual asset within the group can be estimated.

### RUL ANALYSIS PROCEDURES

The procedure used to select the most appropriate survivor curve is called "curve fitting." The basic concept is to find the standardized survivor curve that best explains the actual age/life decay pattern of the subject asset group.

The following procedures are involved in selecting a best fit survivor curve.

1. Selection of a sample population of retired assets (i.e., trade secret document no longer in active use): a random selection of the most recent retired assets is generated. The data needed from the selected sample of retired assets are: (1) the placement date and (2) the retirement date of each retired asset.

Again, a placement is the initial creation of the trade secret document. A retirement is the final discontinuation of the use of the trade secret document.

This information is usually obtained from a computer database, inspection of the subject intellectual property inventory, or discussion with the owner/operator management.

2. Selection of an active asset (i.e., trade secret document in current use) sample population: a random selection of all active assets is generated. The information needed for the actual asset sample is the asset placement (i.e., document creation) date.

Again, this information is usually gathered from a computer database, inspection of the subject intellectual property inventory, or discussions with the owner/operator management.

3. Creation of the survivor table: A survivor table is created by using the retired asset and active asset age/life data described above. A survivor table presents the percent surviving of the sample asset group at a given age.

Table 1 presents a typical survivor table. The percent surviving at a given age  $x$  years is:

$$\text{Percent Surviving at Age } x \text{ years} = \left[ \begin{array}{c} \text{Percent} \\ \text{Surviving} \\ \text{at Age } (x-1) \text{ years} \end{array} \right] \text{ times } \left[ \begin{array}{c} 1 - \text{Retirement Rate} \\ \text{at Age } (x) \text{ years} \end{array} \right]$$

The retirement rate at any age is the ratio of (1) the number of assets that retired during the age interval divid-

ed by (2) the number of assets exposed to retirement at the beginning of the age interval. The number of assets exposed to retirement is simply the number of actual assets (i.e., in-use trade secret documents) at the beginning of the age interval.

For example, with regard to Table 1, let's assume that:

- a. at age interval 5, the percent surviving is 78.448%;
  - b. at age interval 5, the retirement rate is 4.268%;
  - c. then, the percent surviving at age interval 6 is (78.444%) times (1 - 4.268%) = 75.099%.
4. Plotting of the actual survivor table: By selecting the pairs of coordinates (x,y), where  $x$  is the age (the first column in Table 1) and  $y$  is the percent surviving (the last column in Table 1), an "actual" survivor curve is plotted. This "actual" survivor curve is illustrated by the "P" markings on Graph 5.

**Table 1**  
**Trade Secrets RUL Analysis**  
**Illustrative Example of**  
**Percent Surviving Table**

Periodic Interval (in years)	Exposed to Retirement at Beginning (of Interval)	Number of Documents Retired During Interval	Retirement Rate (%)	Percent Surviving at Beginning of Interval
1	305	27	8.852	100.000
2	244	12	4.918	91.143
3	207	12	5.797	86.665
4	179	7	3.910	81.641
5	164	7	4.268	78.448
6	149	5	3.355	75.099
7	135	5	3.703	72.579
8	122	3	2.459	68.891
9	114	3	2.631	68.172
10	106	1	0.943	66.378
11	95	0	0.000	65.752
12	91	10	10.989	65.752
13	76	1	1.315	58.526
14	72	2	2.777	57.756
15	68	0	0.000	56.152
16	62	1	1.612	56.152
17	54	2	3.703	55.246
18	7	1	14.285	53.200
19	6	0	0.000	45.600
20	6	2	33.333	45.600

5. Selection of best fit standardized survivor curve: all standardized survivor curves are plotted on the same graph as the "actual" (i.e., actual survivor table) survivor data described above. These standardized curves are called the ideal curves. The difference between the actual percent surviving (from the actual survivor table) and the ideal percent surviving is the fitting error at each age.

By summing all the squares of the fitting errors for a curve, a ranking factor describing the "fit" of the curve can

be ascertained. The errors are squared both (1) to remove the “cancelling” effect of negative fitting errors and (2) to put more emphasis on large errors.

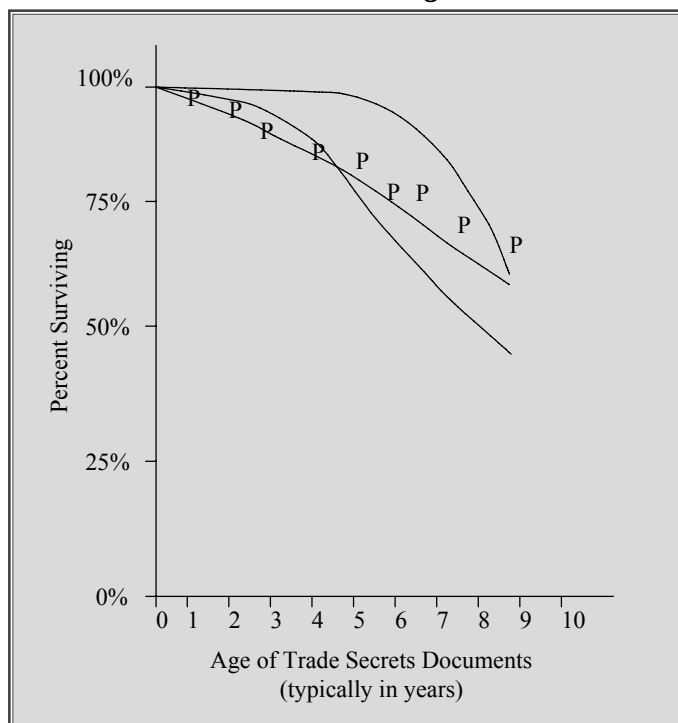
The curve fitting procedure described above is represented by the following formula:

$$\text{Ranking Factor} = \sum_{i=1}^n \left[ \begin{array}{l} \text{Survivor Table (age } i) \\ \text{(minus)} \\ \text{Survivor Curve (age } i) \end{array} \right]^2$$

where  $n$  is the number of entries in the survivor table selected for the curve fitting procedure.

The method described above is called a stub period fitting, and the method is illustrated in Graph 5.

**Graph 5**  
**Trade Secrets RUL Analysis**  
**Illustrative Example**  
**Stub Period Curve Fitting Procedure**



All potential standardized survivor curves are fitted over a logical range of average lives, and a ranking factor is assigned to each curve fitting.

The best fit standardized survivor curve is the survivor curve at the specified average life that has the smallest ranking factor. This procedure is referred to as minimizing the sum of the squared errors.

As each standardized survivor curve is fitted, a correlation coefficient is determined. The correlation coefficient is a ranking from -1 to +1. The correlation coefficient describes how well the standardized survivor curve fits the actual survivor table.

A correlation coefficient of +1 suggests that the standardized survivor curve at the average life being fitting accurately predicts the asset sample’s actual past decay rate activity.

Once a best fit standardized survivor curve is selected, the RUL for all active assets is estimated using the RUL procedure described above.

The RUL represents the remaining number of years that the owner/operator will expect to use (and receive economic benefit from) the trade secret document. Thus, it is the appropriate time period for an economic analysis of that particular intellectual property.

## SUMMARY AND CONCLUSION

Commercial intellectual properties are routinely the subject of valuation, damages, and transfer price economic analyses. And, this phenomenon will only become more common (1) as more companies/industries become intellectual property-intensive and (2) as a greater percentage of most business/stock values is explained by intellectual property (versus tangible asset) commerce.

Increasingly, intellectual properties (1) are the principal target assets in mergers and acquisitions, (2) are the most valuable assets in bankruptcy estates, (3) are the collateral for commercial financing, (4) are the subject of major litigation, and (5) are the source of corporate strategic commercialization opportunities.

Estimating the RUL of the intellectual property is an important component of each type of intellectual property economic analysis. For the trade secrets intellectual property, it is often possible to estimate the RUL of the tangible documentation of the trade secret.

This discussion focused on the analytical method for estimating the RUL of trade secret documents. This method analyzes the historical placements (i.e., creations) and retirements (i.e., discontinued use) of trade secret documents. Unlike some other intellectual property RUL methods, the analytical method (1) provides a specific quantitative conclusion and (2) is objective and unbiased with regard to data sources.

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